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# DEFINITION OF KEY TERMS

| Term | Definition |
|---|---|
| Affinities | Sets of textual references that have an underlying common meaning or theme, synonymous to factors or topics (Northcutt & McCoy 2004: 81) |
| Analysis | To identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express belief, judgement, experiences, reasons, information or opinions (Facione 1990a: 7, 2011: 5) |
| Cognitive style | A certain approach to problem-solving, based on intellectual schemes of thought; individual characteristics of cognitive processing that are peculiar to a particular individual; a person's typical approach to learning activities and problem-solving (Pritchard 2014: 47) |
| Competence | The broad range of knowledge, skills, attitudes and behaviour that together account for the ability to deliver a specified professional service. Competence also involves adoption of a professional role that values accountability to the public and leadership in professional practice, the public sector, the corporate sector and education (South African Institute of Chartered Accountants 2014a: 24) |
| Competency | The particular tasks that chartered accountants perform while applying or bringing to bear, the pervasive qualities and skills that are characteristic of chartered accountants to the level of proficiency defined as appropriate by the profession (South African Institute of Chartered Accountants 2014a: 24) |
| Constituencies | Groups of people who have a similar understanding of the phenomenon (Northcutt & McCoy 2004: 46) |
| Critical pedagogy | The use of higher education to overcome and unlearn the social conditions that restrict and limit human freedom (Davies & Barnett 2015: 18) |
| Critical thinking | Purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation and inference, as well as explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgement is based (Facione 1990a: 2) |
| Dispositions | A nexus of attitudes, intentions, values and beliefs; one's dispositions are among the distinguishing features of one's character or personality. Characterological attributes of individuals (Facione 2000: 63) |
| e-Learning | The use of technology to support and enhance learning practice (Mayes & de Freitas 2004: 5). In its broadest definition, e-Learning includes instruction delivered via all electronic media including the internet, intranets, extranets, satellite broadcasts, audio or video tape, interactive TV and CD-ROM (Govindasamy 2002: 288) |
| Epistemology | A view of the nature of knowledge (Harasim 2012: 12) |
| Ethical behaviour and professionalism | The chartered accountancy profession is committed to maintaining the confidence of clients, employers and the public through an overriding commitment to integrity in all professional tasks. Thus, all chartered accountants are expected at all times to abide by the highest standards of integrity; they must be and must be seen to be, carrying out all assignments objectively and independently, in accordance with the ethical values outlined in detail in Section I of the competency framework (South African Institute of Chartered Accountants 2014a: 24) |
| Evaluation | To assess the credibility of statements or other representations which are accounts or descriptions of a person's perception, experience, situation, judgement, belief or opinion; and to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, questions or other forms of representation (Facione 1990a: 8, 2011: 6) |

| Term | Definition |
|---|---|
| Explanation | To present in a cogent and coherent way the results of one’s reasoning. To state and to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological and contextual considerations upon which one’s results were based; and to present one’s reasoning in the form of cogent arguments (Facione 1990a: 10, 2011: 6–7) |
| Inference | To identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to reduce the consequences flowing from data, statements, principles, evidence, judgements, beliefs, opinions, concepts, descriptions, questions or other forms of representation (Facione 1990a: 9, 2011: 6) |
| Instructional approaches | Differ in terms of how explicitly critical thinking principles are developed and taught as well as how these principles are taught in relation to course content (Bensley & Spero 2014: 56) |
| Interpretation | To comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgements, conventions, beliefs, rules, procedures or criteria (Facione 1990a: 6, 2011: 5) |
| Learning style | A particular way in which an individual learns; a mode of learning; an individual’s preferred means of acquiring knowledge and skills; habits, strategies or regular mental behaviours concerning learning, particularly deliberate educational learning, that an individual displays (Pritchard 2014: 46) |
| Learning theories | Provide empirically-based accounts of the variables which influence the learning process and provide explanations of how that influence occurs. A learning theory is an attempt to describe how people (and animals) learn; thereby helping us understand the inherently complex process of learning (Alzaghoul 2012: 27). An empirical explanation of how people learn (Harasim 2012: 12) |
| Metacognition | Refers to knowledge, awareness and control of one’s cognition and is thus related to a person’s ability to do self-assessment of their own comprehension, knowledge and thinking (Bensley & Spero 2014: 56) |
| Pedagogy | Strategies of instruction and teaching methods. Often this means developing an approach to support student learning. Other times, the term pedagogy is used to describe a style of instruction. In either case, pedagogy approaches the process of learning from the teaching side (McHaney 2011: 164) |
| Personal attributes | Chartered accountants are expected to develop a number of personal qualities that shape the way they conduct themselves as professionals. These qualities or attributes are outlined in Section I of the competency framework (South African Institute of Chartered Accountants 2014a: 24) |
| Pervasive qualities and skills | The professional qualities and skills that all chartered accountants are expected to bring to all tasks - the “how” of a chartered accountant’s work. The competency framework identifies pervasive qualities in three categories: IA - Ethical behaviour and professionalism, IB - Personal attributes and IC - Professional skills (South African Institute of Chartered Accountants 2014a: 24) |
| Professional skills | Chartered accountants are also expected to develop a wide range of professional skills that, while not unique to the chartered accountancy profession, are critical to its successful practice. These skills are outlined in Section I of the competency framework (South African Institute of Chartered Accountants 2014a: 24) |
| Self-regulation | To monitor one’s cognitive activities, the elements used in those activities and the results educed, particularly by applying skills in analysis and evaluation to one’s own inferential judgements with a view toward questioning, confirming, validating or correcting either one’s reasoning or one’s results (Facione 1990a: 10, 2011: 7) |

| Term | Definition |
| --- | --- |
| Socratic method | A teaching methodology that emphasises dialectical exchange among students. The method uses probing questions to guide a dialogue about a text or concept (Giuseffi 2015: 6–14) |
| Teaching strategy | Teaching strategies and pedagogies are terms interchangeably used and refer to strategies of instruction, teaching methods or styles of instruction and are focused on the process of learning from a teaching perspective (McHaney 2011: 164) |
| Virtual environments | Computer-generated, three-dimensional (3D), artificial worlds (Van Wyk & De Villiers 2009: 53) |
| Virtual reality | A rapidly growing technology which utilises the ever-increasing power of computing to simulate real-world and imaginary environments and situations with a high degree of realism and interactiveness (Van Wyk & De Villiers 2008: 276) |
| Web 2.0 | A new way of using internet technologies. The term Web 2.0 doesn't refer to a technical update of underlying software and hardware but rather to changes in the way the Web is being used by businesses, universities and society in general. Web 2.0 comprises five major, interrelated components: social computing, social media, content sharing, filtering or recommendations and Web applications (McHaney 2011: 79) |
| Web-based simulations | Internet-based, synthetic learning environments where decisions are made within a complex as well as dynamic setting and where students experience real-time information and feedback (Lovelace, Eggers & Dyck 2016: 101) |

# ACRONYMS

| Acronym | Description |
|---|---|
| ADFs | Asynchronous discussion forums |
| ACL | Audit Command Language |
| AECC | Accounting Education Change Commission |
| AICPA | American Institute of Certified Public Accountants |
| AOD | Asynchronous online discussion |
| APA | American Philosophical Association |
| APC | Assessment of Professional Competence |
| ART | Affinity Relationship Table |
| CAT | Critical Thinking Assessment Test |
| CCTDI | California Critical Thinking Disposition Inventory |
| CCTST | California Critical Thinking Skills Test |
| CCTT | Cornell Critical Thinking Test |
| CPA | Certified Public Accountants |
| CTA | Certificate in the Theory of Accounting |
| DART | Detailed Affinity Relationship Table |
| ETI | Elements of Thought Instrument |
| GPA | Grade point average |
| HERSA | Higher Education Research and Development Society of Australasia |
| HSRT | Health Science Reasoning Test |
| IAASB | International Auditing and Assurance Standards Board |
| IAESB | International Accounting Education Standards Board |
| IESs | International Educational Standards |
| ICT | Information communication technology |
| ICTs | Information communication technologies |
| IFAC | International Federation of Accountants |
| IQA | Interactive Qualitative Analysis |
| IT | Information technology |
| ITC | Initial Test of Competence |
| IRBA | Independent Regulatory Board for Auditors |
| IRD | Interrelationship Diagram |
| ISAs | International Standards on Auditing |
| PBL | Problem-based learning |
| RPSC | Research Permission Subcommittee |

| Acronym | Description |
|---|---|
| SAICA | South African Institute of Chartered Accountants |
| SAT | Scholastic Aptitude Test |
| SID | Systems Influence Diagram |
| SRIPCC | Senate Research Innovation Postgraduate Degrees and Commercialisation Committee |
| TQM | Total Quality Management |
| Unisa | University of South Africa |
| VE | Virtual environments |
| VLEs | Virtual learning environments |
| WEF | World Economic Forum |
| WGCTA | Watson-Glaser Critical Thinking Appraisal |
| 3D | Three-dimensional |

# CHAPTER 1
# INTRODUCTION TO THE STUDY

## 1.1 BACKGROUND TO THE STUDY

Advances in artificial intelligence and communications technologies are having profound influences on how tasks are performed. These developments also have an impact on who performs these tasks as automation influences job specifications (Agarwal, Bersin, Lahiri, Schwartz & Volini 2018: 4). With automation technologies substituting routine manual tasks, it is becoming increasingly more important for individuals to be able to solve unstructured problems and analyse information (World Economic Forum 2015: 2). Rapid changes in technology are thus forcing organisations to recreate themselves around artificial intelligence and robotics, forge new career models and incorporate new skills into their workforce (Agarwal et al. 2018: 41). With the unprecedented pace of technological development, pure technical competency is no longer adequate. Organisations are seeking cross-disciplinary thinkers who can use technology to innovate, create and provide specialised services (Agarwal et al. 2018: 74).

Access to data and technological advancements also have significant implications for the auditing profession. Technologies such as blockchain and artificial intelligence are reshaping the auditing profession. The automation of routine audit tasks has necessitated enhanced skills and competencies such as judgement, analysis, interpretation as well as critical thinking. To stay relevant, an auditor has to be tech-savvy, with good communication and thinking skills (Guthrie 2017: 1–2). In a survey conducted by Deloitte, organisations identified problem-solving, cognitive abilities and social skills as the most important competencies of the future (Agarwal et al. 2018: 41–42). Employers are also increasingly seeking individuals who are able to collaborate, think creatively as well as critically (World Economic Forum 2015: 2).

A shift in the demand for certain skills prompted the World Economic Forum (WEF) to identify the skills required to meet the needs of the 21$^{st}$ century workforce. A meta-analysis was conducted by the WEF of close to 100 countries, which indicated that many students are not obtaining the education they need to develop the skills required for the 21st century. The WEF subsequently categorised the essential 21st century skills into three broad categories, namely, foundational literacies, competencies and character qualities, as illustrated in Figure 1 (World Economic Forum 2015: 1–3).

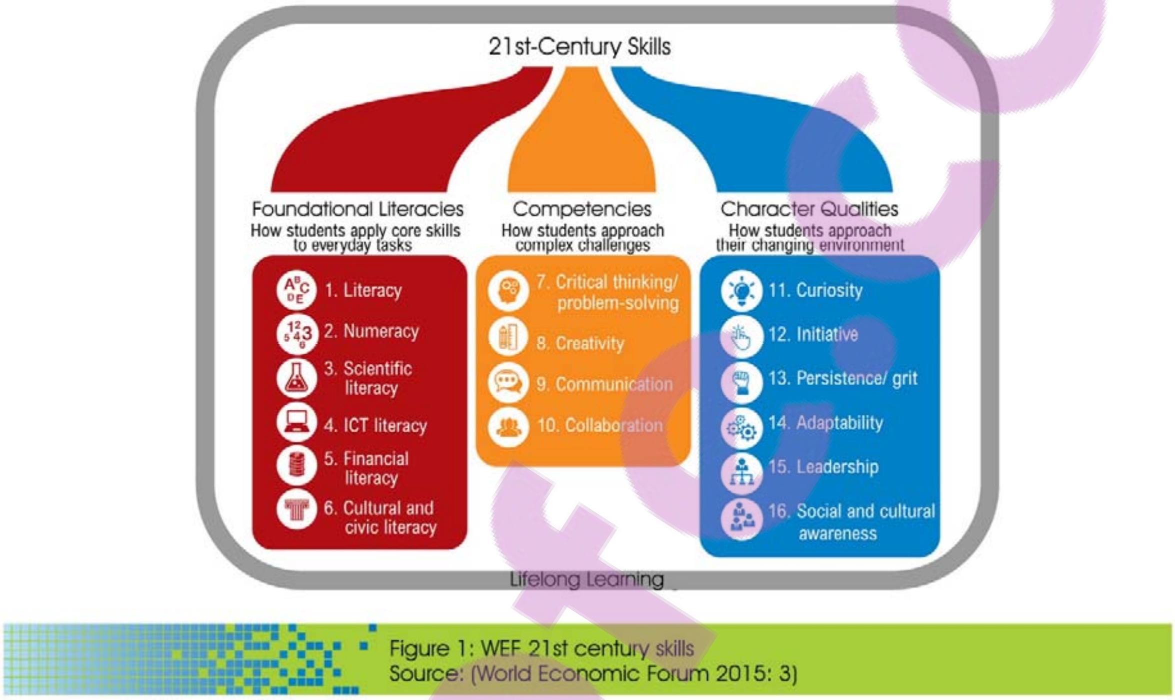


**Figure 1: WEF 21st century skills**
**Source:** (World Economic Forum 2015: 3)

Traditionally, the focus of education has been on the development of many of the foundational literacies (No. 1 to 6 in Figure 1). These foundational literacies are now considered only the starting point to acquiring 21st century skills, competencies and character qualities (World Economic Forum 2015: 2–3). Critical thinking (No. 7 in Figure 1) is considered vital for survival in the 21st century workforce (World Economic Forum 2015: 2–3) and has been described as one of the main goals of higher education (Davies & Barnett 2015: 27; Tiruneh, Verburgh & Elen 2014: 1–2; Van Gelder 2005: 41), a defining characteristic of a university graduate (Phillips & Bond 2004: 277) and even the ultimate goal of higher education (Garrison, Anderson & Archer 2010: 6). Davies and Barnett (2015: 2) are of the view that *"critical thinking in higher education is a global concern with* *a potential worldwide audience of millions".* They further indicate that *"all educators across all the disciplines are interested – or should be interested – in critical thinking"* (Davies & Barnett 2015: 2–3). This study therefore takes a particular interest in the development of the critical thinking where the focus is on students' approaches to unstructured problems and challenges (World Economic Forum 2015: 2–3).

Against this backdrop, a fresh perspective on how auditing students are being prepared for the future workforce is essential (Guthrie 2017: 1–2) as most learning programmes are not equipped to develop these required skills (Agarwal et al. 2018: 41–42). With decreasing budgets, increasing class sizes and mounting pressure from the business world to develop critical thinking, traditional teaching strategies are no longer adequate (EON Reality 2018: 1). Given that current factual content knowledge acquired by students will likely change or simply be irrelevant in the future, the focus of higher education has shifted from teaching *what to think* to *how to think* (Purvis 2009: 1). Teaching strategies and educational interventions such as problem-based learning (PBL), simulations or concept mapping are generally used to develop critical thinking (Carter, Creedy & Sidebotham 2016: 218; Lee et al. 2013: 1219). However, there seems to be little agreement as to the effectiveness of critical thinking instructional interventions (Abrami et al. 2015: 283; Tiruneh et al. 2014: 1–2) and how critical thinking can best be developed through teaching strategies (Abrami et al. 2015: 276). Given these concerns, educational institutions are currently failing to effectively develop students' critical thinking (Abrami et al. 2015: 276). There thus continues to be a concern that higher education students are not sufficiently developing their critical thinking capabilities (Davies & Barnett 2015: 1).

Advances in information communication technologies (ICTs) have also had major implications on education, as instant access to information has almost negated the need for memorisation of content knowledge (Ahuna, Tinnesz & Kiener 2014: 2; Purvis 2009: 1). Educators are now faced with the challenge and opportunity to develop learning environments that focus on critical thinking, which calls for innovations in education (Ahuna et al. 2014: 2). The WEF asserts that technology-based educational interventions provide effective platforms for developing the essential 21st century skills. Technology-based educational interventions such as augmented and virtual reality can achieve faster learning through immersive, interactive experiences. This provides students with the opportunity to apply, analyse and evaluate their knowledge to develop their creativity, critical thinking, problem-solving and communication skills (EON Reality 2018: 1). Students furthermore need to know how to use technology to solve complex problems. For this, 21st century skills, such as critical thinking, are needed (Zygouris-Coe 2013: 20–26). Innovative technologies are used to foster the development of critical thinking, yet critical thinking requires the use of technology as well (Kivunja 2014: 81).

Although various frameworks for critical thinking development currently exist (Atabaki, Keshtiaray & Yarmohammadian 2015: 93–102; Dwyer, Hogan & Stewart 2014: 43–52; Nair & Stamler 2013: 131–138; Vieira, Tenreiro-Vieira & Martins 2011: 43–54; Simpson & Courtney 2007: 56–63; Duron, Limbach & Waugh 2006: 160–166; Bailin, Case, Coombs & Daniels 1999a: 285–302; Colucciello 1997: 236–245), more research is needed to offer a robust framework for critical thinking development (Abrami et al. 2015: 305). The current frameworks generally only offer insights into isolated concepts or dimensions of critical thinking. Davies and Barnett (2015: 5) note that a specific model for critical thinking applied to higher education has long been overdue. I was unable to identify a robust, holistic framework for critical thinking development through technology-based educational interventions. I was also unable to identify such a framework specifically designed for auditing students. A gap in the literature was thus identified.

To address this gap, this study offers an original contribution from an educational perspective by proposing a conceptual framework for the development of critical thinking in auditing students through technology-based educational interventions. To arrive at this conceptual framework, Chapters 2, 3 and 4 provide more insights into the conceptualisation of critical thinking, the measurement of critical thinking and factors that may influence critical thinking. Chapter 4 also explores how critical thinking can effectively be developed through teaching strategies and technology-based educational interventions. The insights gained from these chapters, derived inductively and deductively from the body of knowledge, create the theoretical foundation for the concepts and relationships proposed in a preliminary, literature-based, conceptual framework (presented in Chapter 5). To validate the concepts and relationships proposed in this preliminary framework and to identify any additional concepts or relationships that should be included in the final conceptual framework, the perspectives of three groups of participants were solicited, using an IQA design. Several concepts, referred to as affinities in IQA methodology, were obtained from the three IQA focus groups. These affinities represent concepts that the three groups believed should be taken into account in critical thinking development in auditing students through technology-based educational interventions. The end product is a novel, integrated and robust conceptual framework aimed at the development of critical thinking in auditing students through technology-based educational interventions. The rationale for this study is provided in section 1.2.

## 1.2 RATIONALE FOR THE STUDY

I was partly motivated due to my own active involvement in the education and training of students registered for the Postgraduate Diploma in Accounting Sciences at the University of South Africa (Unisa). These students, upon successful completion of the Postgraduate Diploma, are awarded a Certificate in the Theory of Accounting (CTA) and are allowed to write the Initial Test of Competence (ITC) of the South African Institute of Chartered Accountants (SAICA). I have been specifically involved in the auditing module of this course since 2008.

During this time, it was my own observation that teaching strategies in accounting education primarily focus on the delivery of technical content knowledge. Traditional lecturing and case studies mainly form the basis of these teaching strategies. It was my personal observation that the development of pervasive skills, including critical thinking, took the form of implicit instruction. Yet the *open distance learning policy* of Unisa describes that a student-centred approach should be followed, with rich environments for active learning and the encouragement of critical thinking (Unisa 2008: 2). Although discussion forums and podcasts are used in this auditing course, advanced, technology-based educational interventions, such as simulations and virtual reality, have not been used in accounting education at Unisa.

I became increasingly aware that it was the responsibility of the educators involved in these courses to develop pervasive skills, including critical thinking, at an advanced level in students. I was aware that the literature (refer to section 2.2 of Chapter 2) confirmed these observations. Additionally, the SAICA competency framework sets out the professional competencies (knowledge, skills and attributes) that chartered accountants in South Africa should possess when they enter the profession. The competency framework places the responsibility of teaching and assessing pervasive skills and specific competencies on the SAICA-accredited programme providers. The framework is, however, not prescriptive and encourages innovative ways to achieve this (South African Institute of Chartered Accountants 2010: 3–16).

I also became gradually more aware of the increasing need for critical thinking in the auditing profession. With advances in technology, such as artificial intelligence and robotics, the profession is under more pressure than ever to deliver chartered accountants with competence in higher order thinking, which includes critical thinking (Barac 2017: 1). Educators should also make use of the advances in educational technologies as these technologies provide effective platforms for critical thinking. Higher education is advancing into the 21st century and the use of technology is becoming the norm as opposed to a novelty. Educators in higher education in many instances have access to various technologies such as wikis, blogs, online discussion forums, social media, simulations, virtual reality, to only name a few, and can no longer shy away from using these technologies because of fear or lack of expertise. Educators should learn how to use these technologies and how they can facilitate critical thinking development (Little & Feldhaus 2015: 98–116). These observations encouraged me to explore how educators in the field of accounting education could apply technology-based educational interventions to develop critical thinking in auditing students.

While I have discussed the specifications of the rationale, the research is also driven by the need to extend and use theory to broaden the body of knowledge. The study therefore has the following theoretical rationale. Numerous educators refer to Bloom's taxonomy or Bloom's revised taxonomy (Anderson & Krathwohl 2001: 67–68) as the foundation for determining students' critical thinking abilities (Nelson & Crow 2014: 78). Bloom's taxonomy is also seen as an established theoretical framework on thinking and learning (Bali 2014: 50). For critical thinking to be developed, educators should create learning environments that engage students in the upper three levels (analysis, synthesis and evaluation) of Bloom's taxonomy (Yusuf & Adeoye 2012: 314). Ennis (1993: 179), however, asserts that although the upper three levels of Bloom's taxonomy can form a foundation for critical thinking definitions, the taxonomy does not provide adequate guidance for the actual development of critical thinking (Atabaki et al. 2015: 95–96). Numerous researchers have thus attempted to examine intellectual development in students and the underlying assumptions. Various developmental theories have subsequently been proposed for the different stages of intellectual development, higher levels of epistemological development, cognitive development and critical thinking development (Kurfiss 1988: 67–86). Learning theories also lay the foundation for how teaching strategies are designed and implemented (Harasim 2012: 4–8). Educators are also encouraged to use teaching strategies grounded in constructivism when they wish to develop critical thinking in students (Lai 2011: 2). Against this backdrop, an integrated and robust conceptual framework is needed to broaden the existing body of knowledge on critical thinking development. This rationale is further articulated in the problem statement in section 1.3.

The findings of this study could therefore be useful to:

- Educators involved in accounting education, both internationally and in South Africa, with an interest in imparting critical thinking to students;
- Curriculum developers, especially in higher education institutions;
- Academics involved in research regarding critical thinking development in students;
- Professional accounting and auditing bodies. The findings of this study could make a valuable contribution to how critical thinking is defined in competency frameworks and could provide guidance on how this skill could be developed through technology-based educational interventions;
- Policy makers who wish to inform the debate with evidence-based data on critical thinking development and shaping of professions; and
- Interdisciplinary teams seeking to address complex issues with a nexus of disciplinary thinking.

## 1.3 PROBLEM STATEMENT

Having established some key areas of the context, it is also important to locate the research problem within the domain of scholarship and theory. One of the main aims of education is to develop students' critical thinking (Tunca 2015: 183). Existing evidence suggests that students' level of critical thinking is inadequate for solving complex problems within their discipline and indeed, for solving problems experienced in life in general (Tiruneh et al. 2014: 1; Van Gelder 2005: 41). Technology-based educational interventions provide ideal platforms for the development of 21st century skills such as critical thinking, however, more research is needed (World Economic Forum 2015: 1–8). The importance of critical thinking for success in the auditing profession is not in dispute. Consequently, research focus must now move away from describing the importance of critical thinking, to ways of developing it (Apostolou, Dorminey, Hassell & Watson 2013: 146). There is thus a need for robust frameworks that address the development of critical thinking (Abrami et al. 2015: 305).

To identify whether any such frameworks exist, I consulted some of the main academic databases such as EBSCOhost, Emerald, Google Scholar and ProQuest. Search terms such as *'critical thinking frameworks', 'frameworks for critical thinking development through technology-based interventions'* and *'frameworks for developing critical thinking in auditing students',* were entered. Although some critical thinking frameworks did appear in the searches, I was unable to identify a robust, holistic framework using technology-based educational interventions, let alone a framework specifically designed for auditing students.

I therefore posit that a disciplinary and interdisciplinary gap exists that requires a novel contribution in extending the theories of Bloom's taxonomy and Bloom's revised taxonomy (Anderson & Krathwohl 2001: 67–68). With this point in mind, the research aims and objectives of the present study are formulated, as set out in section 1.4.

## 1.4 RESEARCH OBJECTIVES

The primary objective of this study is to develop a new conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions. To arrive at this conceptual framework, I had to obtain an understanding of the key constructs, concepts, assumptions, beliefs and theories relevant to critical thinking as well as the relationships between them.

For this reason, this study commences with an overview of what critical thinking is and how it can be measured (Chapter 2). This is followed by an overview of factors that may influence students' critical thinking (Chapter 3) as well as an overview of how critical thinking is most effectively developed through teaching strategies and technology-based educational interventions (Chapter 4). The insights presented in Chapters 2 to 4, including the gaps identified in the body of knowledge, provide the theoretical framework which will serve as the foundation for a preliminary, literature-based, conceptual framework for critical thinking development in auditing students through technology-based educational interventions (Chapter 5).

To validate the concepts and relationships proposed in the preliminary framework and to identify any other concepts or relationships that should be added, the perspectives of three groups of participants were solicited. An IQA design was followed (section 1.7), where participants were allowed to construct their own meaning of the phenomenon by generating the components of the phenomenon, referred to as affinities, as well as the relationships between these affinities. Three groups of participants, who were knowledgeable about the phenomenon, were identified. These groups shared a common understanding of the phenomenon and were classified according to their power over and distance from the phenomenon (section 6.4.2, Chapter 6). These three groups included:

- Instructional designers, online learning designers, educational technologists, teaching and learning consultants as well as experts in e-learning environments;
- Auditing lecturers at SAICA-accredited programme providers and SAICA representatives; and
- Postgraduate auditing students at Unisa.

The data obtained from these focus groups validated certain concepts and relationships in the preliminary framework and provided insights into additional concepts and relationships that needed to be incorporated into the framework. The final proposed conceptual framework for the development of critical thinking in auditing students through technology-based educational interventions forms the primary objective of this study. The primary and secondary research objectives are indicated in Table 1. This table also lists the cognitive process dimensions, in line with Bloom's revised taxonomy (Anderson & Krathwohl 2001: 67–68) that enabled me to address the research objectives of this study.

## Table 1: Research objectives

| Research objectives<br><br>(A) | Description | My cognitive process dimensions to address the research objectives, in line with Bloom's revised taxonomy (Anderson & Krathwohl 2001: 67–68) |
|---|---|---|
| **Primary research objective (A)**<br><br>To propose a conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions (Chapter 8) | | Create<br>Evaluate<br>Analyse<br>Apply<br>Understand |
| **Secondary research objective A1** | To obtain an understanding of what critical thinking is and how it is measured (Chapter 2) | Evaluate<br>Analyse<br>Understand |
| **Secondary research objective A2** | To obtain an understanding of factors that may influence students' critical thinking (Chapter 3) | Evaluate<br>Analyse<br>Understand |
| **Secondary research objective A3** | To obtain an understanding of how critical thinking is most effectively developed through teaching strategies and technology-based educational interventions (Chapter 4) | Evaluate<br>Analyse<br>Understand |
| **Secondary research objective A4** | To propose a preliminary, literature-based, conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions (Chapter 5) | Create<br>Evaluate<br>Analyse<br>Apply<br>Understand |
| **Secondary research objective A5** | To obtain an understanding of the concepts that should be considered when critical thinking is developed in auditing students through technology-based educational interventions (Chapter 7) | Evaluate<br>Analyse<br>Understand |
| **Secondary research objective A6** | To obtain an understanding of how these concepts relate to one another (Chapter 7) | Evaluate<br>Analyse<br>Understand |
| **Secondary research objective A7** | To obtain an understanding of how the concepts and the systems of the three groups compare to one another (Chapter 7) | Evaluate<br>Analyse<br>Understand |

**Source:** Author

## 1.5 RESEARCH QUESTIONS

Given that a conceptual framework is in the domain of theoretical extension, it is necessary to obtain an understanding of key constructs, concepts, assumptions, beliefs and theories relevant to critical thinking. An understanding of the relationships between these constructs or concepts is also required. Such exploration and inter-linkages assist with the amplification of theory. As mentioned in section 1.4, the final conceptual framework is the primary objective of this study. To address this objective, the primary research question thus focuses on the concepts and the relationships between them, which should be considered when critical thinking is developed in auditing students through technology-based educational interventions. Consequently, several secondary research questions are presented in Table 2. Secondary research questions B1 to B7 address the key constructs, concepts, assumptions, beliefs and theories related to critical thinking, its development and measurement as well as the relationships between these concepts. Secondary research questions B1 to B3 lay the foundation for the preliminary framework.

To validate the concepts and relationships proposed in the preliminary framework and to identify any other concepts or relationships that should be added, the perspectives of three IQA focus groups were sought. Secondary research questions B5 to B7 sought to elicit concepts as well as interrelationships between these concepts, that the three groups believed should be taken into account when critical thinking is developed in auditing students through technology-based educational interventions. Northcutt and McCoy (2004: 28) advise three research questions for an IQA design when more than two systems are compared. Secondary research questions B5 to B7 are in the requisite sequence advised by Northcutt and McCoy (2004: 28) for an IQA design. Table 2 provides an overview of the primary and secondary research questions.

### Table 2: Research questions

<table>
<tr><th>Research question (B)</th><th>Description</th></tr>
<tr><td colspan="2">Primary research question (B)<br><br>Which concepts, and relationships between these concepts, should be considered when critical thinking is developed in auditing students through technology-based educational interventions? (Chapter 8)</td></tr>
<tr><td>Secondary research question B1</td><td>What is critical thinking and how is it measured? (Chapter 2)</td></tr>
<tr><td>Secondary research question B2</td><td>Which factors may potentially influence students’ critical thinking? (Chapter 3)</td></tr>
<tr><td>Secondary research question B3</td><td>How is critical thinking most effectively developed through teaching strategies and technology-based educational interventions? (Chapter 4)</td></tr>
<tr><td>Secondary research question B4</td><td>Which concepts and the relationships between these concepts, should be considered when critical thinking is developed in auditing students through technology-based educational interventions, as evident from the literature? (Chapter 5)</td></tr>
<tr><td>Secondary research question B5</td><td>Which concepts should be considered when critical thinking is developed in auditing students through technology-based educational interventions, from the perspective of (Chapter 7):<br>• Instructional designers, online learning designers, educational technologists, teaching and learning consultants as well as experts in e-learning environments;<br>• Auditing lecturers at SAICA-accredited programme providers and SAICA representatives; and<br>• Postgraduate auditing students at Unisa?</td></tr>
<tr><td>Secondary research question B6</td><td>How are these concepts related to one another? (Chapter 7)</td></tr>
<tr><td>Secondary research question B7</td><td>How do the concepts as identified by the three groups, and the systems of the three groups, compare to one another? (Chapter 7)</td></tr>
</table>

**Source:** Author

## 1.6 SCOPE OF THE STUDY

This study focuses on how critical thinking can be developed in auditing students through technology-based educational interventions. In the rationale for this study, it was noted that it is the responsibility of the SAICA-accredited programme providers to develop pervasive skills, including critical thinking, to an advanced level in students (South African Institute of Chartered Accountants 2014a: 45). Critical thinking forms part of the pervasive qualities and skills component, specifically professional skills, of the SAICA competency framework (South African Institute of Chartered Accountants 2014a: 34–37). Auditing forms part of specific competencies prescribed by the SAICA competency framework (South African Institute of Chartered Accountants 2014a: 2). This study therefore focuses on how critical thinking can be developed through technology-based educational interventions, specifically in auditing courses presented by SAICA-accredited programme providers in South Africa.

Davies and Barnett (2015: 6) state that there are three perspectives that can be adopted on critical thinking in higher education. The *philosophical perspective* is focused on clear, rigorous, logical thinking with an interest in formal and informal thinking. This perspective is also interested in how critical thinking forms part of metacognitive processes. The *socially active perspective* is concerned with how society is transformed by critical thinking attitudes. It is focused on critical pedagogy [*"the use of higher education to overcome and unlearn the social conditions that restrict and limit human freedom"* (Davies & Barnett 2015: 18)] and critical citizenship (Davies & Barnett 2015: 6). The critical pedagogy movement is concerned with social conditions of freedom, liberation from oppressive systems and freedom of thought. Critical pedagogues are also focused on "*turning students against the idea of being trained for the economic needs of large corporations*" (Davies & Barnett 2015: 20). The third perspective is an *educational perspective*, which is mainly concerned with the educational development of critical thinking in students and ways in which critical thinking can then benefit the wider society outside the classroom. Although these three perspectives are not mutually exclusive, this study takes an *educational perspective* as it is concerned with the development of auditing students' critical thinking through technology-based educational interventions.

This study thus takes an interest in the educational value and benefits of critical thinking development in auditing students. This may ultimately benefit the student, the auditing profession and society at large.

Given that critical thinking is vital for survival in the 21st century workforce (World Economic Forum 2015: 2–3) and is the ultimate goal of higher education (Garrison et al. 2010: 6), the findings of this study should prove useful not only to the auditing profession, but also to other professions, both in South Africa and internationally.

## 1.7 RESEARCH DESIGN AND METHODOLOGY

This study proposes a conceptual framework for the development of critical thinking in auditing students through technology-based educational interventions. A conceptual framework is a system of concepts, assumptions, beliefs and theories that support research and the enhanced understanding of that which is researched. It is either presented graphically or narratively and sets out key constructs, factors or variables together with the relationships between them (Maxwell 2013: 39–60).

With its foundations in systems theory (Northcutt & McCoy 2004: xxii; 40-41), an IQA design facilitates the process of obtaining the constucts, factors or variables and identifying the relationships between them. Systems are the representations of how individuals or groups understand a phenomenon (Northcutt & McCoy 2004: xxii; 40-41). IQA allows participants to construct their own meaning of a phenomenon by generating the components of the phenomenon, referred to as affinities, as well as the relationships between them (Northcutt & McCoy 2004: 66). The affinities and the relationships between them are then represented in the form of a mindmap or Systems Influence Diagram (SID) which is a visual representation of the group's analysis of the phenomenon (Northcutt & McCoy 2004: xiii–xiv). IQA also allows for mindmaps of different groups to be compared to gain even more insight into the phenomenon being explored (Northcutt & McCoy 2004: 66). Based on this discussion, this study followed the principles prescribed by IQA, namely, a qualitative approach to research developed by Northcutt and McCoy (2004: xxi).

To achieve its goals, IQA employs ethnographic tools of observation and interviews as well as other tools from market research such as focus groups (Northcutt & McCoy 2004: xxi). To obtain an understanding of how critical thinking can be developed in auditing students through technology-based educational interventions, I solicited the views of three groups of participants through focus group discussions. Focus groups are generally seen as a qualitative data collection method where group discussions are conducted with several participants at the same time (Saunders, Lewis & Thornhill 2016: 416; Creswell 2014: 191; Leedy & Ormrod 2005: 146). The following groups of participants were selected for this purpose:

- Group 1: Instructional designers, online learning designers, educational technologists, teaching and learning consultants as well as experts in e-learning environments;
- Group 2: Auditing lecturers from various SAICA-accredited programme providers and SAICA representatives; and
- Group 3: Students registered for Applied Auditing (AUE4862) which forms part of the Postgraduate Diploma in Applied Accounting Sciences offered at Unisa in 2017.

The study adopted an constructivist philosophical paradigm where the emphasis is on sense-making and the assignment of meaning (Fincham 2002: 2). According to Creswell (2014: 8–9), participants should be allowed to construct their own meaning of the phenomenon and generate meaning through interaction with others. The main aim of a constructivist researcher is then to explore or interpret the meanings of individuals with regard to a particular phenomenon (Creswell 2014: 8).

## 1.8 ROLE OF THE RESEARCHER

I conducted the literature review in this study (Chapters 2 to 4) and proposed a conceptual framework for developing critical thinking in auditing students through technology-based educational interventions (Chapters 5 and 8). I also selected and invited the participants of the IQA focus groups. During these focus groups, I acted as a non-participating observer. I was also actively involved in the data collection, analysis and interpretation of the IQA results for the three focus groups. The role of the researcher is discussed in more detail in Chapter 6 (section 6.7.1) and Chapter 9 (section 9.4).

The recursive IQA design has been described as a formal version of critical thinking where the researcher has to find the answers to a question by obtaining different perspectives on the phenomenon (Northcutt & McCoy 2004: 61). In Table 1 of section 1.4, the cognitive processes, in line with Bloom's revised taxonomy (Anderson & Krathwohl 2001: 67–68), were specified which enabled me to address the research objectives of this study. I used various cognitive dimensions throughout this study to achieve these research objectives and also applied my own critical thinking skills and dispositions throughout the study.

## 1.9 DELIMITATIONS

The following delimitations were applicable to this study:

- This study focuses on the development of critical thinking, taking into account specific theoretical propositions associated with this skill. The WEF identifies various other skills, competencies and character qualities that should be developed to equip students for the 21st century workforce. These, however, fall outside the scope of this particular study.
- The study focuses on the development of auditing students' critical thinking as auditing is the subject in which I specialise. The participants in the focus groups were limited to undergraduate and postgraduate auditing lecturers from various universities in Gauteng and postgraduate auditing students registered at Unisa. The proposed conceptual framework could, however, have similar value for other subject areas including taxation, accounting and financial management, internationally as well as in South Africa. These subject areas, however, fall outside the scope of the study.
- This study was conducted in a South African context and focused on the development of critical thinking in auditing students from a South African perspective. The study furthermore focused on critical thinking from a higher education perspective. The WEF, however, indicates that critical thinking forms part of the competencies and skills that are internationally required for the 21st

century workforce and this study thus has relevance not only in South Africa but internationally as well. These competencies and skills should also be developed at other levels of education including school and undergraduate level. These, however, fall outside the scope of this study.

- Critical thinking in higher education can include discussions on critical pedagogy, political analyses of the role of higher education in society, different approaches to curriculum development and how critical thinking relates to creativity (Davies & Barnett 2015: 3–8). Although reference might be made to some of these topics, they fall outside the scope of this study.
- The participants in all three focus groups were mainly recruited from the Gauteng province in South Africa. This was done for logistical reasons as the focus groups were conducted on the Unisa campus in Pretoria, Gauteng.
- Participants in the focus groups were selected by way of purposive sampling techniques. The sample selection was thus based on the availability of participants. I aimed to explore a particular phenomenon and the results of this study are therefore not representative of the entire population.
- The definition and dimensions described by the American Philosophical Association (APA) provide a foundation for this study's conceptual framework as discussed in Chapter 2. Various other definitions of critical thinking exist in the literature which could also be used by researchers in their studies. However, I found the APA's definition and dimensions to be the most comprehensive.
- IQA generally makes use of focus groups. Focus groups can have certain limitations as not all individuals in the group may be equally articulate (Creswell 2014: 191) or may feel uncomfortable sharing their ideas in a group setting. IQA addresses this limitation by allowing each participant to write down their own thoughts on note cards during a silent brainstorming session (Northcutt & McCoy 2004: 47). This allows less articulate individuals or individuals who are not comfortable in a group setting to contribute their ideas on the phenomenon without being influenced by others.

## 1.10 ASSUMPTIONS

The following assumptions were made during this study:

- The educator's own philosophical beliefs as to the purpose of education influence the importance the educator accords to critical thinking development. If the educator believes that the purpose of education is solely to relay content knowledge, then the memorisation of facts and rote learning are sufficient. If, on the other hand, the educator believes that the purpose of education is to foster increased reasoning, judgement and problem-solving skills, then critical thinking development plays a vital role (Kurfiss 1988: 16). This study assumes that educators, particularly those involved in educating chartered accountants, understand and value the importance of critical thinking development in students.
- In this study, it is assumed that auditing students value their own ability to think critically and are concerned about their critical thinking development or its lack.
- Teaching students to think critically requires educators to be sound critical thinkers themselves. This study assumes that educators are committed and willing to improve their own critical thinking, in order to improve the critical thinking abilities of their students.
- This study assumes that there are predictable stages of critical thinking development through which a student has to pass to become an accomplished critical thinker. For the student to pass from one stage to another, a certain level of commitment is required from both the student and the educator.
- IQA prescribes rigorous procedures for both data collection and analysis (Northcutt & McCoy 2004: 38). It was assumed that the participants in the three focus groups were truthful and honest in the views that they provided in the focus group discussions and Detailed Affinity Relationship Tables (DARTs) for the results to be accurately represented.

## 1.11 ETHICAL CONSIDERATIONS

Ethical considerations in research require particular attention (Creswell 2014: 92). I considered the possible ethical issues that could arise during this study. Data from the participants was collected through focus group discussions. This required ethical approval from the Unisa College of Accounting Sciences Ethics Review Committee as well as the Research Permission Sub-Committee (RPSC) of the Senate Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC) of Unisa. Ethical clearance was obtained from both committees (reference number 2017_CAS_001 and number 2017_RPSC_020). The approval certificates from these two committees are attached in Annexures A and B. Note that the title of the study, as indicated in Annexures A and B, was originally ‘Developing critical thinking in auditing students in an e-learning environment’ but was subsequently amended to the current title.

The data obtained through these focus groups was viewed as strictly confidential and kept as such by myself. No personal information of any of the participants was divulged and feedback remained anonymous in the study. Participants signed informed consent letters to participate in the study (Annexure I). These letters set out the purpose of the study, the procedures of participation, the fact that the participation was entirely voluntary, that responses were anonymous and that participants had the right to withdraw at any stage.

All audio recordings of focus group discussions are stored on a password-protected computer with backups on a password-protected external hard-drive device. All data obtained in this study will be stored for at least a five-year period by myself.

## 1.12 OUTLINE OF CHAPTERS

The objective of this study is to provide a conceptual framework for the development of critical thinking in auditing students through technology-based educational interventions. Chapter 1 provided the background to and rationale for this study. This introductory chapter outlined the problem statement, research objectives and research questions. Chapter 1 described the delimitations and assumptions of the study as well as ethical considerations that were taken into account during the study. The research design and methodology section provided an overview of the IQA research design that was followed.

**Chapter 2 – Critical thinking: Definition, dimensions and measurement**

Chapter 2 provides an overview of **what** critical thinking is. Through the literature, an understanding of critical thinking, its definitions and dimensions are obtained. This chapter also examines **how** critical thinking can be measured. Researchers use various types of measurement instruments to evaluate the effectiveness of critical thinking instruction and educational interventions. Chapter 2 thus describes the different types of critical thinking measurement instruments, both standardised and non-standardised, that are most commonly used.

**Chapter 3 – Factors that may influence students' critical thinking**

Critical thinking can be influenced by various factors. Factors relating to the educator, the student and other instructional factors may influence students' critical thinking as well as the results of critical thinking measurement instruments. There is a need to explore these factors as they may have an impact on educational practices (Kwan & Wong 2015: 68–69). These factors are discussed in Chapter 3.

**Chapter 4 – Critical thinking development through teaching strategies and technology-based educational interventions**

Chapter 4 explores **how critical thinking is most effectively developed**, with a particular focus on teaching strategies and technology-based educational interventions. This chapter examines learning theories that underpin the teaching strategies used to develop critical thinking. The chapter also outlines the main teaching strategies and technology-based educational interventions that are considered to effectively facilitate the development of critical thinking.

**Chapter 5 – Preliminary conceptual framework**

Chapter 5 presents the preliminary literature-based, conceptual framework proposed in this study for developing critical thinking in auditing students through technology-based educational interventions. The concepts and relationships, as set out in this preliminary framework, are derived from the literature presented in Chapters 2 to 4.

**Chapter 6 – Research design and methodology**

Chapter 6 provides an overview of the research paradigm that informed this study as well as the research design and research method. The IQA research design and data analysis are also described in more detail.

**Chapter 7 – Data presentation – Focus groups 1 to 3**

To validate the concepts and relationships proposed in the preliminary framework and to provide insights into additional concepts and relationships that should be included in the final framework, the perspectives of three groups of participants were solicited, using IQA. Chapter 7 presents the results of the theoretical coding performed in terms of the IQA process. This chapter provides an overview of the affinities contributed by the three IQA focus groups, the perceived relationships that exist among these affinities, a description of the overall placement of the affinities in the SID for each group and a comparison of the systems of the three groups. In total, 30 affinities were identified through the focus groups. These affinities represent concepts that participants believed should be taken into account when critical thinking is developed in auditing students through technology-based educational interventions. An affinity reconciliation protocol was also performed in Chapter 7 to arrive at a single reconciled list of twenty common core affinities.

**Chapter 8 – Final conceptual framework**

The reconciled list of twenty common core affinities (arrived at in Chapter 7) is further analysed and interpreted in Chapter 8 to establish whether these affinities validate the concepts and relationships proposed in the preliminary framework or whether they provide insights into concepts and relationships that should be added to the final conceptual framework. The concepts and relationships in the final conceptual framework were thus derived inductively and deductively from the literature presented in Chapters 2 to 4 as well as from the perspectives of three groups of participants who were considered knowledgeable in the field under investigation. The final conceptual framework provides a model to understand how critical thinking could be developed in auditing students through technology-based educational interventions.

### Chapter 9 – Conclusions, recommendations and reflections

Chapter 9 provides an overview of the contributions of this study, the conclusions drawn, reflections on my role as researcher and the methodology as well as recommendations for further research.

# CHAPTER 2
# CRITICAL THINKING: DEFINITION, DIMENSIONS AND MEASUREMENT

## 2.1 INTRODUCTION

In Chapter 1 it was noted that the focus of this study is on the development of critical thinking. Critical thinking is, however, a multifaceted concept with various definitions. It is thus vital to obtain a thorough understanding of what exactly constitutes critical thinking in order to ensure that it is effectively developed and measured. To this end, the objective of Chapter 2 is to gain an understanding of **what critical thinking is** and **how it is measured,** thereby addressing secondary research objective A1 and secondary research question B1.

| | |
|---|---|
| **Secondary research objective A1** | To obtain an understanding of what critical thinking is and how it is measured. |
| **Secondary research question B1** | What is critical thinking and how is it measured? |

Through this understanding, Chapter 2 provides insights into several key constructs, concepts, assumptions, beliefs and theories related to critical thinking as well as possible relationships between these. This understanding creates a foundation for the preliminary, literature-based, conceptual framework presented in Chapter 5.

A traditional literature review was carried out (Jesson, Matheson & Lacey 2011: 73–76) to obtain an understanding of the current state of knowledge about what constitutes critical thinking and to obtain an understanding of how critical thinking can be measured. This literature review covered seminal works and key studies on the topic. I consulted some of the main scholarly databases such as EBSCOhost, Emerald, Google Scholar and ProQuest. Search terms such as: *'what is critical thinking?', 'what are the features of critical thinking?', 'definition of critical thinking', 'dimensions of critical thinking', 'how is critical thinking measured?', 'assessing critical thinking'* and *'critical thinking* *measurement instruments'* were entered. An overview of critical thinking definitions and dimensions is provided in section 2.2 while section 2.3 provides an overview of the different types of critical thinking measurement instruments that are generally used. These include standardised and non-standardised instruments. Figure 2 provides an illustration of the layout of Chapter 2.

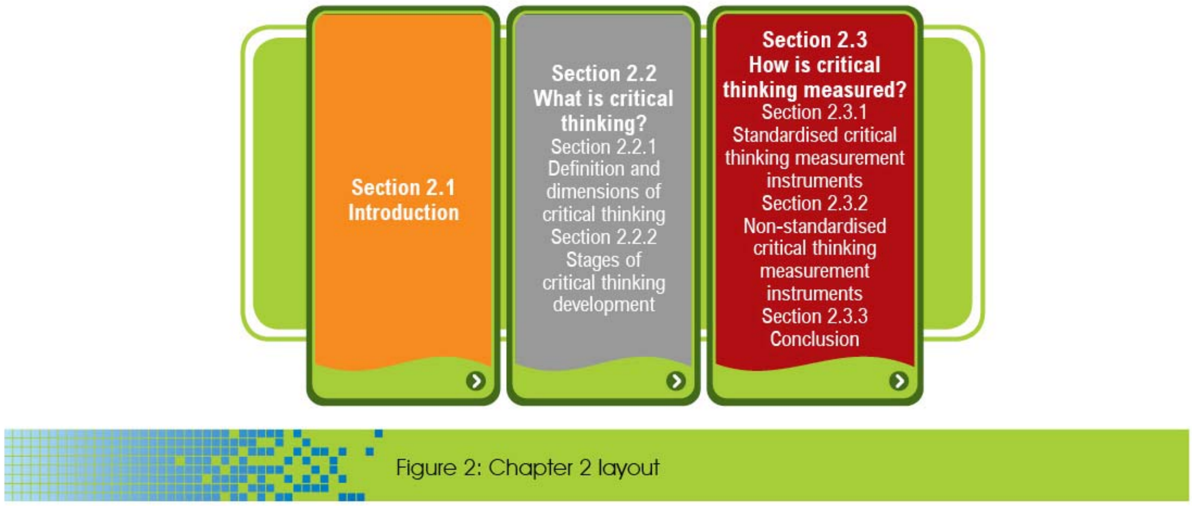


**Figure 2: Chapter 2 layout**
**Source:** Author

## 2.2 WHAT IS CRITICAL THINKING?

Critical thinking is a complex concept with virtually no consensus on a clear definition (Hepner 2015: 68; Rubenfeld & Scheffer 2015: 28–34). As a result, it is not well understood, not applied consistently (Kataoka-Yahiro & Saylor 1994: 351), considered to be abstract and interpreted in many different ways (Nair & Stamler 2013: 131). The concept of critical thinking has been studied in various disciplines and countless definitions of critical thinking exist in the literature (Atabaki et al. 2015: 93–97; Jordan D'Ambrisi 2011: 16–28). From the abundance of definitions in the literature, it is clear that defining critical thinking is not a simple task (Mojica 2010: 16) as it is understood in many different ways (Jordan D'Ambrisi 2011: 19). Hepner (2015: 68) is of the opinion that the lack of consensus regarding the concept of critical thinking among various disciplines has had negative effects on both students, educators and employers.

The absence of an agreed upon terminology has also created confusion and further lack of consensus (Hepner 2015: 73–74; Reed 1998: 14–15). The sheer number of surrogate terms contributes to the confusion surrounding the concept (Turner 2005: 275). Turner (2005: 275) performed a concept analysis on critical thinking and found 27 surrogate terms in the literature. 'Problem-solving' as well as 'decision-making' are some of the surrogate terms most often used according to this concept analysis. These should, however, rather be seen as arenas in which critical thinking capabilities can be utilised (Bailin et al. 1999a: 276–277). The term 'critical thinking' is also often interchangeably used with 'higher-order thinking' (Hepner 2015: 73–74; Lewis & Smith 1993: 131; Facione 1990a: 5). Ennis (1985: 45), however, maintains that critical thinking is a much more clearly defined concept than the vague term, 'higher-order thinking'. Other surrogate terms for critical thinking include 'creative thinking' (Mojica 2010: 16; Facione 1990a: 5), 'rational thought' (Lewis & Smith 1993: 131), 'reasoning' (Hepner 2015: 73–74; Lewis & Smith 1993: 131), 'thinking skills' (Mojica 2010: 16), 'critical reflection', 'argumentation', 'judgement' and 'metacognition' (Hepner 2015: 73–74). For the purposes of this study, the term 'critical thinking' will be used, as this is the most widely used term in the literature, with the others used as related terms (Mojica 2010: 16).

To overcome some of these conceptual problems, a thorough understanding of critical thinking is essential (Bailin, Case, Coombs & Daniels 1999b: 286). Although, a universally accepted definition of critical thinking may not exist, it is the responsibility of each researcher to precisely state the definition of critical thinking that forms the basis for their own study (Brunt 2005: 66) and for educators to state the working definition that drives their teaching strategies (Van Erp 2008: 29–30). In this regard, section 2.2.1 provides a brief historical overview of some of the core definitions, dimensions and theories relating to critical thinking that have emerged in literature over the years as well as the key individuals who have shaped their development. The aim is not to provide a complete history of critical thinking, but rather to present a brief overview of the origins of critical thinking in Western history and the subsequent development that shaped the concept as we understand it today.

### 2.2.1 Definition and dimensions of critical thinking

To explain what critical thinking is, it is important to provide some form of contextual and historical background (Rubenfeld & Scheffer 2015: 29). Annexure C, which is summarised as a historical timeline in Figure 3, highlights some of the key individuals and organisations in Western history which have shaped the evolution of critical thinking over the decades.

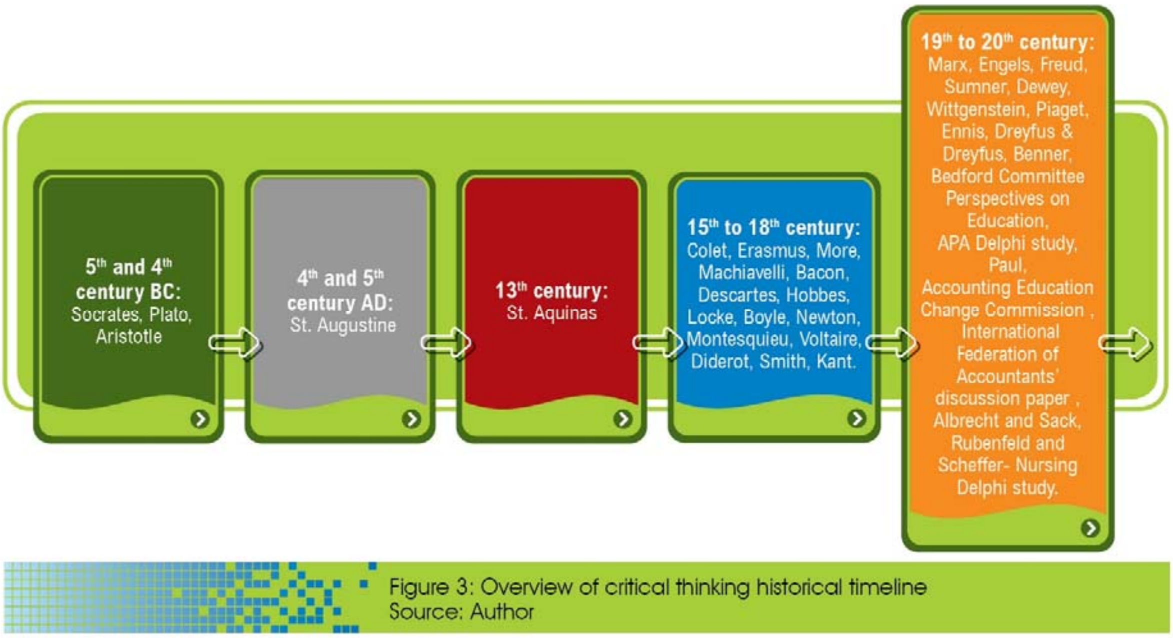


**Figure 3: Overview of critical thinking historical timeline**
**Source:** Author

Critical thinking is certainly not a new concept (Abrami et al. 2008: 1103) as evident from Annexure C and Figure 3. Numerous key individuals have contributed to the concept as it is understood today. For many years, both philosophers and psychologists have been debating the definition, theories and dimensions of critical thinking (Atabaki et al. 2015: 93–95; Hepner 2015: 73–74). These *"two academic disciplines"* (Hepner 2015: 73) have mainly provided the theoretical foundations of the concept over the years (Atabaki et al. 2015: 93–99; Hepner 2015: 73–77).

Philosophers tend to focus more on the nature and quality of critical thinking as well as the aspects a person needs for thinking (Atabaki et al. 2015: 94; Reed 1998: 15). They concentrate on logical reasoning and how one should perfect thinking to decide what to believe or do (Lewis & Smith 1993: 132). These aspects can be linked to critical thinking attitudes (Atabaki et al. 2015: 95). Facione (1990a: 11) mentions that these attitudes are also referred to as 'dispositions', 'habits of the mind', 'traits of the mind' or 'personal traits'. Philosophy-based theories and definitions of critical thinking can be traced back to the Greek philosophers Socrates (Norris 2011: 18; Jones-Devitt & Smith 2007: 1), Plato and Aristotle (Staib 2003: 498; Daly 1998: 324). Socrates is still referred to by many as the founder of critical thinking (Denardo 2003: 13). It is thus no wonder that the word 'critical' is derived from the Greek 'kriticos' - to question, make sense of, to analyse and judge (Paul & Elder 1997: 6).

Ennis, a philosopher of education, defines critical thinking as reflective and reasonable thinking aimed at making decisions about what to believe or do (Ennis 1985: 45). He provides twelve skills and thirteen dispositions of critical thinking (Ennis 1985: 46). Table 3 presents a summary of the definition and dimensions of critical thinking as described by Ennis. Ennis (1993: 179) asserts that although the upper three levels of Bloom's taxonomy, namely, analysis, synthesis and evaluation (see Figure 4) form a basis for critical thinking definitions, Bloom's taxonomy does not provide sufficient guidance for the actual development of critical thinking (Atabaki et al. 2015: 95–96).

Bloom's taxonomy is seen as an established theoretical framework on thinking and learning. It has been used in educational settings for many years and serves as guidance to educators when they set learning objectives and assessments for higher order thinking (Bali 2014: 50). A revision on this taxonomy was conducted by Anderson and Krathwohl (2001: 1–289), with the revised levels depicted in Figure 4. The lower levels of cognitive processes are classified as remembering, understanding and applying. The higher levels of cognitive processes are classified as analysing, evaluating and creating.

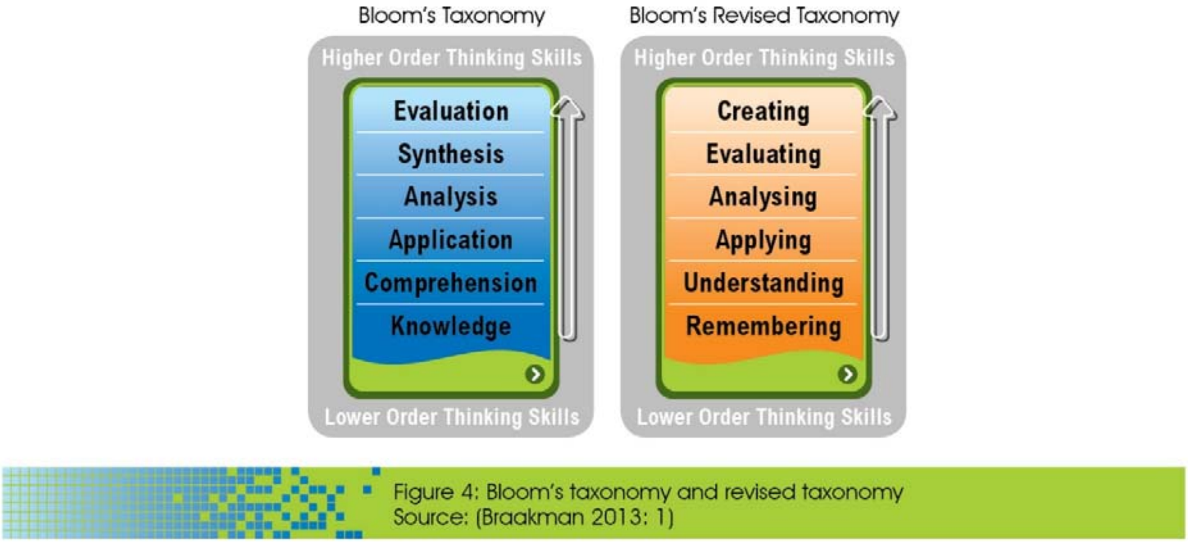


**Figure 4: Bloom's taxonomy and revised taxonomy**
**Source:** (Braakman 2013: 1)

A more recent philosopher who has also helped shape the definition and dimensions of critical thinking is Paul (Reed 1998: 17–19). His definition of critical thinking is still widely accepted amongst philosophers (Hepner 2015: 75–76). According to Paul, critical thinking can be regarded as disciplined and self-directed thinking (Paul 1992: 9). Paul identified seven traits of the mind, referred to as 'dispositions' (Paul 1992: 12–13). Table 3 provides a summary of Paul's definition of critical thinking and these seven dispositions.

The lack of consensus between philosophers and psychologists can also be attributed to discussions on reflection and metacognition. Bensley and Spero (2014: 56) indicate that although philosophers such as Ennis and Paul noted the importance of self-reflection for critical thinking, they did not mention metacognition in their concept of critical thinking. Metacognition refers to knowledge, awareness and control of one's own cognition and is thus related to a person's ability to do self-assessment of their own comprehension, knowledge and thinking (Bensley & Spero 2014: 56).

## Table 3: Overview of key individuals' critical thinking definitions and dimensions

| **Ennis**<br>**Definition** (Ennis 1985: 45):<br>Critical thinking is reflective and reasonable thinking that is focused on deciding what to believe or do. | | **Paul**<br>**Definition** (Paul 1992: 9):<br>Critical thinking is disciplined, self-directed thinking that exemplifies the perfection of thinking appropriate to a particular mode or domain of thought. | **Halpern**<br>**Definition** (Halpern 1998: 450–451):<br>Critical thinking is purposeful, reasoned and goal-directed. It is the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods and making decisions. | |
|---|---|---|---|---|
| **Abilities** (Ennis 1985: 46)**:** | **Dispositions** (Ennis 1985: 46): | **Traits of the mind** (Paul 1992: 12–13)**:** | **Skills** (Halpern 1998: 452)**:** | **Dispositions or attitudes** (Halpern 1998: 452)**:** |
| Focusing on a question | Seeking a clear statement of the thesis or question | Intellectual humility | Verbal reasoning skills | Willingness to engage in and persist at a complex task |
| Analysing arguments | Seeking reasons | Intellectual courage | Argument analysis skills | Habitual use of plans and the suppression of impulsive activity |
| Asking and answering questions of clarification | Trying to be well-informed | Intellectual empathy | Skills in thinking as hypothesis testing | Flexibility or open-mindedness |
| Judging the credibility of a source | Using credible sources and mention them | Intellectual good faith (integrity) | Likelihood and uncertainty | Willingness to abandon non-productive strategies |
| Observing and judging observation reports | Taking into account the total situation | Intellectual perseverance | Decision-making and problem-solving skills | An awareness of the social realities that need to be overcome |
| Deducing and judging deductions | Trying to remain relevant to the main point | Faith in reason | | |
| Inducing and judging inductions | Keeping in mind the original and/or basic concern | Intellectual sense of justice | | |
| Making and judging value judgements | Looking for alternatives | | | |
| Defining terms and judging definitions | Being open-minded | | | |
| Identifying assumptions | Taking a position and changing a position when the | | | |

| | | | |
|---|---|---|---|
| | evidence and reasons are sufficient to do so | | |
| Deciding on an action | Seeking as much precision as the subject permits | | |
| Interacting with others | Dealing in an orderly manner with the parts of a complex whole | | |
| | Being sensitive to the feelings, level of knowledge and degree of sophistication of others | | |

**Source:** Author

Psychologists view metacognition as central to critical thinking development (Bensley & Spero 2014: 56; Halpern 1998: 449) and emphasise the importance of cognitive processes with its components (Atabaki et al. 2015: 94–95; Reed 1998: 15–16). This is normally linked more to the cognitive skills dimension of critical thinking (Atabaki et al. 2015: 95). Psychologists in many instances refer to higher-order thinking (Ten Dam & Volman 2004: 361–362) and thinking skills rather than critical thinking and also regularly link critical thinking to problem-solving (Hepner 2015: 77; Reed 1998: 22). Halpern, a cognitive and developmental psychologist (Hepner 2015: 77), refers to critical thinking in her study. She defines it as purposeful and reasoned thinking involving problem-solving, making inferences and judgements (Halpern 1998: 450–451). Psychologists often research the skills dimension of critical thinking but tend to ignore the dispositions dimension (Reed 1998: 22–23). In recent years, however, more psychologists such as Halpern (1998: 449–455) have addressed both the skills dimension and the dispositions dimension in their studies (Hepner 2015: 77; Reed 1998: 23). A summary of how Halpern defines critical thinking and its dimensions is provided in Table 3.

Although philosophers and psychologists might not fully agree on the exact definition and conceptualisation of critical thinking, there is agreement on some of the foundational aspects (Hepner 2015: 77). Critical thinking does not incorporate all types of thinking. It does, however, refer to a process of reasoning that is aimed at arriving at a thorough, reasonable conclusion, decision or judgement which is based on certain standards (Vardi 2013: 1–13; Bailin et al. 1999a: 286–288; Facione 1990a: 2; Kurfiss 1988: 19–21; Lipman 1988: 38–41). Table 3 and various definitions of critical thinking in the literature indicate that the ability involves self-disciplined, self-directed, reasoned and focused thinking (Brunt 2005: 60–61; Halpern 1998: 449–451; Kataoka-Yahiro & Saylor 1994: 351–353; Paul 1992: 9–10; Facione 1990a: 1–18; Ennis 1985: 45). It is also not uncommon to conceptualise critical thinking by listing certain cognitive skills and dispositions (Bailin et al. 1999a: 289; Colucciello 1999: 294–295; Taube 1995: 27–29; Ennis 1985: 44–48). Most researchers agree that critical thinking involves both these dimensions although more attention, especially in psychology, is given to the skills dimension (Ten Dam & Volman 2004: 361–362). Bailin *et al*. (1999a: 286) are, however, of the opinion that for any conceptualisation of critical thinking to be defendable as a goal of education, it must encapsulate that which most educators understand as the core meaning of critical thinking. If not, the conceptualisation is irrelevant. Researchers in education therefore noted the benefits of learning from both philosophers and psychologists when designing teaching strategies aimed at developing critical thinking in their students (Atabaki et al. 2015: 93–102; Hepner 2015: 68–78; Reed 1998: 16).

By the end of the 20th century, there were concerted efforts to incorporate critical thinking into higher education curricula. There were, however, still many unanswered questions on its exact definition, related skills and dispositions, its measurement as well as effective teaching strategies to develop it (Facione 1990a: 13–14). To resolve some of these questions, the APA Committee on Pre-College Philosophy sponsored a Delphi research study on critical thinking. Directed by Facione, this study was considered a ground-breaking attempt at reaching consensus between various disciplines (Hepner 2015: 77–78; Rubenfeld & Scheffer 2015: 31). Section 2.2.1.1 takes a closer look at the APA's Delphi study on critical thinking and its conceptualisation.

#### *2.2.1.1 Definition and dimensions of critical thinking as per the APA Delphi study*

The APA's Delphi study ran from February 1988 to November 1989 with an interactive panel of 46 experts in critical thinking assessment, instruction and theory from the United States and Canada (Facione 1990a: 2–3, 2011: 8). Annexure C and Figure 3 indicate where this project fits into the historical timeline of critical thinking. Of the expert panel, 52% of the experts were from Philosophy, 22% from Education, 20% from Social Sciences and 6% from Physical Sciences (Facione 1990a: 3). Both Ennis and Paul (referred to in Table 3), who are viewed as leading critical thinking scholars, formed part of the APA Delphi panel of experts (Abrami et al. 2008: 1103; Facione 1990a: 18). The project began by identifying key elements of critical thinking that could be expected from a higher education student (referred to in the Delphi study as freshman and sophomore general education college level student) (Facione 1990a: 3). The end product in 1990 was a comprehensive conceptualisation of critical thinking for instructional and educational purposes over various disciplines. This conceptualisation of critical thinking was summarised in a document entitled *Critical thinking: A statement of expert consensus* *for purposes of educational assessment and instruction - executive summary of "The Delphi Report"* (Facione 1990a: 1–19).

The final definition of critical thinking, as reached through the APA's Delphi study, has been cited as a seminal work in various studies and has laid the foundation in various other studies and disciplines since (Carter, Creedy & Sidebotham 2015: 864; Hepner 2015: 77–78; Pitt, Powis, Levett-Jones & Hunter 2015: 126; Rubenfeld & Scheffer 2015: 31–38; Shin, Ma, Park, Ji & Kim 2015: 538; Paul 2014: 1357–1358; Brudvig, Dirkes, Dutta & Rane 2013: 12; Van Erp 2008: 8–12; Scheffer & Rubenfeld 2000: 353; Reed 1998: 27–30). Turner (2005: 274) as well as Raymond-Seniuk and Profetto-McGrath (2011: 1) assert that this definition is one of the most cited critical thinking definitions evident from the literature. It is also considered a high-profile and leading definition of critical thinking (Abrami et al. 2008: 1103, 2015: 277) given the calibre of the participants. The Higher Education Research and Development Society of Australasia (HERSA) guide made extensive use of the APA's definition and dimensions of critical thinking and referred to it as widely used (Vardi 2013: 1–12).

The expert panel arrived at the following consensus statement (definition) with regards to critical thinking and the ideal critical thinker:

> We understand critical thinking to be purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation and inference, as well as explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgement is based. Critical thinking is essential as a tool of inquiry. As such, critical thinking is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, critical thinking is a pervasive and self-rectifying human phenomenon.
>
> The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgements, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating good critical thinkers means working toward this ideal. It combines developing critical thinking skills with nurturing

> those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society (Facione 1990a: 2).

The experts in the APA's Delphi report agree that critical thinking is considered to be purposeful and self-adjusting judgement of what to believe or do (Facione 1990a: 2–3, 2000: 61). Apart from developing a definition of critical thinking, the APA panel of experts also determined that critical thinking comprises two dimensions, namely, a cognitive skills dimension and a dispositions dimension (Carter et al. 2015: 865; Facione 1990a: 4–18). It is clear that the conceptualisation of critical thinking thus revolves around these two dimensions (Facione 1990a: 2–18, 2000: 61–62; Taube 1995: 2).

Both the cognitive skills and disposition dimensions are illustrated in Figure 5 and subsequently discussed. Note that the size of the cognitive skills dimension in Figure 5 does not indicate that it is more important than the disposition dimension, only that it is dealt with first.

- ***Cognitive skills dimension of critical thinking as per APA Delphi report***

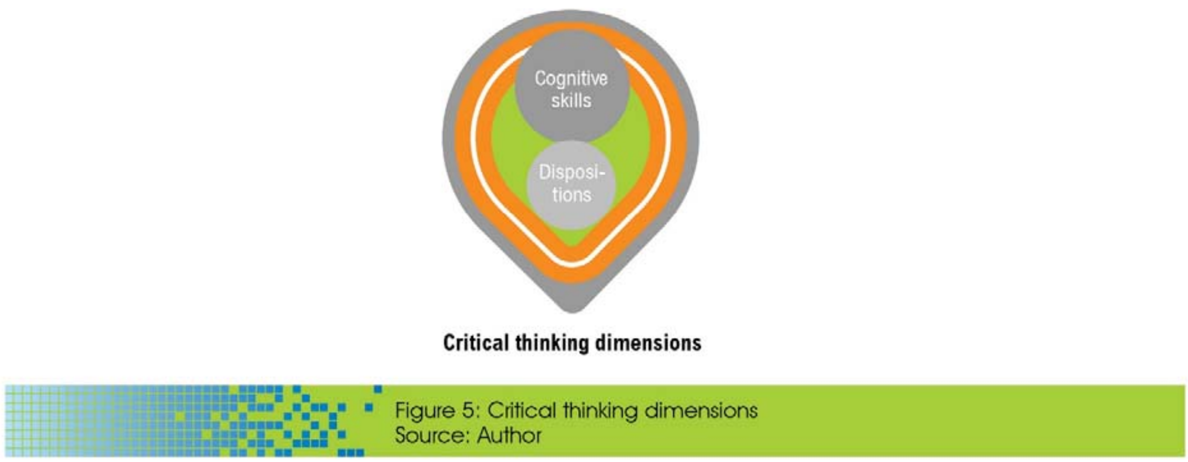


**Figure 5: Critical thinking dimensions**
**Source:** Author

As part of this dimension, the APA expert panel identified six core cognitive skills, which are considered central to critical thinking. A person makes use of some or all of these cognitive skills or abilities in making judgements and evaluating their quality when engaged in critical thinking (Facione 1990a: 4–11). The six core cognitive skills as identified by the APA panel are interpretation, analysis, evaluation, inference, explanation and self-regulation as illustrated in Figure 6 (Facione 2011: 5).

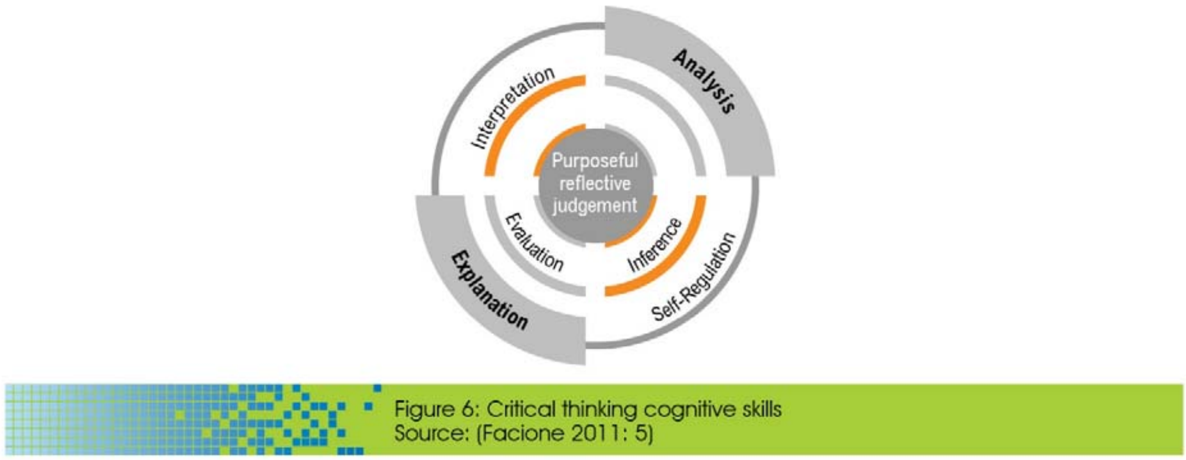


**Figure 6: Critical thinking cognitive skills**
**Source:** (Facione 2011: 5)

Table 4 provides a summary of these core cognitive skills together with a short description of each. Table 4 is a summary of Annexure D which details these core cognitive skills in greater detail, together with the description of the sub-skills related to each of the six core cognitive skills as provided in the APA Delphi report (Facione 1990a: 2–11, 2011: 5–9).

**Table 4: APA critical thinking cognitive skills**

| **Core cognitive skill** (Facione 1990a: 2–11) | **APA consensus description of cognitive skill** (Facione 1990a: 2–11) |
|---|---|
| **Interpretation** | To comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgements, conventions, beliefs, rules, procedures or criteria. |
| **Analysis** | To identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express beliefs, judgements, experiences, reasons, information or opinions. |
| **Evaluation** | To assess the credibility of statements or other representations which are accounts or descriptions of a person's perception, experience, situation, judgement, belief or opinion; and to assess the logical strength of the actual or intend inferential relationships among statements, descriptions, questions or other forms of representation. |
| **Inference** | To identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to educe the consequences flowing from data, statements, principles, |

| Core cognitive skill (Facione 1990a: 2–11) | APA consensus description of cognitive skill (Facione 1990a: 2–11) |
|---|---|
| | evidence, judgements, beliefs, opinions, concepts, descriptions, questions or other forms of representation. |
| **Explanation** | To state the results of one's reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological and contextual considerations upon which one's results were based; and to present one's reasoning in the form of cogent arguments. |
| **Self-regulation** | Self-consciously to monitor one's cognitive activities, the elements used in those activities and the results educed, particularly by applying skills in analysis and evaluation to one's own inferential judgements with a view toward questioning, confirming, validating or correcting either one's reasoning or one's results. |

**Source:** (Facione 1990a: 2–11) - adapted

Irrespective of the importance of cognitive skills in critical thinking, a person is only considered a good critical thinker if they actually apply their cognitive skills*. "These experts argue that being adept at CT (sic) skills but habitually not using them appropriately disqualifies one from being called a critical thinker at all"* (Facione 1990a: 12). Some individuals may possess many cognitive skills but do not have the keenness of mind to use them. According to Facione, this is not considered a good critical thinker (Facione 2011: 10). This view is shared by Halpern (1998: 452), who explains that although someone might have outstanding critical thinking skills, they may choose not to use them, which is of no value. To be a good critical thinker, a person should possess critical thinking skills but also the positive attitude and willingness to use the skills, referred to as dispositions (Halpern 1998: 452). According to the APA experts, good critical thinkers should have a 'critical spirit' which provides them with an eagerness to search for trustworthy evidence, devotion to reason as well as a keen and inquisitive mind (Facione 1990a: 11, 2011: 10). This critical spirit is also referred to as the dispositions towards critical thinking. Facione (1990a: 11–12) explains that cognitive skills can be compared to a growing plant. Without water, the dispositions, the thirsty plant would not be able to grow. The APA panel of experts thus agreed that a good critical thinker has to possess both cognitive skills and dispositions as these cannot function without each other (Facione 2011: 1–24). Critical thinking dispositions are thus vital in the development of critical thinking (Colucciello 1999: 294–297). A closer look will now be taken at this other dimension of critical thinking.

- ***Dispositions dimension of critical thinking as per APA Delphi report***

Dispositions are also known as habits of the mind, personal traits and attitudes (Facione 1990a: 11). They are a person's distinguishable tendencies, intentions, values and beliefs towards life and living in a general sense. These are known features of a person's personality and are considered habitual ways of acting or reacting in certain circumstances (Facione 2000: 62–64). Table 5 presents the dispositions related to critical thinking which are divided into approaches to life and living in general as well as approaches to specific issues, questions and problems as per the APA's Delphi report (Facione 1990a: 11–13, 2011: 10–13).

**Table 5: APA critical thinking dispositions**

| **Dispositions** (Facione 1990a: 2–13) |
|---|
| **Approaches to life and living in general** (Facione 1990a: 2–13)**:**<br>• Inquisitiveness with regard to a wide range of issues;<br>• Concern to become and remain generally well-informed;<br>• Alertness to opportunities to use critical thinking;<br>• Trust in the processes of reasoned inquiry;<br>• Self-confidence in one's own ability to reason;<br>• Open-mindedness regarding divergent world views;<br>• Flexibility in considering alternatives and opinions;<br>• Understanding of the opinions of other people;<br>• Fair-mindedness in appraising reasoning;<br>• Honesty in facing one's own biases, prejudices, stereotypes, egocentric or socio-centric tendencies;<br>• Prudence in suspending, making or altering judgements; and<br>• Willingness to reconsider and revise views where honest reflection suggests that change is warranted. |
| **Approaches to specific issues, questions or problems** (Facione 1990a: 2–13)**:**<br>• Clarity in stating the question or concern;<br>• Orderliness in working with complexity;<br>• Diligence in seeking relevant information;<br>• Reasonableness in selecting and applying criteria;<br>• Care in focusing attention on the concern at hand;<br>• Persistence though difficulties are encountered; and<br>• Precision to the degree permitted by the subject and the circumstance. |

**Source:** (Facione 1990a: 13) - adapted

In summary, critical thinking thus comprises two essential dimensions, namely, cognitive skills and dispositions (Facione 1990a: 2, 2011: 5). It is important to note that the APA Delphi report specifically mentions that a person does not have to be skilful in all cognitive skills and sub-skills to be perceived to have critical thinking abilities (Facione 1990a: 3).

Equally, an individual may not have refined all dispositions which characterise a good critical thinker. It might be that no single human possesses and perfectly uses all cognitive skills and dispositions related to critical thinking. Facione (1990a: 14–18) is, however, adamant that educators should not abandon their quest to develop good critical thinkers and that they still have a responsibility to instil critical thinking into educational systems.

Another seminal work on critical thinking is that of Scheffer and Rubenfeld (2000: 352–359). Rubenfeld and Scheffer (2015: 29–35) indicate that although the definition of critical thinking provided by the APA has been widely used and accepted in the nursing profession, no healthcare or nursing professionals participated in the APA Delphi study. Therefore some concerns were raised over whether the definition and conceptualisation of critical thinking as set out in the APA's Delphi report could be directly applied to the nursing profession (Rubenfeld & Scheffer 2015: 29–38). It is for this reason that a Nursing Delhi study was performed (Rubenfeld & Scheffer 2015: 29–35; Scheffer & Rubenfeld 2000: 352–353) which is discussed in section 2.2.1.2.

#### *2.2.1.2 Definition and dimensions of critical thinking in the Nursing Delphi study*

Scheffer and Rubenfeld (2000: 352) conducted a similar Delphi study to that of the APA from 1995 to 1998. The aim was to achieve consensus on a definition and conceptualisation of critical thinking specific to nursing. The expert panel consisted of 55 nurses from Brazil, Canada, England, Iceland, Korea, Japan, Netherlands, Thailand and 23 states in the United States. The nursing experts also came from various fields such as education, practice and research (Scheffer & Rubenfeld 2000: 352). Refer to Figure 3 for reference to where the Nursing Delphi study fits into the historical timeframe of critical thinking. The Nursing Delphi study's conceptualisation of critical thinking was reported in *A consensus statement on critical thinking in nursing* (Scheffer & Rubenfeld 2000: 352–359). The expert nursing panel arrived at the following consensus statement with regards to critical thinking in the nursing profession:

> Critical thinking in nursing is an essential component of professional accountability and quality nursing care. Critical thinkers in nursing exhibit these habits of the mind: confidence, contextual perspective, creativity, flexibility, inquisitiveness, intellectual integrity, intuition, open-mindedness, perseverance and reflection. Critical thinkers in nursing practice the cognitive skills of analysing, applying standards, discriminating, information-seeking, logical reasoning, predicting and transforming knowledge (Scheffer & Rubenfeld 2000: 357).

The consensus statement reached in this Nursing Delphi study has been referred to in numerous studies (Carter et al. 2015: 865; Andreou, Papastavrou & Merkouris 2014: 363–364; Lunney 2010: 82–88; Howard 2007: 21; Mashele 2003: 87). Raymond-Seniuk and Profetto-McGrath (2011: 1) assert that this definition is one of the most cited, nursing-specific critical thinking definitions evident in the literature.

As in the APA Delphi report, the Nursing Delphi report also identified the same two dimensions of critical thinking, namely, the cognitive skills and the dispositions (which they referred to as habits of the mind). A comparison of the two studies is provided in Tables 6 and 7, similar to a comparison performed by Rubenfeld and Scheffer (2015: 33–39) in *Critical Thinking TACTICS for Nurses*. Table 6 provides the comparison between the APA and the Nursing Delphi reports' cognitive skills while Table 7 provides the comparison between these two reports' dispositions.

**Table 6: APA Delphi cognitive skills versus Nursing Delphi cognitive skills**

| **APA Delphi report (Refer Table 4 and Annexure D)** (Facione 1990a: 6–11) | **Nursing Delphi report** (Scheffer & Rubenfeld 2000: 358) |
|---|---|
| **Cognitive skills** | |
| **Analysis:**<br>To identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express beliefs, judgements, experiences, reasons, information or opinions. | **Analysing:**<br>Separating or breaking a whole into parts to discover their nature, function and relationships. |
| **Evaluation:**<br>To assess the credibility of statements or other representations which are accounts or descriptions of a person's perception, experience, situation, judgement, belief or opinion; and to assess the logical strength of the actual or intend inferential relationships among statements, descriptions, questions or other forms of representation. | **Applying standards:**<br>Judging according to established personal, professional or social rules or criteria. |
| **Interpretation:**<br>To comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgements, conventions, beliefs, rules, procedures or criteria. | **Discriminating:**<br>Recognising differences and similarities among things or situations and distinguishing carefully as to category or rank. |
| **Inference (part of):**<br>To identify and secure elements needed to draw reasonable conclusions. | **Information seeking:**<br>Searching for evidence, facts or knowledge by identifying relevant sources and gathering objective, subjective, historical and current data from those sources. |
| **Explanation:**<br>To state the results of one's reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological and contextual considerations upon which one's results were based; and to present one's reasoning in the form of cogent arguments. | **Logical reasoning:**<br>Drawing inferences or conclusions that are supported in or justified by evidence. |
| **Inference (sub-skill) - Conjecturing alternatives:**<br>• To formulate multiple alternatives for resolving a problem, to postulate a series of suppositions regarding a question, to project alternative hypotheses regarding an event, to develop a variety of different plans to achieve some goal; and<br>• To draw out presuppositions and project the range of possible consequences of decisions, positions, policies, theories or beliefs. | **Predicting:**<br>Envisioning a plan and its consequences. |
| **NO COMPARABLE SKILL** | **Transforming knowledge:**<br>Changing or converting the condition, nature, form or function of concepts among contexts. |
| **Self-regulation** | **NO COMPARABLE SKILL but comparable to reflection disposition in Table 5.** |

**Source:** (Rubenfeld & Scheffer 2015: 35–38) - adapted

**Table 7: APA Delphi dispositions versus Nursing Delphi dispositions**

| **APA Delphi report (Refer Table 5)** (Facione 1990a: 13) | **Nursing Delphi report** (Scheffer & Rubenfeld 2000: 358) |
|---|---|
| **Dispositions (habits of the mind)** | |
| Self-confidence in one's own ability to reason. | **Confidence:**<br>Assurance of one's reasoning abilities. |
| Concern to become and remain generally well-informed.<br>Precision to the degree permitted by the subject and the circumstance. | **Contextual perspective:**<br>Consideration of the whole situation, including relationships, background and environment, relevant to some happening. |
| **NO COMPARABLE DISPOSITION** | **Creativity:**<br>Intellectual inventiveness used to generate, discover or restructure ideas: imagining alternatives. |
| Flexibility in considering alternatives and opinions.<br>Willingness to reconsider and revise views where honest reflection suggests that change is warranted. | **Flexibility:**<br>Capacity to adapt, accommodate, modify or change thoughts, ideas and behaviours. |
| Inquisitiveness with regard to a wide range of issues.<br>Diligence in seeking relevant information. | **Inquisitiveness:**<br>An eagerness to know by seeking knowledge and understanding through observation and thoughtful questioning in order to explore possibilities and alternatives. |
| Fair-mindedness in appraising reasoning.<br>Reasonableness in selecting and applying criteria. | **Intellectual integrity:**<br>Seeking the truth through sincere, honest processes, even if the results are contrary to one's assumptions and beliefs. |
| **NO COMPARABLE DISPOSITION** | **Intuition:**<br>Insightful sense of knowing without conscious use of reason. |
| Open-mindedness regarding divergent world views.<br>Honesty in facing one's own biases, prejudices, stereotypes, egocentric or socio-centric tendencies.<br>Understanding of the opinions of other people. | **Open-mindedness:**<br>A viewpoint characterised by being receptive to divergent views and sensitive to one's biases. |
| Persistence though difficulties are encountered.<br>Care in focusing attention on the concern at hand.<br>Orderliness in working with complexity. | **Perseverance:**<br>Pursuit of a course with determination to overcome obstacles. |
| **NO COMPARABLE DISPOSITION but comparable to self-regulation cognitive skill in Table 4.**<br>Self-consciously to monitor one's cognitive activities, the elements used in those activities and the results educed, particularly by applying skills in analysis and evaluation to one's own inferential judgements with a view toward questioning, confirming, validating or correcting either one's reasoning or one's results. | **Reflection:**<br>Contemplation upon a subject, especially one's assumptions and thinking for the purposes of deeper understanding and self-evaluation. |

**Source:** (Rubenfeld & Scheffer 2015: 35–38) - adapted

Although, it was not possible to make direct comparisons between all skills and dispositions in the two studies, there are strong correlations (Rubenfeld & Scheffer 2015: 33–39). From the discussion above, it is evident that critical thinking has been frequently discussed in nursing education and nursing practice literature for several years (Turner 2005: 272). In recent years, the accounting and auditing profession has also started showing support for the development of critical thinking, amongst other competencies. As the conceptual framework proposed in this study is aimed at the development of auditing students' critical thinking, section 2.2.1.3 provides an overview of how critical thinking is defined and conceptualised in the auditing profession, both internationally and in South Africa, and specifically in terms of the SAICA competency framework. This provides an indication of how critical thinking is currently defined and understood in the auditing profession.

#### *2.2.1.3 Definition and dimensions of critical thinking in the auditing profession*

This section provides a broad overview of the international context in which SAICA functions and the professional bodies and organisations that govern it. This sets the foundation for further insight into how these bodies and organisations define critical thinking or related concepts. This is followed by how critical thinking is defined and conceptualised in the auditing profession in South Africa, specifically in the SAICA competency framework.

- ***An overview of professional skills as defined and conceptualised by IFAC, IAESB and IAASB***

The International Federation of Accountants (IFAC) is a global organisation for the accountancy profession. IFAC was founded in 1977 and has over 175 members and associates in more than 130 countries and jurisdictions (International Federation of Accountants 2017: 4). IFAC aims to establish high-quality, international educational standards, which is mainly achieved through the International Accounting Education Standards Board (IAESB). The IAESB is an independent, standard-setting body that develops education standards and support material for the use of IFAC member bodies (International Federation of Accountants 2017: 3). The IAESB develops, adopts and implements the International Educational Standards (IESs) (International Federation of Accountants 2017: 6). IFAC also aims to ensure high-quality, international auditing and assurance standards. This aim is supported by the International Auditing and Assurance Standards Board (IAASB) (International Federation of Accountants 2014: 4) which issues the International Standards on Auditing (ISAs) amongst others.

As early as 1994, IFAC identified a need for change in the accounting profession, shifting away from a purely knowledge-based approach to one which was more competency-based. The IFAC discussion paper, *2000 and beyond - A strategic framework for pre-qualification education for the accountancy profession in the year 2000 and beyond,* focused on ‘learning to learn’ as opposed to the mere accumulation of content knowledge (International Federation of Accountants 1994: 1–26). Intellectual skills were emphasised and included “*the ability to locate, obtain and organise information needed to identify and solve unstructured problems in unfamiliar settings and to exercise judgement based on comprehension of unfocused, and sometimes incomplete, sets of facts*”. These intellectual skills also included the ability to think logically, inductive or deductive reasoning and critical analysis (International Federation of Accountants 1994: 22).

Currently, IES 3, issued by the IAESB, deals with professional skills and prescribes, amongst others, the learning outcomes that professional accountants should achieve by the end of their initial professional development in terms of professional values, ethics and attitudes (International Federation of Accountants 2017: 54). A specific learning outcome under professional values, ethics and attitudes is professional scepticism and professional judgement where a professional accountant should “***apply a questioning mindset critically*** *to assess financial information and other relevant data”* (International Federation of Accountants 2017: 55). Professional scepticism is defined in IES 3 as “*an attitude that includes a* ***questioning mind****, being alert to conditions which may indicate possible misstatement due to error or fraud and a* ***critical assessment*** *of evidence”* (International Federation of Accountants 2017: 58). Professional scepticism is similarly defined in the IAASB glossary of terms (International Federation of Accountants 2017: 58). IES 3 also defines intellectual skills as those *“relating to the ability of a professional accountant to solve problems, to make decisions and to exercise good* ***judgement****”*

(International Federation of Accountants 2017: 20). Apart from these references to **judgement** and **critical assessment**, however, no specific definition for critical thinking could be found in the IAESB or IAASB glossary of terms.

- ***Critical thinking as defined and conceptualised in the SAICA competency framework***

SAICA is seen as the main professional accounting body in South Africa, accredited by the Independent Regulatory Board for Auditors (IRBA) (South African Institute of Chartered Accountants 2014a: 5). SAICA is also a member body of IFAC. Prior to the establishment of the competency framework in 2010, SAICA also relied on a knowledge-based syllabus which focused on the transfer of detailed technical knowledge (South African Institute of Chartered Accountants 2014a: 4; Streng 2011: 26). Without doing away with the knowledge component, the SAICA competency framework shifted its focus to the overall competence of chartered accountants. To be a life-long learner and remain adaptive to an ever-changing business world, chartered accountants need a robust combination of intellect, aptitude and skills (South African Institute of Chartered Accountants 2014a: 10). In essence, competence encompasses the full range of knowledge, skills, attitudes and behaviours (attributes) which provide a person with the necessary abilities to render a specific professional service. The competency framework thus stipulates the professional competencies (knowledge, skills and attributes) that chartered accountants in South Africa should possess when they enter the profession (South African Institute of Chartered Accountants 2014a: 9–24).

Competency is acquired when a chartered accountant (South African Institute of Chartered Accountants 2014a: 16–23):

- Obtains the required **technical knowledge** through **specific competencies** as well as **pervasive qualities and skills**. Technical knowledge offers a basis for competency development. Understanding of content is, however, critically important where the aim is to move away from rote learning and memorisation of pure facts. Pervasive qualities and skills are divided into three categories, namely, ethical behaviour and professionalism, personal attributes and professional skills.

Critical thinking falls into the last category, namely, professional skills. When chartered accountants enter the profession, it is expected of them to demonstrate all pervasive qualities and skills at the highest level of proficiency, namely, Level X. At Level X, it is expected that a chartered accountant should be able to complete all parts of a task successfully, identify problems and analyse them appropriately, make relevant recommendations, exhibit pervasive skills at an advanced level, execute complex calculations and determine suitable strategies.

- **Understands** where the knowledge obtained should be applied as well as how it should be applied.
- Has **experience in performing tasks**. Knowledge and understanding thereof does not render a person competent. Application is crucial. In academic programmes and SAICA-accredited universities, contextualised, real-world case studies are used to provide practical experience in applying theoretical knowledge and understanding. The theoretical and practical foundations underlying the SAICA competency framework are based on the concepts and ideas of the great educational philosopher, John Dewey (South African Institute of Chartered Accountants 2014a: 11–12). Based on Dewey's theories (mentioned in Annexure C and Figure 3), the SAICA competency framework requires a high degree of contextualisation in teaching, learning and assessment strategies through real-world case studies and questions. These case studies should contain several real-world problems and alternatives which would allow the chartered accountant to use judgement in coming to reasonable conclusions. Competency is therefore closely linked to the ability of a chartered accountant to perform professional tasks in the real-world (South African Institute of Chartered Accountants 2014a: 12).

SAICA-accredited programme providers need to incorporate the pervasive qualities and skills that they feel are appropriate for inclusion in their programmes. Motivation is required in the case of exclusion. They also need to address all appropriate professional skills in their programmes and integrate these skills with specific competencies (South African Institute of Chartered Accountants 2014a: 17–18). Figure 7 shows an illustration of the six professional skills as required by the SAICA competency framework.

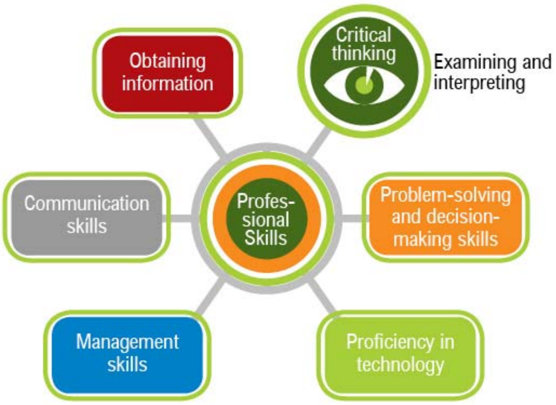


Figure 7: SAICA competency framework - professional skills
Source: Author

**Figure 7: SAICA competency framework - professional skills**
**Source:** Author

As mentioned, critical thinking forms part of professional skills which in turn forms part of pervasive qualities and skills in the SAICA competency framework. Table 8 summarises the definition and conceptualisation of critical thinking as per the SAICA competency framework. Upon entering the profession, chartered accountants should be able to demonstrate all the skills set out in Table 8 at Level X, which is thus at an advanced level.

### Table 8: SAICA competency framework - critical thinking

| **Examines and interprets information and ideas critically (critical thinking)**<br>(South African Institute of Chartered Accountants 2014a: 35–37) |
|---|
| **Definition** (South African Institute of Chartered Accountants 2014a: 35):<br>Critical thinking is the process of actively conceptualising, applying, analysing, synthesising and/or evaluating information. It is evidenced by clarity, accuracy, precision, consistency, relevance, sound evidence, good reasoning, depth and breadth. |
| **Analyses information or ideas:**<br>• Identifies the purpose of the analysis and the information and/or ideas and material to be considered and considers qualitative factors;<br>• Breaks down information or ideas in detail, seeking to identify essential elements and hence to uncover new information or gain new insights;<br>• Chooses and applies appropriate analysis techniques;<br>• Uses information technology (IT) to support and improve analysis;<br>• Identifies the limitations of given information with regard to achieving the identified purpose of the analysis;<br>• Compares information from internal or external sources as needed to achieve the identified purpose:<br>- Internal comparisons – compares elements of a body of information for insights and as a check on consistency and reliability;<br>- External comparisons – compares information to data obtained from other relevant, credible sources;<br>• Makes logical inferences;<br>• Performs and interprets results of analysis techniques applied. |

| Examines and interprets information and ideas critically (critical thinking)<br>(South African Institute of Chartered Accountants 2014a: 35–37) |
|---|
| **Performs computations:**<br>• Identifies the purpose of the computation(s) and whether a precise calculation, an estimate, a forecast or a projection is required; and<br>• When the computation involves a forecast or projection, identifies the supporting facts, data and knowledge of trends necessary to achieve the purpose and states most of the key assumptions.<br>**Verifies and validates information:**<br>• Identifies information that needs to be verified;<br>• Determines the extent of testing needed to validate the completeness, accuracy and reliability of information used in the analysis;<br>• Identifies corroborating information that will strengthen the ability to draw sound conclusions about the information; and<br>• Concludes, based on the work done, whether to accept or reject the information or whether to modify the testing.<br>**Evaluates information and ideas:**<br>• Studies the available information in detail;<br>• Determines whether information collected and work performed are sufficient to support conclusions;<br>• Identifies further work or action that is appropriate in response to unexpected findings.<br>**Integrates ideas and information from various sources (integrated thinking):**<br>• Considers and combines ideas and information from a variety of sources to create a design, formulate a plan, arrive at a solution to a problem, obtain a broader understanding of an issue, etc.;<br>• Considers and applies integrated thinking;<br>• Explores a variety of potentially viable solutions;<br>• Analyses cause and effect relationships and makes logical inferences;<br>• Considers alternative interpretations of qualitative and quantitative information;<br>• Synthesises the views of others to develop a more complete understanding of issues and/or implications of alternatives;<br>• Integrates information and results of analyses to evaluate alternative solutions;<br>• Considers longer term and indirect implications; and<br>• Explicitly articulates and justifies assumptions.<br>**Draws conclusions or forms opinions:**<br>• Forms an opinion on the outcome of an issue or on the impact of the information on a situation, taking into account the identified purpose, the information gathered and the analysis of that information; and<br>• Recommends and justifies a solution or opinion or reaches a conclusion based on an integrative view of the information and analysis. |

**Source:** (South African Institute of Chartered Accountants 2014a: 35–37) - adapted

From the description of critical thinking in the SAICA competency framework highlighted in Table 8, it can be noted that emphasis is placed on the critical thinking skills dimensions. No direct reference is made to critical thinking abilities, dispositions, habits of the mind, traits of the mind or personal traits which directly link to critical thinking. The SAICA competency framework does, however, refer to ethical behaviour and professionalism as well as personal attributes that also fall under pervasive qualities and skills, together with professional skills. Some indirect links could perhaps be drawn between the critical thinking dispositions dimension and some of the attributes mentioned under these two sections of pervasive qualities and skills. Examples include:

- *'Manages time effectively'* (South African Institute of Chartered Accountants 2014a: 31) could perhaps be linked to *'Orderliness in working with complexity'* (Facione 1990a: 13); and
- *'Manages change'* (South African Institute of Chartered Accountants 2014a: 31) shows some links to *'Willingness to reconsider and revise views where honest reflection suggests that change is warranted'* (Facione 1990a: 13) and *'Flexibility in considering alternatives and opinions'* (Facione 1990a: 13).

These links are, however, very vague and the dispositions, as described in Tables 3, 5 and 7, are not visible in the SAICA competency framework.

The aim of section 2.2.1 was to examine, through a review of the seminal works and major studies on critical thinking, how critical thinking is defined and what the dimensions of critical thinking are. A brief historical overview of critical thinking was also provided. An overview of how critical thinking is defined and conceptualised in the auditing profession, both internationally and in South Africa, with specific reference to the SAICA competency framework, was also provided in this section. To grow as critical thinkers, students must, however, pass through various stages of critical thinking development (Elder & Paul 2010: 1). Section 2.2.2 provides an overview of these critical thinking development stages.

### 2.2.2 Stages of critical thinking development

Elder and Paul (2010: 1) note that most educators are not aware of the stages of critical thinking development or that students have to pass through these stages to become accomplished critical thinkers. Elder and Paul (2010: 1) developed a stage theory based on some 20 years of research at the Center for Critical Thinking. This theory approaches the human mind from an intellectual stance rather than from a psychological position.

Figure 8 provides a conceptual map of the six stages of critical thinking development proposed by Elder and Paul (Elder & Paul 2010: 1)


**Figure 8: Critical thinking development - A stage theory**
**Source:** (Elder & Paul 2010: 1) **-** adapted

The six stages of critical thinking development are briefly explained as follows (Elder & Paul 2010: 1):

- **Stage one: The unreflective thinker** – Unreflective thinkers are mainly unaware of the role that critical thinking plays in their lives, they lack the ability to assess their thinking and consequently struggle to improve their thinking. Students can graduate from school or even university (college) and still be unreflective thinkers.
- **Stage two: The challenged thinker –** Challenged thinkers have become somewhat aware of the role that critical thinking plays in their lives and that problems in their thinking are causing them serious difficulties in their lives. Challenged thinkers are becoming aware that reflective thinking is required to improve one's thinking.

- **Stage three: The beginning thinker –** Beginning thinkers are actively taking command of their thinking across various domains of their lives. They are able to recognise that they have problems in their own thinking and can make initial attempts at improving their thinking. They do, however, still lack a systematic plan for improving their thinking.
- **Stage four: The practicing thinker –** Practicing thinkers generally have a good sense of what is needed to take charge of their thinking. They can recognise the problems in their thinking and can systematically improve their thinking. These thinkers are actively involved in analysing their thinking in various domains of their lives. They, however, still have limited insight into deeper levels of thought.
- **Stage five: The advanced thinker –** Advanced thinkers have established good habits of thought which allow them to actively analyse their own thinking in all important domains of their lives. They also have significant insight into deeper levels of thought. They are, however, still not able to consistently think at this high level across all these domains.
- **Stage six: The accomplished thinker –** Accomplished thinkers are able to systematically take charge of their thinking. They can monitor, revise and re-think strategies continuously. Critical thinking becomes highly intuitive as they have internalised this ability. Accomplished thinkers continuously analyse their thinking at deep levels of thought at all important domains in their lives. The vast majority of students will, however, never become accomplished thinkers. It is important though for students to understand what it would take to become an accomplished thinker.

Elder and Paul (2010: 1) assert that it should be a central goal of all students to advance through these six stages as critical thinkers. They also note that educators have a responsibility to assist students through these stages of critical thinking development.

The definition and dimensions of critical thinking as well as the stages of its development, form the foundation of the conceptual framework proposed in this study. It is, however, also important to obtain an understanding of how critical thinking can be assessed or measured. Section 2.3 provides an overview of the different types of critical thinking measurement instruments that are generally used, as evident from the literature, to assess or measure critical thinking.

## 2.3 HOW IS CRITICAL THINKING MEASURED?

It is important to measure students' critical thinking to identify problems in their cognitive capacities as well as to recognise ineffective critical thinking teaching strategies (Carter et al. 2015: 864). There is limited consensus on how critical thinking should be measured (Nair & Stamler 2013: 135; Bronson 2008: 50; Boyd 2001: 1). Some researchers are interested in only measuring the critical thinking skills dimension while others are interested in both the skills and the dispositions dimensions (Nair & Stamler 2013: 131–138).

Tiruneh *et al.* (2014: 3–8) explain that researchers utilise various types of critical thinking measurement instruments to evaluate the effectiveness of critical thinking instruction and educational interventions. These instruments often differ in format, scope, conceptualisation of critical thinking and psychometric characteristics which makes comparability and evaluation of critical thinking development difficult. The evaluation of the effectiveness of critical thinking instructional interventions is also most likely influenced by the type of critical thinking measurement instrument utilised. Tiruneh *et al.* (2014: 7–8) refer to standardised and non-standardised measurement instruments. Abrami *et al.* (2008: 1109) also categorise critical thinking measurement instruments into standardised tests, those developed and conducted by the educator or researcher and secondary source measures. For the purposes of this study, critical thinking measurement instruments are grouped according to standardised and non-standardised instruments. These are discussed in sections 2.3.1 and 2.3.2 respectively.

### 2.3.1 Standardised critical thinking measurement instruments

Standardised or general critical thinking tests, instruments or measures are generally commercially available and are focused on measuring the main aspects of critical thinking (Carter et al. 2015: 864–874). Most of these instruments were developed during the 1980s and 1990s (Nair & Stamler 2013: 134). None of these measures test all aspects of all critical thinking dimensions and assess only certain skills and/or dispositions. Researchers have spent years developing these measures and have tested their reliability and validity which makes them effective in educational research projects (Reed 1998: 33). The reliability and validity of these instruments allow comparison across settings, disciplines and time (Carter et al. 2015: 865).

The most commonly utilised standardised critical thinking measures evident from the literature are the Cornell Critical Thinking Test (CCTT), the California Critical Thinking Skills Test (CCTST), the California Critical Thinking Disposition Inventory (CCTDI), the Watson-Glaser Critical Thinking Appraisal (WGCTA), the Health Science Reasoning Test (HSRT) and the Ennis-Weir Critical Thinking Essay Test (Cone et al. 2016: 2; Abrami et al. 2008: 1109, 2015: 286; Carter et al. 2015: 865; Tiruneh et al. 2014: 7–8; Nair & Stamler 2013: 134; Lai 2011: 38). An overview of the characteristics of these instruments is provided in Annexure E. Mortellaro (2015: 27–28) indicates that the two instruments used most extensively are the WGCTA and the CCTST. The CCTST and the CCTDI are both based on the APA Delphi study's definition and dimensions of critical thinking. These instruments measure both critical thinking skills and dispositions and are considered leading international measurement instruments for critical thinking in graduate students. They are ideal for use in research studies and educational settings across disciplines (California Academic Press 2016a: 1, b: 1). Carter *et al.* (2015: 864–865) performed a systematic review of these instruments in nursing and midwifery undergraduate students. Of the studies examined in their review, 21 of the 34 (61.8%) used standardised measuring instruments. These included the CCTST (five studies), the CCTDI (ten studies), the WGCTA (three studies) and the HSRT (three studies). These 34 studies all measured critical thinking in students after the completion of an educational intervention or after completion of an undergraduate nursing programme.

However, standardised measurement instruments for critical thinking are often Likert scale type assessments or multiple choice type questions and are sometimes considered ineffective for measuring critical thinking development (Bronson 2008: 52–53). They also tend to be generalised as opposed to subject- or discipline-specific (Mortellaro 2015: 28; Nair & Stamler 2013: 134–135; Lai 2011: 38). For this reason, some researchers and educators feel non-standard measurement instruments are more appropriate as they can be adapted (Bronson 2008: 50–61). Rubenfeld and Scheffer (2015: 283–291) also note that, although they may be relatively easy to use, quantitative measuring instruments often struggle to capture the complexities of critical thinking. Qualitative measuring instruments, on the other hand, may have the ability to capture the complexities of critical thinking but are often difficult to use and require more resources to administer. As critical thinking is such a multidimensional concept, Carter *et al.* (2015: 872) view a mixed approach between various instruments as a better option to provide enhanced validity, reliability and understanding of critical thinking development. In a mixed approach, qualitative information complements quantitative information. Numerical facts are obtained while rich descriptions can also be elicited on the development of critical thinking (Tiwari, Lai, So & Yuen 2006: 547–554).

In section 2.3.2 an overview of non-standardised critical thinking measures is provided. This overview offers a general idea of the most commonly used non-standardised critical thinking measurement instruments and should not be seen as an exhaustive list.

### 2.3.2 Non-standardised critical thinking measurement instruments

Non-standard critical thinking measurement instruments are those which have been developed by a researcher or educator. They are not as commonly used as the standardised measurement instruments (Tiruneh et al. 2014: 1–17). Table 9 lists some of these non-standardised instruments.

**Table 9: Non-standardised critical thinking measurement instruments**

| Consensus statement or definition | Literature reference |
|---|---|
| Reflective judgement interview | (Boyd 2001: 1–60) |
| Graduate Management Admission Test's Analytical Writing Ability essay test | (Boyd 2001: 96–100) |
| Content analysis of students' responses to interview questions or open-ended and essay-type tasks | (Abrami et al. 2015: 286) |
| Critical Thinking Inventory | (Rubenfeld & Scheffer 2015: 286) |
| Assessing Critical Thinking (free-response and vignette-response items) | (Rubenfeld & Scheffer 2015: 286) |
| Lasater Clinical Judgement Rubric | (Rubenfeld & Scheffer 2015: 286–287) |
| Assignments, essays and rubrics | (Rubenfeld & Scheffer 2015: 286–287) |
| Think aloud analytic framework | (Carter et al. 2015: 866) |
| Critical Thinking Ability Scale for College Students | (Carter et al. 2015: 866) |
| Critical Thinking Disposition Scale for Nursing Students | (Carter et al. 2015: 866) |
| Critical Thinking Process Test | (Carter et al. 2015: 867) |
| Thinking aloud protocol | (Carter et al. 2015: 867) |
| Discussion board analysis | (Carter et al. 2015: 867) |
| Critical Thinking Scale | (Carter et al. 2015: 867) |
| Critical Thinking Assessment | (Carter et al. 2015: 867) |
| Bloom's Taxonomy | (Carter et al. 2015: 867) |
| Concept map scoring | (Carter et al. 2015: 867) |
| Critical Thinking Scale | (Carter et al. 2015: 867) |
| Flexible semi-structured interviews | (Tiwari et al. 2006) |

**Source:** Author

The reflective judgement interview is an example of a non-standard critical thinking measure that focuses on adult levels of critical thinking. It is, however, considered to be time-consuming and expensive (Boyd 2001: 1–60). The Graduate Management Admission Test's Analytical Writing Ability essay test is advertised as a critical thinking measurement tool, but has not been empirically validated (Boyd 2001: 96–100).

Rubenfeld and Scheffer (2015: 285–288) mention that there are some instruments which, although not used commercially, have been applied in certain disciplines or programmes. One example is the Critical Thinking Inventory which is used mainly in Baccalaureate Nursing Programmes. Other rubrics also used in the nursing discipline are the Assessing Critical Thinking and the Lasater Clinical Judgement Rubric. Since 2000, nursing researchers have also started focusing their attention on reflective processes (qualitative approaches) which include assignments, essays and rubrics. Carter *et al.* (2015: 866–867) also mention various non-standardised instruments which were used in studies that formed part of their systematic review of instruments administered to nursing and midwifery undergraduate students. These are also listed in Table 9. Tiwari *et al.* (2006: 547–554) applied flexible semi-structured interviews to obtain qualitative data on critical thinking development in undergraduate nursing students. This gave the researchers insight into students' perceptions of their learning experiences as well as their feelings and views with regards to the experience. This type of information could not have been obtained using a standardised measurement tool.

In their systematic review of 33 studies, Tiruneh *et al.* (2014: 7–10) found that 93% of the studies that utilised non-standardised measures reported substantial gains in critical thinking development. In contrast, only 55% of the studies that used standardised critical thinking measures reported significant gains in critical thinking development. Tiruneh *et al.* (2014: 7–10) also found that studies where participants were required to respond through essay type items reported more noteworthy gains in critical thinking development than those studies where multiple choice questions were asked. Reed (1998: 36), however, points out that even though non-standardised measures developed by educators or researchers can be successfully used in a class setting, there are certain limitations to their effectiveness in educational research projects.

### 2.3.3 Conclusion

The objective of Chapter 2 was to provide an understanding of **what critical thinking is** and **how it is measured.** This chapter shed light on several key constructs, concepts, assumptions, beliefs and theories related to critical thinking and possible relationships between these.

Various studies have been conducted on critical thinking − Ennis (1985: 44–48), Halpern (1998: 449–455), Paul (1992: 3–24), Facione (1990a: 1–19), Scheffer and Rubenfeld (2000: 352–359) and Atabaki *et al.* (2015: 93–102), to name a few. These individuals have all made major contributions to the development of the concept as we understand it today. From the literature it is clear that critical thinking is considered to be a process of self-disciplined, self-directed, focused thinking and/or reasoning, aimed at arriving at reasonable inferences, conclusions or judgements based on certain standards. The literature also shows that most researchers agree that critical thinking involves both cognitive skills and dispositions – two dimensions which are considered equally important in developing students' critical thinking.

Chapter 2 (together with Chapters 3 and 4) thus provided the theoretical framework which serves as the foundation for the preliminary, literature-based, conceptual framework presented in Chapter 5. The chapter also highlighted certain gaps in existing literature, pointing to the need for a working theory. It was established that critical thinking is a multifaceted concept and there is no universally-accepted definition of the concept. Although a number of seminal works were described in this chapter that define critical thinking, very few of these works related specifically to accounting education. It is therefore evident that there is no consensus on a clear definition of critical thinking for accounting education specifically. Even though the SAICA competency framework defines critical thinking, this definition does not make direct reference to critical thinking dispositions. To address this gap, the comprehensive conceptualisation provided in the APA's Delphi study (Facione 1990a: 1–19) forms the lens through which critical thinking is defined and conceptualised in this study's preliminary framework. The APA study provides detailed descriptions of critical thinking skills and dispositions for instructional and educational purposes. It is also the most ambitious attempt yet at providing consensus on a definition of critical thinking across various disciplines (Hepner 2015: 77–78; Rubenfeld & Scheffer 2015: 31–33). The APA definition can therefore be applied to any discipline or profession, including chartered accountancy. The APA study, which is still considered seminal today (Hepner 2015: 77–78; Rubenfeld & Scheffer 2015: 31), defines critical thinking as:

> (p)urposeful, self-regulatory judgement which results in interpretation, analysis, evaluation and inference, as well as explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgement is based (Facione 1990a: 2).

Although the APA study definition provides detail on the skills and dispositions needed for critical thinking, it does not, however, offer adequate guidance on how critical thinking should be developed in students. Similarly, Bloom's taxonomy and its revised version provide guidance to educators in setting learning objectives and assessments for higher order thinking as well as useful critical thinking definitions, however, they do not provide sufficient guidance on the actual development of critical thinking in students. Though a definition and conceptualisation of critical thinking has been established for this study's preliminary framework, more guidance is thus needed on the actual development of critical thinking.

In section 2.2.2 of this chapter, the six stages of critical thinking development (Elder and Paul, (2010: 1) were described. The importance of progressing through these stages, from unreflective thinker to accomplished thinker, was discussed. Section 2.3.1 provided an overview of critical thinking standardised measurement instruments while section 2.3.2 described non-standardised measurement instruments. These instruments are used to evaluate the effectiveness of critical thinking instruction and educational interventions. Although section 2.3.1 stressed the importance of the measurement or assessment of critical thinking in students, I could not identify conceptual frameworks in the literature that include pre- or post-educational intervention evaluation. This presented another gap in the literature, pointing to the need for a comprehensive conceptual framework.

Finally, Chapter 2 emphasised that critical thinking is a complex and multifaceted concept. Given its multidimensional nature, other factors may also influence its development. These factors, which could relate to the educator, the student or the instruction, are explored in Chapter 3.

# CHAPTER 3
# FACTORS THAT MAY INFLUENCE STUDENTS' CRITICAL THINKING

## 3.1 INTRODUCTION

Chapter 2 examined **what** critical thinking is and **how** it can be measured. It provided an understanding of several key constructs, concepts, assumptions, beliefs and theories related to critical thinking and possible relationships between these. Critical thinking is, however, an active process that may be influenced by various factors.

The objective of Chapter 3 is to obtain a clearer understanding of factors that may influence students' critical thinking, thereby addressing secondary research objective A2 and secondary research question B2.

| | |
|---|---|
| **Secondary research objective 2 (A2)** | To obtain an understanding of factors that may influence students' critical thinking. |
| **Secondary research question 2 (B2)** | Which factors may potentially influence students' critical thinking? |

Through this understanding, Chapter 3 offers insight into key constructs, concepts, assumptions, beliefs and theories related to factors that may influence critical thinking and its development in students. This understanding also sheds light on possible relationships between these concepts and sets the foundation for the preliminary framework presented in Chapter 5. Knowledge on these factors may assist educators in making critical thinking instruction more effective and may lead to optimised use of critical thinking assessment instruments (Facione 1990b: 7).

In Chapter 3 some of the major studies on factors that may influence students' critical thinking were identified and reviewed. A traditional literature review was carried out (Jesson et al. 2011: 73–76), providing a broad overview of potential factors that could influence students' critical thinking. This review was issue-based, looking at examples of these factors, and not necessarily sequences of events. The purpose was thus not to provide an exhaustive list of factors or their correlation with critical thinking. Some of the main scholarly databases were consulted such as EBSCOhost, Emerald, Google Scholar and ProQuest. Search terms such as: *'factors that may influence student's critical thinking', 'aspects that affect the development of critical thinking', 'student-related factors that influence critical thinking', 'educator-related factors that influence critical thinking in students' and 'instructional factors that influence students' critical thinking'* were entered. Section 3.2 provides an overview of the main categories of factors that may potentially influence students' critical thinking.

## 3.2 BACKGROUND INFORMATION

Given the nuanced nature of critical thinking and its different dimensions, it is no surprise that several factors may affect the development of critical thinking in students (Mortellaro 2015: 17–18). Various studies in the literature have endeavoured to examine these aspects as well as their influence on students' critical thinking. There is, however, little consensus with regards to these factors and their exact influence on students' critical thinking (Mortellaro 2015: 17–18).

The literature on these factors is extensive and is distributed among various disciplines with frequently contradicting views. This literature review suggests that the factors which may influence students' critical thinking involve (i) the **student** (Mortellaro 2015: 33–46; Rubenfeld & Scheffer 2015: 59–74; Tiruneh et al. 2014: 1–8; Chan 2013: 236–240; Purvis 2009: 64–70; Facione 1990b: 1–7), (ii) the **educator** (Tiruneh et al. 2014: 1–8; Chan 2013: 236–240; Facione 1990b: 1–7) and (iii) **instruction** (Mortellaro 2015: 33–46; Rubenfeld & Scheffer 2015: 97–103; Tiruneh et al. 2014: 1–8; Chan 2013: 236–240; Purvis 2009: 51–64). Student-related factors, educator-related factors and instructional factors are therefore discussed in sections 3.3 to 3.5. Figure 9 provides the layout of the sections addressed in Chapter 3.

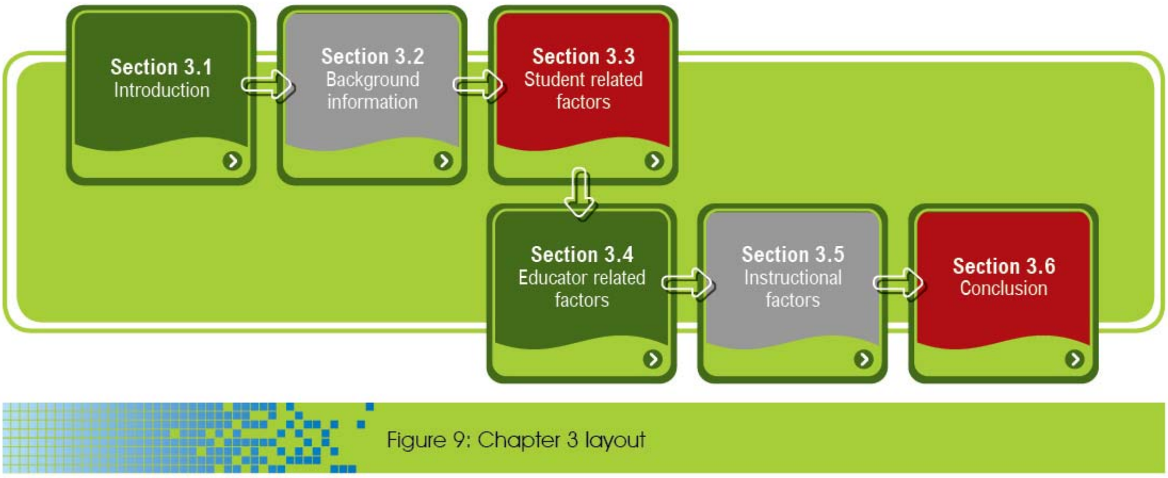


**Figure 9: Chapter 3 layout**
**Source:** Author

## 3.3 STUDENT-RELATED FACTORS

Students differ regarding preferred learning styles, gender, ethnicity, culture, race, emotional development, intellectual level, self-esteem, knowledge level, characteristics, maturity, to only name a few (Elder 2004: 1). Certain factors related to the student may potentially influence their critical thinking scores as measured by various measurement instruments (Facione 1990b: 1). These factors might also influence critical thinking capabilities in general (Rubenfeld & Scheffer 2015: 59–76) and its development (Mortellaro 2015: 33–47). The effectiveness of critical thinking educational interventions may also be influenced by these student-related factors (Tiruneh et al. 2014: 6–10). The literature is not consistent regarding the exact influence these factors have on critical thinking (Mortellaro 2015: 12; Purvis 2009: 70). This is indeed the case with most of the student-related factors discussed in this section. Table 10 provides a summary of several student-related factors.

**Table 10: Summary of student-related factors and their influence on critical thinking**

| Student-related factor | Influence on critical thinking scores based on literature | Literature reference | Critical thinking measurement tool utilised |
|---|---|---|---|
| **Age**<br>**Section 3.3.1** | Significant correlation between age and critical thinking scores i.e. greater age is highly correlated with higher critical thinking scores | (Martin 2002: 246) | Elements of Thought Instrument (ETI) |
| | | (Shinnick & Woo 2013: 1065) | HSRT |
| | | (Günaydin & Barlas 2015: 4) | CCTDI |
| | No significant correlation between age and critical thinking scores | (Azizi-Fini, Hajibagheri & Adib-Hajbaghery 2015: 3; Chau et al. 2001: 116; Facione 1990b: 5) | CCTST |
| | | (Reed 1998: 156) | Ennis-Weir Critical Thinking Essay Test, CCTDI |
| | | (Cevik 2013: 58) | CCTDI (Turkish version) |
| | | (Perry 2014: 122–123) | Critical Thinking Assessment Test (CAT) |
| | | (Mortellaro 2015: 117; Hunter, Pitt, Croce & Roche 2014: 812) | HSRT |
| **Gender**<br>**Section 3.3.2** | Significant correlation between gender and critical thinking scores where **females** obtained higher critical thinking scores | (Arslan, Gulveren & Aydin 2014: 49; Yenice 2011: 500; Besoluk & Onder 2010: 679) | CCTDI |
| | | (Serin 2013: 241–242) | Critical Thinking Skills Scale developed by the researcher |
| | Significant correlation between gender and critical thinking scores where **males** obtained higher critical thinking scores | (King, Wood & Mines 1990: 176) | CCCTT, WGCTA, Reflective Judgement Interview |
| | | (Facione 1991: 11–12) | CCTST |
| | No significant correlation between gender and critical thinking scores | (Reed 1998: 157–158) | Ennis-Weir Critical Thinking Essay Test, CCTDI |
| | | (Whitten & Brahmasrene 2011: 9; Chau et al. 2001: 116) | CCTST |
| | | (Martin 2002: 246) | ETI |
| | | (Burbach, Matkin & Fritz 2004: 487) | WGCTA |
| | | (Azizi-Fini et al. 2015: 4; Gedik 2013: 1022) | CCTT |

| Student-related factor | Influence on critical thinking scores based on literature | Literature reference | Critical thinking measurement tool utilised |
|---|---|---|---|
| | | (Mortellaro 2015: 76; Hunter et al. 2014: 813; Shinnick & Woo 2013: 1062–1067) | HSRT |
| | | (Perry 2014: 75) | CAT |
| | | (Günaydin & Barlas 2015: 1; Karagöl & Bekmezci 2015: 89; Sunay 2015: 659) | CCTDI |
| **Academic performance**<br><br>**Section 3.3.3** | Significant correlation between grade point average (GPA) and critical thinking scores | (Ghazivakili et al. 2014: 98; Facione 1990b: 4) | CCTST |
| | | (Jenkins 1998: 277–278; Taube 1995: 26) | WGCTA |
| | | (Martin 2002: 246) | ETI |
| | Significant correlation between Scholastic Aptitude Test (SAT) verbal as well as SAT mathematical scores and critical thinking scores | (Whitten & Brahmasrene 2011: 10; Facione 1990b: 4) | CCTST |
| | | (Taube 1995: 26) | WGCTA |
| | Significant correlation between academic performance and critical thinking scores | (Karagöl & Bekmezci 2015: 90–91) | CCTDI |
| | No significant correlation between GPA and critical thinking scores | (Cevik 2013: 57) | CCTDI-Turkish version |
| | | (Perry 2014: 91) | CAT |
| | | (Azizi-Fini et al. 2015: 4) | CCTST |
| | | (Mortellaro 2015: 119) | HSRT |
| | No significant correlation between academic performance and critical thinking scores | (Günaydin & Barlas 2015: 6) | CCTDI |
| **Prior knowledge or experience**<br><br>**Section 3.3.4** | Significant correlation between prior knowledge or experience and critical thinking scores | (Martin 2002: 246) | ETI |
| | | (Mortellaro 2015: 109; Hunter et al. 2014: 812; Shinnick & Woo 2013: 1065) | HSRT |
| | No significant correlation between prior knowledge or experience and critical thinking scores | (Chau et al. 2001: 116) | CCTST |
| **Type of academic programme or field of study**<br><br>**Section 3.3.5** | Significant correlation between type of academic programme or field of study and critical thinking scores | (Ghazivakili et al. 2014: 98; Facione 1991: 14) | CCTST |
| | | (Cevik 2013: 62–63) | CCTDI-Turkish version |
| | | (Karagöl & Bekmezci 2015: 90; Sunay 2015: 660; Arslan et al. 2014: 50) | CCTDI |

| Student-related factor | Influence on critical thinking scores based on literature | Literature reference | Critical thinking measurement tool utilised |
|---|---|---|---|
| | No significant correlation between type of academic programme or field of study and critical thinking scores | (Whitten & Brahmasrene 2011: 9) | CCTST |
| **Academic grade or level**<br><br>**Section 3.3.6** | Significant correlation between academic grade or level and critical thinking scores | (Gedik 2013: 1022–1023; Burbach et al. 2004: 488–489; King et al. 1990: 178; Mines, King, Hood & Wood 1990: 544) | CCTT, WGCTA, Reflective Judgement Interview |
| | | (Whitten & Brahmasrene 2011: 10; O'Hare & McGuinness 2009: 123; McCarthy, Schuster, Zehr & McDougal 1999: 142) | CCTST |
| | | (Günaydin & Barlas 2015: 6; Arslan et al. 2014: 56; McCarthy et al. 1999: 142) | CCTDI |
| | | (Serin 2013: 242) | Critical Thinking Skills Scale developed by the researcher |
| | | (Hunter et al. 2014: 812) | HSRT |
| | | (Ralston & Bays 2015: 85) | Holistic critical thinking rubric based on the Paul-Elder critical thinking framework (developed by researchers) |
| | No significant correlation between academic grade or level and critical thinking scores | (Facione 1990b: 4) | CCTST |
| | | (Yenice 2011: 500) | CCTDI |
| | | (Azizi-Fini et al. 2015: 4) | CCTT |
| | | (Mortellaro 2015: 118) | HSRT |
| **Student learning styles**<br><br>**Section 3.3.7** | Significant correlation between student learning styles and critical thinking scores | (Nasrabadi, Mousavi & Farsan 2012: 679; Besoluk & Onder 2010: 679; Colucciello 1999: 300) | CCTDI and Kolb's Learning Style Inventory or Perceptual Learning Style Questionnaire |
| | | (Ghazivakili et al. 2014: 98–101) | CCTST and Kolb's Learning Style Inventory |
| | No significant correlation between student learning styles and critical thinking scores | (Mortellaro 2015: 121–122; Shinnick & Woo 2013: 1065) | HSRT and Kolb's Learning Style Inventory or Gregorc Style Delineator |

| | | |
|---|---|---|
| **Other student-related factors**<br><br>**Section 3.3.8** | Varied findings | **Self-concept** (Rubenfeld & Scheffer 2015: 62–64)<br>Rubenfeld and Scheffer discuss how self-concept, positive or negative feedback and life circumstances can affect one's critical thinking. |
| | | **Feelings** (Rubenfeld & Scheffer 2015: 64–65; Jeffries 2005: 98)<br>Emotions such as love, hate, depression, anxiety and other intense feelings may influence one's critical thinking. Anxiety in students should be acknowledged and can be reduced through teaching and mentoring strategies (Rubenfeld & Scheffer 2015: 64–65). |
| | | **Culture** (Indah & Kusuma 2016: 91; Rubenfeld & Scheffer 2015: 69–71)<br>Rubenfeld and Scheffer (2015: 69–71) discuss how cultural differences could influence critical thinking. This includes communication styles, cultural norms, different views on roles and relationships, values and others.<br>Indah and Kusuma (2016: 91–93) found a weak correlation between critical thinking and cultural background. |
| | | **Personal characteristics** (Purvis 2009: 126–152)<br>Participants in this study indicated that personal characteristics or factors such as curiosity, confidence and perseverance had an influence on critical thinking skills and development. Participants noted that curiosity improved their critical thinking skills. Participants also believed that critical thinking skills improved as they gained confidence in reasoning. Perseverance was also linked to improved critical thinking skills. |
| | | **Nationality** (Hunter et al. 2014: 813)<br>In this particular study, nationality predicted higher scores for total critical thinking skills. Australian students scored higher critical thinking skill scores than students from Korea and China (with English as a second language). |
| | | **Ethnicity or race** (Whitten & Brahmasrene 2011: 10; Facione 1991: 13)<br>In the study conducted by Whitten and Brahmasrene (2011: 8–10), race had a significant influence on total critical thinking scores and inductive thinking scores. These researchers noted that it could be due to Caucasion students having better access to academic resources and home computers in many instances. |
| | | **Type of high school attended** (Karagöl & Bekmezci 2015: 89; Cevik 2013: 58; Yenice 2011: 501)<br>Yenice (2011: 501) found a significant difference between the critical thinking disposition scores of pre-service science teachers' from Anatolian High Schools and those from Academical High Schools.<br>Cevik (2013: 58–63), however, found no significant difference between the critical thinking disposition scores of students based on the high schools from which they graduated.<br>Karagöl and Bekmezci (2015: 89) also found that the type of high school had no significant effect on critical thinking disposition scores. |

| | | |
|---|---|---|
| | | **Income level of parents** (Karagöl & Bekmezci 2015: 90)<br>Karagöl and Bekmezci (2015: 90) found that the income level of parents had no significant effect on critical thinking disposition scores or academic achievements of teacher candidates. |
| | | **Mother's education level** (Arslan et al. 2014: 56; Cevik 2013: 57)<br>Cevik (2013: 57–65) found that the students' mother's education level had a significant influence on critical thinking disposition scores. This could, however, have either a positive or negative effect on the level of critical thinking. |
| | | **Native English language and reading ability** (Indah & Kusuma 2016: 91; Mahapoonyanont 2012: 149; Facione 1990b: 10–12)<br>Mahapoonyanont (2012: 149) found that reading ability has a significant influence on critical thinking skills.<br>Indah and Kusuma (2016: 91–93) also found reading ability or language proficiency as a noteworthy factor affecting the ease of expresssing critical thinking. |

**Source:** Author

The student-related factors summarised in Table 10 are discussed in greater detail in sections 3.3.1 to 3.3.8.

### 3.3.1 Age

Critical thinking is a developmental phenomenon in which age plays an important role (Kuhn 1999: 16–23). Some believe that critical thinking develops only late in adolescence to adulthood (Springer & Borthick 2004: 278), while others believe that it develops gradually from childhood, throughout school and higher education (Gharib, Zolfaghari, Mojtahedzadeh, Mohammadi & Gharib 2016: 275). As a person ages, he or she is faced with more opportunities to utilise their reasoning skills (Purvis 2009: 65). Critical thinking capabilities of students can thus vary with age and educators should take this into account in their instructional strategies (Ten Dam & Volman 2004: 364).

Various studies have attempted to examine the influence of age on critical thinking and whether there is a significant correlation between greater age and higher critical thinking scores. Eleven studies were identified that examined this potential correlation. These are summarised in Table 10. Three studies support the idea that greater age is highly correlated with higher critical thinking scores (Günaydin & Barlas 2015: 4; Shinnick & Woo 2013: 1065; Martin 2002: 246), while eight studies found no significant correlation between age and critical thinking scores (Azizi-Fini et al. 2015: 3; Mortellaro 2015: 117;

Hunter et al. 2014: 812; Perry 2014: 122–123; Cevik 2013: 58; Chau et al. 2001: 116; Reed 1998: 156; Facione 1990b: 5).

It is difficult to determine the exact influence of age on critical thinking scores without taking into account the influence of other factors such as prior knowledge or experience (section 3.3.4) and academic grade or level (section 3.3.6). One reason being that students with no or low levels of knowledge and/or experience could be in the younger age groups, while more knowledgeable and/or experienced students could be in the older age groups (Shinnick & Woo 2013: 1065–1066; Martin 2002: 246). It could thus be that correlations observed between critical thinking scores and age could rather be related to knowledge or experience than in fact, age. Insight Assessment (2017: 70), which owns the copyright of the CCTST and the CCTDI measurement instruments, also asserts that age does not significantly predict critical thinking capabilities if academic grade or level (section 3.3.6) is controlled for. Another factor that may influence critical thinking is gender. Section 3.3.2 provides an overview of gender and its potential influence on critical thinking.

### 3.3.2 Gender

Twenty studies were identified which explored the influence of gender on critical thinking scores. Table 10 provides a summary of these studies. Six studies found that gender is strongly correlated with higher critical thinking scores. Of these six studies, four found that females achieved higher critical thinking scores than males (Arslan et al. 2014: 49; Serin 2013: 241–242; Yenice 2011: 500; Besoluk & Onder 2010: 679). Two studies reported higher scores in favour of males (Facione 1991: 11–12; King et al. 1990: 176). However, Facione (1991: 11–12) credits this result to other factors such as differences in Scholastic Aptitude Test (SAT) results and grade point averages (GPA) (section 3.3.3). Fourteen studies found that there was no significant correlation between gender and critical thinking scores (Günaydin & Barlas 2015: 1; Karagöl & Bekmezci 2015: 89; Mortellaro 2015: 76; Azizi-Fini et al. 2015: 4; Sunay 2015: 659; Hunter et al. 2014: 813; Perry 2014: 75; Shinnick & Woo 2013: 1062–1067; Gedik 2013: 1022; Whitten & Brahmasrene 2011: 9; Burbach et al. 2004: 487; Martin 2002: 246; Chau et al. 2001: 116;

Reed 1998: 157–158). Insight Assessment (2017: 70) asserts that there is no significant difference between the critical thinking scores achieved by males compared to those achieved by females as measured by the CCTST and CCTDI. They note that when there are differences, these can in most cases be attributed to skewed sample selections.

Perry (2014: 24) maintains that academic performance is a more reliable predictor of students' critical thinking scores than demographic factors such as age or gender. Section 3.3.3 provides an overview of academic performance as a factor that may influence students' critical thinking.

### 3.3.3 Academic performance

Williams and Stockdale (2003: 200–201), as well as Lovelace *et al.* (2016: 105) note that critical thinkers are more likely to achieve better grades. Similarly, students who are obtaining higher grades are more likely to develop better critical thinking skills than students who are performing worse. On this basis, Lovelace *et al.* (2016: 105) point to a reciprocal relationship between critical thinking and academic performance.

Twelve studies were identified which examined the influence of academic performance on critical thinking scores. As a proxy for academic performance, the studies largely used high school or college GPA, year in school, SAT verbal and/or SAT mathematical scores (Perry 2014: 24). These studies are summarised in Table 10. Seven of these studies found that academic performance is strongly correlated with higher critical thinking scores. Facione (1990b: 4) found a significant correlation between critical thinking scores and GPA, SAT verbal scores as well as SAT mathematical scores of undergraduate students. Taube (1995: 26) found similar results to that of Facione (1990b: 4) with educational psychology students. Jenkins (1998: 277–278) asserts that auditing students with higher critical thinkings scores will, in general, perform better academically in auditing courses than those students with lower critical thinking scores. Martin (2002: 246) found a significant correlation between GPA and critical thinking scores as well as decision-making in nursing students. Whitten and Brahmasrene (2011: 10) found that SAT verbal scores were significant predictors of higher critical thinking scores. SAT mathematical scores showed a significant correlation with the total critical thinking score as well as the inductive, deductive, evaluative and analytical reasoning sub-scores. Ghazivakili *et al.* (2014: 98) indicate that GPA is significantly correlated with critical thinking scores while Karagöl and Bekmezci (2015: 90–91) found a significant relationship between critical thinking dispositions and academic performance.

Five studies, however, found no significant correlation between critical thinking scores and academic performance (Azizi-Fini et al. 2015: 4; Günaydin & Barlas 2015: 6; Mortellaro 2015: 119; Perry 2014: 91; Cevik 2013: 57). Section 3.3.4 provides an overview of prior knowledge and experience as a factor that may influence students' critical thinking.

### 3.3.4 Prior knowledge or experience

Banning (2006: 460) notes that some researchers believe that critical thinking can only be developed through education, while others believe it can be developed through experience as well. In section 3.3.1 it was mentioned that it is often difficult to determine the influence of a factor such as age on critical thinking scores without taking into account the influence of other factors such as prior knowledge or experience. Correlations observed between critical thinking and age could, in essence, be attributed to knowledge and experience.

Five studies were identified which examined the influence of prior knowledge or experience on critical thinking scores. A summary of these studies is provided in Table 10. Four of these studies found a significant correlation between prior knowledge or experience and critical thinking scores. Martin (2002: 244–246) reported that as clinical nursing expertise increased from novice to expert, so did critical thinking scores. She asserts that factors such as knowledge and expertise could lead to higher critical thinking scores and found a strong correlation between critical thinking scores and years of nursing experience. Shinnick and Woo (2013: 1065) found that nursing students with higher pre-test knowledge scores had higher critical thinking scores. Hunter *et al.* (2014: 812) found that nursing experience was significantly correlated with the critical thinking analysis sub-score. This correlation was, however, only witnessed in first- and second-year students and not in third-year students. Mortellaro (2015: 109) found a significant correlation between critical thinking scores and healthcare experience.

Chau *et al.* (2001: 116), on the other hand, found no significant correlation between critical thinking scores and previous work experience or previous experience of attending a college course. Section 3.3.5 provides an overview of the type of academic programme or field of study as a factor influencing critical thinking development.

### 3.3.5 Type of academic programme or field of study

Seven studies were identified which examined the influence of the type of academic programme or field of study on critical thinking scores. These are presented in Table 10. Six of these seven studies showed a significant correlation between the academic programme or field of study and critical thinking scores. Facione (1991: 14) found a significant correlation between academic programme or field of study and critical thinking pre-test scores. Cevik (2013: 62–63) also found a significant correlation between the subject areas of pre-service educators and critical thinking disposition scores and concluded that this could be attributed to differences in quality of critical thinking instruction in the various subject areas. Arslan *et al.* (2014: 50) found significant differences between faculties regarding critical thinking scores. Their study found that students in economics or administrative sciences faculties scored higher in critical thinking disposition scores than those in other faculties such as education and engineering. Students studying economics, public administration and literature also scored higher than those in the mathematics departments (Arslan et al. 2014: 50). Ghazivakili *et al.* (2014: 98) included students from sanitation, nursing and midwifery as well as paramedics and emergency medical technicians. Their study found a significant correlation between critical thinking scores and students' academic programme or field of study (Ghazivakili et al. 2014: 98). Karagöl and Bekmezci (2015: 90) established that critical thinking dispositions of education candidates correlated significantly to their field of study. Sunay (2015: 660) found that students from other faculties had higher critical thinking scores than students studying at the School of Physical Education and Sport in his study.

Whitten and Brahmasrene (2011: 9–10), however, found no significant correlation between critical thinking scores and academic programme or field of study. Section 3.3.6 provides an overview of the academic grade or level as a student-related factor.

### 3.3.6 Academic grade or level

It is believed that critical thinking develops as a student progresses through his or her education and that higher education enhances a student's critical thinking skills (Facione 1990b: 4–5). The literature indicates that students' critical thinking capabilities increase as they progress through college or higher education (Mortellaro 2015: 36; Young & Warren 2011: 861). Academic grade or level of education is thus regularly studied as a factor that may influence critical thinking development (Mortellaro 2015: 36).

Sixteen studies were identified that inspected the influence of academic grade or level on critical thinking scores. These studies are presented in Table 10. Twelve of these studies indicated a strong correlation between academic grade or level and critical thinking scores (Günaydin & Barlas 2015: 6; Ralston & Bays 2015: 85; Hunter et al. 2014: 812; Arslan et al. 2014: 56; Gedik 2013: 1022–1023; Serin 2013: 242; Whitten & Brahmasrene 2011: 9–10; O'Hare & McGuinness 2009: 123; Burbach et al. 2004: 488–489; McCarthy et al. 1999: 142; King et al. 1990: 178; Mines et al. 1990: 544). King *et al.* (1990: 178) found that graduate students obtained higher critical thinking scores than undergraduate students. Mines *et al.* (1990: 544) indicated that overall critical thinking scores increased from a freshman, senior to graduate level. McCarthy *et al.* (1999: 142) found similar results and concluded that senior nursing undergraduate students obtained significantly higher critical thinking scores and dispositions scores than sophomore junior students. O'Hare and McGuinness (2009: 123) found that third-year undergraduate psychology university students scored significantly higher on the evaluation disposition sub-score than first-year undergraduate psychology students. Whitten and Brahmasrene (2011: 9–10) found that the academic grade or level at the university of the student had a significant influence on all critical thinking scores apart from evaluation and analysis sub-scores. Gedik (2013: 1022–1023) also found that critical thinking scores of second- and third-year students were higher than those of first-year students. Serin (2013: 242) supports this view, reporting that first-year students' critical thinking skills started out very low and increased as the students progress through classes and semesters.

Arslan *et al.* (2014: 56), however, found that critical thinking skill scores of the first-year students were higher than those of the fourth-year students. Hunter *et al.* (2014: 812) report that students in their third year of studies scored higher critical thinking scores than those in their second and first year. Günaydin and Barlas (2015: 6) found that critical thinking disposition scores increased from first-year students up to fourth-year students while Ralston and Bays (2015: 85) found a statistically significant increase in critical thinking scores in each year from first-year to fourth-year undergraduate engineering students.

Four studies found no significant correlation between academic grade or level and critical thinking scores. Facione (1990b: 4–5) found no significant correlation between critical thinking scores and academic units completed. Yenice (2011: 500) investigated the correlation between science educators' academic grade levels and critical thinking disposition scores but found no significant correlation. Azizi-Fini *et al.* (2015: 4) found that the critical thinking scores of freshmen and senior nursing students in their study showed no significant difference. Mortellaro (2015: 118) could not find a significant correlation between either highest degree earned or academic level and critical thinking scores. Section 3.3.7 provides an overview of student learning styles as a factor that may influence students' critical thinking.

### 3.3.7 Student learning styles

Since the 1970s, various fields of education, learning and psychology, have shown interest in the particular ways individuals learn as each student learns uniquely (Pritchard 2014: 46–66). Learning styles, also known as learning preferences, refer to a person's preferred way of learning as well as obtaining knowledge and skills. Related to learning styles are cognitive styles which mainly refer to an individual's preferred style of thinking and problem-solving (Pritchard 2014: 46–66). Learning styles are not fixed as a student can adopt different styles in different environments. A student may also have characteristics of more than one learning style (Rubenfeld & Scheffer 2015: 60; Pritchard 2014: 44–46).

Various models for defining and measuring student learning styles currently exist. Annexure F provides an overview of some of the main models of such styles. One such model is Kolb’s Learning Style Inventory which is based on extensive research on Kolb’s experiential learning theory (Kolb & Kolb 2005: 1–8). Researchers use these models to measure students’ learning styles along with critical thinking measurement instruments to examine whether there is a correlation between certain student learning styles and critical thinking scores. Table 10 provides a summary of six studies identified from the literature that examined this correlation.

Four of these studies found a significant correlation between certain learning styles and critical thinking scores. Colucciello (1999: 300) used Kolb’s Learning Style Inventory and found a positive correlation between critical thinking (the self-confidence critical thinking sub-score) and the reflective observation learning style. Besoluk and Onder (2010: 679) utilised the Perceptual Learning Style Questionnaire and established that there is a positive correlation between critical thinking dispositions, deep learning approaches and the kinaesthetic learning style. Nasrabadi *et al.* (2012: 296) reported that Kolb’s convergent learning style showed the highest academic achievement and the highest critical thinking attitudes. Ghazivakili *et al.* (2014: 98–101) found that learning styles, critical thinking and academic performance are significantly associated with one another. The results of their study indicated a significant correlation between critical thinking scores and student learning styles. They noted a particularly strong positive correlation between critical thinking evaluation and inductive reasoning skills and student learning style. The findings show that the most common learning style, among the medical science students, was Kolb’s convergent style followed by the assimilating style.

Two studies, however, found no significant correlation. Shinnick and Woo (2013: 1065) found no correlation between Baccalaureate nursing students’ learning styles and their critical thinking scores. Mortellaro (2015: 121–122) also found no significant relationship between learning styles and critical thinking scores.

From Table 10 it would seem that several more studies suggest that there could be a significant correlation between certain student learning styles and higher critical thinking scores. Section 3.3.8 provides an overview of other student-related factors that may influence students' critical thinking but which are not as prevalent in the literature.

### 3.3.8 Other student-related factors

In the literature, various other student-related factors have been noted which may influence critical thinking. These factors are less prevalent in the literature than those discussed in sections 3.3.1 to 3.3.7 but are still worth mentioning. Table 10 summarises some of these factors. These factors include, but are not limited to, self-concept, feelings, culture, personal characteristics, nationality, ethnicity, type of school, income level of parents, mother's education level, native English language and reading ability.

In conclusion it would seem that the influence of the student-related factors discussed in sections 3.3.1 to 3.3.8 on critical thinking seems to be varied and in many instances inconclusive. These factors may, however, still have an influence on students' critical thinking scores as measured by various measurement instruments, critical thinking capabilities in general and the effectiveness of critical thinking educational interventions. Consideration should thus be given to the influence of these student-related factors on critical thinking development in auditing students through technology-based educational interventions. These student-related factors can be summarised as:

- Age;
- Gender;
- Academic performance;
- Prior knowledge or experience;
- Type of academic programme or field of study;
- Academic grade or level;
- Student learning styles; and
- Other student-related factors, including self-concept, feelings, culture, personal characteristics, nationality, ethnicity, type of high school, income level of parents, mother's educational level, native English language and reading ability.

The next set of factors addressed in section 3.4 relate to the educator. An overview is provided of educator-related factors that may potentially influence students' critical thinking.

## 3.4 EDUCATOR-RELATED FACTORS

Educators are vital in developing critical thinking in students (Chan 2013: 239; Van Erp 2008: 114–116). In her study, Van Erp (2008: 114–116) found that the educator's efforts were the most important factor that influenced students' critical thinking development. Educators furthermore play a crucial role in assessing students' critical thinking and should thus have proper knowledge of critical thinking instruction (Chan 2013: 239). However, it cannot simply be assumed that educators understand critical thinking concepts or how to teach them (Paul & Elder 2007: 5). Having been mostly taught through passive teaching strategies such as lectures themselves, most educators were not taught to be critical thinkers (Paul & Elder 2007: 7).

Critical thinking can only be successfully developed in students when educators themselves truly understand the fundamentals of critical thinking and when institutions support educators in acquiring this ability (Paul & Elder 2007: 5). An educational institution thus has an obligation to support the educator in understanding how to teach to achieve critical thinking development specifically and allow them time to achieve this goal (Van Erp 2008: 114–116). Management should create a support system for educators where they feel empowered to nurture critical thinking in students and where they can collaborate with others to do so (Gharib et al. 2016: 274).

Educators furthermore require specific training to effectively infuse critical thinking into their curriculum and teaching strategies (Reed 1998: 166). Gharib *et al.* (2016: 274) agrees, advising that educators should be empowered through dedicated workshops and courses. Abrami *et al.* (2008: 1121) found that when educators received specific training on how to develop critical thinking or when the educators' critical thinking teaching practices were specifically monitored, the impact of educational interventions on students' critical thinking scores were the greatest. Tiruneh *et al.* (2014: 7) also found, although evidence is not conclusive, that significant critical thinking development could be observed where the research author or trained educator implemented a critical thinking educational intervention. Of the 27 studies in their systematic review (Tiruneh et al. 2014: 1–17), 15 (56%) indicated that the intervention was applied by the research author or trained educator. Nine (60%) of these studies showed significant critical thinking improvement. Unfortunately, no information was available in those studies on whether the author or educator received specific prior training on critical thinking instruction. As a result, Tiruneh *et al.* (2014: 7) caution that it cannot simply be assumed that there is a strong correlation between the educator's prior experience or training in critical thinking and the effectiveness of a critical thinking educational intervention.

Certain educator attributes and characteristics could furthermore assist students in their learning. These include the educator being friendly, respectful, impartial, compassionate and selfless. Critical thinking is specifically mentioned as an attribute of an effective educator (De Villiers 2015: 58–69). Gharib *et al.* (2016: 275–277) also found that the educator's teaching philosophy, attitude and values all play a crucial role in critical thinking development. The educator's belief system and personal characteristics are equally important. Personal characteristics such as the ability to accept criticism influence how students view the educator as a role model for critical thinking. An educator should furthermore be truthful, flexible, responsive and polite, according to Gharib *et al.* (2016: 277). Educators should model critical thinking (Facione 2000: 80) for students to observe their reasoning and logic to support arguments (Lai 2011: 36).

Only a limited number of studies were identified which examined the correlation between educator-related factors and students' critical thinking scores. Table 11 provides a summary of these studies. Table 11, as well as the conclusions reached in this section, should not be seen as a full review of all studies associated with the influence of educator-related factors on critical thinking.

**Table 11: Summary of educator-related factors and their influence on critical thinking**

| Educator-related factor | Influence on critical thinking scores based on literature | Literature reference | Critical thinking measurement tool utilised |
|---|---|---|---|
| **Educator trained in critical thinking instruction** | Significant correlation between educators' training in critical thinking instruction and students' critical thinking scores | (Abrami et al. 2008: 1121) | Various |
| **Tenured versus non-tenured status** | No significant correlation found between the status (tenured versus non-tenured) of the educator and students' critical thinking skills scores | (Facione 1990b: 13) | CCTST |
| **Full-time versus part-time employment status** | No significant correlation found between the employment status (full-time versus part-time) of the educator and students' critical thinking skills scores | (Facione 1990b: 13) | CCTST |
| **Doctorate versus non-doctorate preparation or status** | No significant correlation found between the educator having a doctorate or not and students' critical thinking skills scores | (Facione 1990b: 13) | CCTST |
| **Gender** | No significant correlation found between the gender of the educator and students' critical thinking skills scores | (Facione 1990b: 13) | CCTST |
| **Number of years of college or higher education teaching experience** | No significant correlation found between the educator's teaching experience and students' critical thinking skills scores although, in isolation, this factor made up approximately 4% of the variance in CCTST post-test scores | (Facione 1990b: 14) | CCTST |
| **Number of critical thinking instruction sections taught by educator in previous 36 months** | No significant correlation found between critical thinking instruction in the previous 36 months and students' critical thinking skills scores although, in isolation, this factor also made up approximately 4% of the variance in CCTST post-test scores | (Facione 1990b: 14) | CCTST |

**Source:** Author

Although the literature is limited on this topic, educator-related factors that may influence students' critical thinking, can be summarised as follows:

- The educator being trained in critical thinking instruction;
- The educator's prior experience in critical thinking instruction;
- The support that the educator is receiving from the educational institution or management related to critical thinking development;
- The educator's attributes, characteristics, teaching philosophy, attitude and values; and

- The educator’s ability to model critical thinking.

In section 3.5, an overview of instructional factors that may influence students’ critical thinking is provided.

## 3.5 INSTRUCTIONAL FACTORS

Instructional factors, which include critical thinking instructional approaches as well as specific teaching strategies, are mentioned as significant in influencing the effectiveness of critical thinking instruction and educational interventions (Tiruneh et al. 2014: 2). Critical thinking instructional approaches refer to the different approaches with regards to how explicitly critical thinking principles are developed and how these principles are taught in relation to course content. Teaching strategies are more general and refer to strategies of instruction, teaching methods or styles of instruction that focus on the process of learning from a teaching perspective. In their meta-analysis of 117 studies, Abrami *et al.* (2008: 1120) mention that the type of critical thinking instructional approach, together with the teaching strategies, explained 32% of the variance in the effect on critical thinking scores. Critical thinking instructional approaches and teaching strategies may thus significantly influence critical thinking scores.

Section 3.5 addresses both instructional approaches (section 3.5.1) and teaching strategies (section 3.5.2) as part of instructional factors that may influence students’ critical thinking. Tiruneh *et al.* (2014: 2) as well as Behar-Horenstein and Niu (2011: 29–30) specifically mention instructional approaches as factors that may influence the development of critical thinking in students. An overview of critical thinking instructional approaches is provided in section 3.5.1.

### 3.5.1 Instructional approaches

There is much debate as to whether critical thinking can be considered a generic set of skills that can be applied across various disciplines and/or subject fields or whether it is specific to the context of the discipline or subject within which it is developed (Abrami et al. 2015: 280). This debate provides the context to understand critical thinking instructional approaches.

McPeck (1990: 10) strongly opposed the idea of generic critical thinking or critical thinking courses that claim to develop general critical thinking skills. Others, however, strongly support the idea that critical thinking skills are generic. Bailin *et al.* (1999b: 271) assert that critical thinking is a generic process with skills that can be developed without any specific discipline or subject knowledge. These skills can then be transferred to other contexts. Nair and Stamler (2013: 132) also believe that critical thinking skills are universal and that when a student has developed these skills, he or she will be able to apply them in various personal and professional situations regardless of the discipline in which they were developed. Psychologists predominantly tend to support the generic approach where critical thinking is viewed as the development of a series of skills and dispositions that are generalisable across a diversity of contexts. This is the main idea of the meta-cognitive skills discourse which presumes the transfer of skills between different contexts (Abrami et al. 2015: 281).

The experts in the APA Delphi study also believe that critical thinking is not bound to one specific subject, domain, experience or discipline. Importantly, however, these experts indicate that the most effective way of developing critical thinking is within the context of a specific subject or discipline (Facione 1990a: 4–5). They maintain that critical thinking skills are transferable between disciplines or subjects but that to apply these skills successfully in certain settings, discipline-specific knowledge could be required (Facione 1990a: 4–5, 2000: 65). To make sound and rational judgements, knowledge about a specific subject or discipline's methods, techniques, contexts, criteria, theories and principles may be necessary (Facione 1990a: 17, 2000: 65). Atabaki *et al.* (2015: 96) confirm that most researchers believe that critical thinking is transferable between disciplines or subjects but that basic discipline or subject knowledge is still needed.

Based on this debate, some scholars believe critical thinking should be developed as a generic skill in a stand-alone subject or course, while others think it should be developed embedded within a particular subject or discipline (Abrami et al. 2015: 281; Derwin 2008: 31–36). According to Abrami *et al.* (2015: 281), this debate has a considerable impact on education as it influences the way critical thinking is taught through instructional approaches.

Ennis (1989: 4–6) used the explicitness of instruction as a benchmark for categorising different critical thinking instructional approaches. These approaches differ regarding how explicitly critical thinking principles are developed and imparted as well as how these principles are taught in relation to course content (Bensley & Spero 2014: 56). Various researchers refer to these instructional approaches in their studies and emphasise the importance of instructional approaches in the development of critical thinking. These include the **general, infusion, immersion** and **mixed** instructional approaches (Abrami et al. 2008: 1105–1121, 2015: 281–302; Bensley & Spero 2014: 56–58; Tiruneh et al. 2014: 2–8; Lai 2011: 30–32; Prawat 1991: 3–30; Ennis 1989: 4–6), which can be summarised as follows:

- **General or stand-alone approach:** Thinking skills are developed separately from subject or discipline content and are taught in a separate class. This approach could involve some content although it is not strictly necessary. The needs of low-achieving populations are met through such an approach as it does not penalise students who do not have prerequisite subject matter knowledge. Thinking principles are explicitly taught separate from course content. This is often done in a more abstract form as opposed to that of a formal course.
- **Infusion or embedded approach:** Critical thinking is explicitly taught within the context of the subject or discipline. Discipline-specific content is thus collectively taught with critical thinking. An infusion approach requires deep, thoughtful and well-understood subject content. Researchers believe that the dimensions of critical thinking can be developed within a subject or discipline while teaching students. Students are encouraged to develop and practice critical thinking explicitly through well-structured instruction.
- **Immersion approach:** This approach also attempts to integrate critical thinking into subject content instruction, but the actual development of critical thinking skills is not made explicit. Subject matter instruction is delivered in a thought-provoking manner. Thorough understanding of discipline content and engagement with the subject matter is thought to be sufficient for the development of critical thinking skills.

- **Mixed approach:** This approach entails a mixture of the general approach together with either the infusion or the immersion approach. Students are engaged in a separate course or class that teaches general critical thinking but are also expected to be involved in subject-specific critical thinking instruction with either explicit or implicit instruction of critical thinking objectives.

Abrami *et al.* (2008: 1121) found that whether critical thinking is developed separately from the discipline or subject content or whether it is embedded within the content is of less importance empirically. Better outcomes were seen where critical thinking requirements were made explicit, as part of the course design, instead of remaining implicit. The outcomes were the lowest where critical thinking improvement was merely listed as an objective, but course design and implementation were not specifically adapted.

Angeli and Valanides (2009: 323–324) note that during the 1990s, instructional approaches shifted from the general approach to the infusion and immersion approaches. The reason for this change was to allow transferability of critical thinking capabilities to other disciplines or subjects. Tiruneh *et al.* (2014: 8) concur, noting that the majority of studies in their systematic review are based on either the immersion or the infusion approach.

Several studies have also attempted to examine the influence of instructional approaches on critical thinking. Abrami *et al.* (2008: 1102–1134) included 117 studies as part of a meta-analysis. The results show that the mixed approach had the most significant influence on critical thinking development while the immersion approach had the smallest. A moderate influence on critical thinking was seen in the studies that applied the general approach or the infusion approach. Behar-Horenstein and Niu (2011: 25–41) corroborate the findings of Abrami *et al.* (2008: 1121) stating that critical thinking cannot be imparted with implicit expectations. Of the 42 studies reviewed by Abrami *et al.,* 22 studies (52.5%) made use of the immersion approach.

Tiruneh *et al.* (2014: 5–8) performed a systematic review of 33 studies. Of the studies that applied the general approach, 80% reported significant increases in critical thinking scores, while 67% of the studies that applied the mixed approach reported notable increases in scores. Tiruneh *et al.* (2014: 8) suggest that the general or mixed approach seems to be the most effective in developing students' critical thinking, but caution that the studies that adopted these instructional approaches were limited and that findings should be interpreted with care. Abrami *et al.* (2015: 275–314), on the other hand, found that all four of the approaches produced significantly positive average effect sizes in critical thinking scores. The effect sizes, from quasi- to true-experimental studies, did not differ much between the four instructional approaches.

This section illustrates that the instructional approach may influence critical thinking as various researchers have found a significant correlation between instructional approach and critical thinking scores. Tiruneh *et al.* (2014: 8), however, note that the instructional approach alone is not enough to determine the overall effectiveness of a critical thinking educational intervention or critical thinking development in students. These researchers also discuss the importance of teaching strategies in the development of critical thinking in students. These strategies form part of instructional factors that may significantly influence students' critical thinking and are discussed in greater detail in section 3.5.2.

### 3.5.2 Teaching strategies, including active learning strategies

Teaching strategies and pedagogies are terms that are used interchangeably. They refer to strategies of instruction, teaching methods or styles of instruction and are focused on the process of learning from a teaching perspective (McHaney 2011: 164). For purposes of this study, the term 'teaching strategies' will be used throughout.

Mahapooyanont (2012: 149) found that teaching strategies have a significant influence on critical thinking skills. Educators, however, remain largely unsure whether their teaching strategies are effective in developing critical thinking in students (Bensley & Spero 2014: 55) and optimal teaching strategies aimed at developing critical thinking in students remain elusive (Choi, Lindquist & Song 2014: 53). Abrami *et al.* (2015: 282) note that most reviews on educational interventions aimed at developing students' critical thinking have been inconclusive in determining the exact influence of teaching strategies on students' critical thinking. The question of which teaching strategies are effective for critical thinking development therefore remains largely unanswered and a robust framework for developing critical thinking in students does not exist as yet (Abrami et al. 2015: 305).

Ten Dam and Volman (2004: 359) as well as Rudman and Terblanche (2012: 57), assert that to develop critical thinking in students, students should actively participate in the learning process (active learning environment or active learning strategies). To develop critical thinking, learning conditions should provide opportunities for active student participation, as opposed to passive learning where students are mere recipients of information (Ten Dam & Volman 2004: 370). Critical thinking is an active process as opposed to a passive process (Mortellaro 2015: 17–18) and is developed through active learning strategies which stimulate cognitive processes (Mortellaro 2015: 122–123). Zelin II (2010: 7) notes that active learning involves learning by 'doing'. Educators should move away from passive or non-experiential teaching strategies to a student-centred, active or experiential learning approach (Barac & Du Plessis 2014: 60).

Active learning strategies are thus required to develop critical thinking in students (Jordan D'Ambrisi 2011: 36). Stakeholders in accounting education, which include the Accounting Education Change Commission and the American Institute of Certified Public Accountants, are also encouraging the adoption of active learning strategies that integrate creative technologies into the accounting curriculum. Technological tools thus allow students to become active learners through these active learning strategies (Fratto 2011: 13). The main types of tools or vehicles through which active learning is provided are set out in Table 12 (Cone et al. 2016: 1; Rubenfeld & Scheffer 2015: 97; Nelson & Crow 2014: 79; Purvis 2009: 56–70; Jeffries 2005: 99), although this is not an exhaustive list. For ease of reference these will be referred to as active learning strategies.

**Table 12: Examples of active learning strategies**

| | |
|---|---|
| Case studies | Concept mapping |
| Problem-based learning (PBL) | Written assignments |
| Simulations | Reflective writing, logs and journals |
| Questioning techniques (including Socratic questioning) | Modelling |
| Collaboration and asynchronous online discussions | |

**Source:** Author

Lee *et al.* (2013: 1219) note that PBL, concept mapping, simulations and case studies are among the active learning strategies most widely used to develop critical thinking. Carter *et al.* (2016: 218) also state that in their systematic review the active learning strategies mostly used to develop critical thinking were PBL, simulations and concept mapping. These and other active learning strategies are further discussed in Chapter 4. Table 13 provides an overview of some of the studies that have examined the influence of the various types of active learning strategies on students' critical thinking.

**Table 13: Summary of active learning strategies and their influence on critical thinking**

| Instructional factors | Influence on critical thinking scores based on literature | Type of active learning strategy | Critical thinking measurement tool utilised | Summary of main findings | Literature reference |
|---|---|---|---|---|---|
| **Active learning strategies** | Significant correlation between active learning strategies and critical thinking scores | Collaborative groups, questioning techniques | CCTT | Although other influences on critical thinking could not be separated from those provided from the effect of the course, the mean scores from the pre-test to the post-test increased significantly | (Allegretti & Frederick 1995: 46–48) |
| | | Experimental group exposed to concept mapping while control group taught through traditional nursing care plans | CCTST | Scores increased significantly from pre- to post-test overall and each sub-skill. The scores for the experimental group improved significantly on the overall critical thinking score as well as the analysis and evaluation sub-skill scores. The results indicate that concept mapping is effective in developing students' critical thinking skills | (Wheeler & Collins 2003: 339–346) |

| Instructional factors | Influence on critical thinking scores based on literature | Type of active learning strategy | Critical thinking measurement tool utilised | Summary of main findings | Literature reference |
|---|---|---|---|---|---|
| | | Journal writing, small groups, case studies, role plays and Socratic questioning | WGCTA | Significant increases in deduction and interpretation sub-skills as well as total critical thinking scores | (Burbach et al. 2004: 482–492) |
| | | Case studies | Students gave written comments and scaled responses on standard evaluation forms | Integration of case studies provide well-rounded critical thinkers | (Kunselman & Johnson 2004: 87–92) |
| | | Socratic questioning in asynchronous discussion forums (ADFs) | CCTST | Results indicate significant gains in critical thinking scores | (Yang, Newby & Bill 2005: 163–181) |
| | | One group exposed to PBL and control group to lecturing | CCTDI | On pre-test, the overall CCTDI and sub-skill scores for the two groups did not differ significantly. On post-test scores, the PBL group achieved significantly higher scores overall as well as in the truth seeking, analyticity and self-confidence sub-skill scores. | (Tiwari et al. 2006: 547–554) |
| | | One group exposed to online PBL and another group to traditional lecture-based model | CCTDI | Significant differences were found between the critical thinking dispositions scores of the PBL group compared to the group that received traditional model training. Significant differences were seen in the truth-seeking and open-mindedness sub-skill scores | (Ozturk, Muslu & Dicle 2008: 627–632) |

| | | | | | |
|---|---|---|---|---|---|
| | | Structured collaborative asynchronous discussion forums with two levels — without Socratic dialogues and with Socratic dialogues | CCTST | The students in the experimental group significantly improved their critical thinking skills scores and performed better than the comparison students. The use of Socratic questioning via asynchronous discussion forums stimulates critical thinking | (Yang 2008: 241–264) |
| | | One group exposed to PBL and control group to lecturing | CCTST (Chinese-Taiwanese version) | Regarding critical thinking pre-test scores, there was no significant difference between the PBL group and lectured group. The PBL students, however, scored significantly higher in post-test scores overall as well as in the analysis and induction sub-skill scores when compared to students who were simply lectured to. | (Yuan, Kunaviktikul, Klunklin & Williams 2008: 70–76) |
| | | One group exposed to online PBL and another group to instructor-led instruction | WGCTA (Turkish version) | Both PBL (experiment) and instructor-led (control) group had higher scores in the post-test scores compared to their pre-test scores. The PBL group had higher critical thinking scores than the instructor-led group | (Şendağ & Odabaşi 2009: 132–141) |
| | | Medium to high fidelity simulations | Systematic review of simulation-based learning in nurse education | All 12 studies included in the systematic review indicated improvements in knowledge and critical thinking. Five of the 12 studies reported statistically significantly greater scores for critical thinking between the experimental group and the control group | (Cant & Cooper 2010: 3–15) |
| | | One group exposed to case-based learning while another group to didactic learning | CCTST | Case-based learning students obtained higher total critical thinking scores as well as higher critical thinking scores in all sub-skills than the didactic programme students | (Kaddoura 2011: 1–18) |

| | | | | | |
|---|---|---|---|---|---|
| | | PBL, group learning, collaborative learning, concept mapping or logic models | Systematic review to identify teaching strategies that positively impact on students' critical thinking development | All the teaching strategies included in the review followed active learning strategies. Six of the studies relating to PBL indicated significant increases in students' critical thinking scores. The researcher concludes that PBL is an effective teaching strategy that should be used in radiologic science education for the development of critical thinking | (Kowalczyk 2011: 120–132) |
| | | Experimental group exposed to PBL and concept mapping | Critical Thinking Scale | Results show that the experimental group scored higher than the control group in critical thinking scores. The critical thinking scores for the experimental group from pre-test to post-test increased significantly. | (Tseng et al. 2011: 41–46) |
| | | Thinking maps, graphic organisers, collaborative groups and use of real-world examples | Critical Thinking Assessment Instrument developed by the National Center for Teaching Thinking | Results indicated that the explicit critical thinking programme had a significantly positive effect on critical thinking scores | (Alwehaibi 2012: 193–204) |
| | | Experimental group exposed to concept mapping | CCTDI | Results indicated that there were no statistically significant differences in the pre-test mean scores of the experimental and control group students for critical thinking disposition total score and sub-skill scores. There were, however, statistically significant differences in the post-test mean scores of the experimental group and control group students for critical thinking and its sub-skill scores. This indicates that concept mapping is an important teaching strategy in increasing critical thinking dispositions | (Atay & Karabacak 2012: 233–239) |

| | | | | | |
|---|---|---|---|---|---|
| | | Web-based simulation, small groups | Pre-performance test and post-achievement test (not specific) | The study found that there was a significant correlation between the use of a web-based simulation with social networking and students' critical thinking skills | (Salleh, Tasir & Shukor 2012: 372–381) |
| | | One group exposed to high-fidelity human simulation and control group to instructor written case studies | HSRT | Both groups showed increased critical thinking scores from pre-test to post-test. There was, however, no statistically significant difference between students exposed to simulations compared to those exposed to case studies | (Goodstone et al. 2013: 159–162) |
| | | Experimental group exposed to concept mapping and control group to lectures | Critical Thinking Scale | After controlling for individual characteristics, results indicated that the experimental group gained a higher critical thinking score over time than the control group | (Lee et al. 2013: 1219–1223) |
| | | PBL | Meta-analysis and systematic review on the effectiveness of PBL on the development of nursing students' critical thinking | Nine studies were included in this analysis, and the results indicated that PBL did improve nursing students' critical thinking to a higher degree than traditional lectures. | (Kong, Qin, Zhou, Mou & Gao 2014: 458–469) |
| | | High-fidelity paediatric nursing simulation | Yoon's critical thinking dispositions tool (developed for Korean students) and the Simulation Effectiveness Tool (SET) | The results of the study indicated that Group A students with one simulation exposure showed no statistically significant gains in critical thinking scores. Critical thinking scores increased with the number of exposures to the simulation. Group C with three exposures showed significant gains in critical thinking. The single most important finding of this study was that the overall critical thinking score significantly increased after the simulation. The sub-skills prudence, systematicity, healthy scepticism and intellectual eagerness showed significant increases | (Shin et al. 2015: 537–542) |

| | | | | | |
|---|---|---|---|---|---|
| | | One group exposed to interactive electronic simulation (computer-based simulation) and the other group to traditional paper case study simulation | CCTDI | The students exposed to the computer-based simulation achieved significantly higher critical thinking disposition scores overall and specific increases in the truth seeking, open mindedness and confidence in reasoning sub-skills compared to the control group | (Weatherspoon, Phillips & Wyatt 2015: 126–133) |
| | | PBL, concept mapping, simulation and other | Systematic review to investigate the efficacy of teaching methods used to develop critical thinking in nursing and midwifery undergraduate students | Seventeen of the 28 studies reported a significant increase in critical thinking scores of students as a result of an educational intervention. Nine studies indicated no increases. The use of PBL and concept maps showed encouraging effects on critical thinking development. They are both rooted in constructivism. Of the nine studies in the systematic review that utilised PBL, seven reported positive outcomes regarding critical thinking development. Variable results were found with the use of simulations to develop students' critical thinking | (Carter et al. 2016: 209–218) |
| | | Simulation, formative feedback | HSRT | Significant increases in the overall scores and the subskill scores of deduction, evaluation and inference | (Cone et al. 2016: 5) |
| | | Three different web-based simulations (team-based) | Written case analyses evaluated using a 6-step critical thinking rubric | Participation in the simulations did indeed develop students' critical thinking skills | (Lovelace et al. 2016: 100–121) |

| | | | | | |
|---|---|---|---|---|---|
| | No significant correlation between active learning strategies and critical thinking scores | One group exposed to Guided Reciprocal Peer Questioning and control group to traditional seminar course | CCTST | No significant difference in critical thinking skills scores between the two groups | (Velde, Wittman & Vos 2006: 49–60) |
| | | PBL | Systematic review of studies on the development of nursing students' critical thinking through PBL | Ten studies were included in the review, and the results indicated no conclusive evidence that PBL does develop nursing students' critical thinking | (Yuan, Williams & Fan 2008: 657–663) |
| | | Human patient simulation | HSRT | Improvements in knowledge with the use of human patient simulation did not equate to improvements in critical thinking scores | (Shinnick & Woo 2013: 1062–1067) |
| | | One group used traditional lecture methods, while the other used PBL methods, debates and role-plays | Critical Thinking Ability Scale for College Students | Critical thinking scores increased 2.20 points for students after PBL instruction and increased 0.82 points for students in the traditional group. However, this difference was not statistically significant | (Choi et al. 2014: 52–56) |
| | | Role-play, case study and small groups | Student-centred focus groups, journal reflections and self-evaluations completed by the students | Critical thinking skills consistently improved amongst control and experimental conditions but not necessarily as result of active-learning strategies utilised | (Nelson & Crow 2014: 77–91) |
| | | Computer-based virtual patient simulation | HSRT and survey designed by researcher | There was no significant gain in the mean score, but more than one-third of the students scored at least two points higher on the post-test than the pre-test | (Allaire 2015: 1082–1092) |

**Source:** Author

From Table 13 it is evident that various studies have attempted to examine the influence of active learning strategies on critical thinking and to determine whether there is a significant correlation between these strategies and higher critical thinking scores. Ten Dam and Volman (2004: 367) assert, however, that significant correlations between active learning strategies and critical thinking scores are not always evident as there are often limitations in studies. These limitations include too short a period between pre- and post-tests, sample sizes being inadequate and broad measurement instruments being utilised. There also seems to be disagreement regarding the exact influence of the duration of critical thinking instruction or intervention on critical thinking scores. Young and Warren (2011: 862) mention that critical thinking develops at a slow pace and that observing its progress in students over a short period (such as a semester) is very difficult. These researchers mention that it is unlikely that a single intervention will significantly develop students' critical thinking capabilities and that such skills are rather developed over longer periods of time. Shinnick and Woo (2013: 1065) also mention that it is no surprise that a single simulation did not have a significant effect on their students' critical thinking scores as critical thinking takes many years to develop and is influenced by a host of factors. In their meta-analysis, however, Abrami *et al.* (2015: 288–295) reported that the duration of the instruction or intervention did not significantly affect critical thinking scores.

Although the literature is not entirely conclusive as to the exact influence of instructional factors on critical thinking development, these factors have to be considered when critical thinking is developed in auditing students through technology-based educational interventions. Consideration must be given to:

- Critical thinking instructional approach, namely:
    - General or stand-alone approach;
    - Infusion or embedded approach;
    - Immersion approach; or
    - Mixed approach;
- Active learning strategies that develop critical thinking, namely:
    - Case studies;
    - PBL;
    - Simulations;
    - Questioning techniques (including Socratic questioning);
    - Collaboration and asynchronous online discussions;
    - Concept mapping;

- o Written assignments;
- o Reflective writing, logs and journals; and
- o Modelling.

## 3.6 CONCLUSION

The objective of Chapter 3 was to obtain a clearer understanding of factors that may influence students' critical thinking. This provided insight into key constructs, concepts, assumptions, beliefs and theories on factors that may influence critical thinking and its development. It also highlighted possible relationships and influences between these concepts. These relationships are further discussed in Chapter 5 where the preliminary framework is presented.

Chapter 3 also pointed out certain gaps in the existing literature that signalled the need for a working theory. It was evident that the literature was not always consistent on exactly which factors influence critical thinking or what their exact influence was. The literature did, however, show that these factors were mainly student-related, educator-related or instructional. Although the literature disagreed as to the significance of each of these factors, the review sensitised me to aspects which need to be considered in the preliminary framework. Furthermore, I was also unable to identify a comprehensive framework which set out each of these factors. This highlighted a gap in the literature which pointed to the need for a comprehensive framework that would include factors that may influence critical thinking.

Chapter 4 examines how critical thinking is most effectively developed, with a particular focus on the teaching strategies and technology-based educational interventions. The chapter also reviews learning theories that guide the formulation of teaching strategies for critical thinking development.

# CHAPTER 4
# CRITICAL THINKING DEVELOPMENT THROUGH TEACHING STRATEGIES AND TECHNOLOGY-BASED EDUCATIONAL INTERVENTIONS

## 4.1 INTRODUCTION

Chapter 1 provided background information on the importance of developing critical thinking in auditing students. It was noted in section 1.1 that the WEF believes that technology-based educational innovations can provide effective platforms for developing the much needed 21st century skills. More research is, however, needed to identify the most effective interventions to develop these skills, which include critical thinking. Educational technologies are also most effective when they are aligned with appropriate teaching strategies (World Economic Forum 2015: 1–8).

The ideal teaching strategies to develop critical thinking in students, however, remain elusive (Choi et al. 2014: 53) and there seems to be disagreement on how exactly critical thinking should be developed (Mojica 2010: 21–22). As a result, educators remain largely unsure whether their educational practices are effective in developing critical thinking (Bensley & Spero 2014: 55). More research therefore needs to be done on the effectiveness of critical thinking teaching strategies (Carter et al. 2016: 209).

Ten Dam and Volman (2004: 370) assert that the promotion of active learning, a problem-based curriculum, interaction between students and the use of real-world problems are among the characteristics of instruction that are believed to develop critical thinking in students. Concerns have been raised regarding the lack of active learning strategies, cooperative learning environments and the use of real-world examples in accounting education (Massey, Poli & Proctor 2002: 1). For this reason, the Accounting Education Change Commission (AECC) and the American Institute of Certified Public Accountants (AICPA) have been encouraging educators in accounting education to incorporate active learning strategies into their courses and to integrate the use of technology to facilitate this (Fratto 2011: 13).

Based on this, the objective of Chapter 4 is to provide an understanding of how critical thinking is most effectively developed, with a particular focus on the teaching strategies and technology-based educational interventions that facilitate this development. This is to address the secondary research objective A3 and secondary research question B3.

| | |
|---|---|
| **Secondary research objective A3** | To obtain an understanding of how critical thinking is most effectively developed through teaching strategies and technology-based educational interventions. |
| **Secondary research question B3** | How is critical thinking most effectively developed through teaching strategies and technology-based educational interventions? |

Chapter 4 therefore provides insights into several key constructs, concepts, assumptions, beliefs and theories related to teaching strategies and technology-based educational interventions, deemed to be most effective in critical thinking development. The chapter also examines possible relationships between these concepts. As with Chapters 2 and 3, the insights provided in this chapter provide the theoretical framework which will serve as the foundation for the preliminary framework presented in Chapter 5. Figure 10 provides an overview of the layout of Chapter 4.

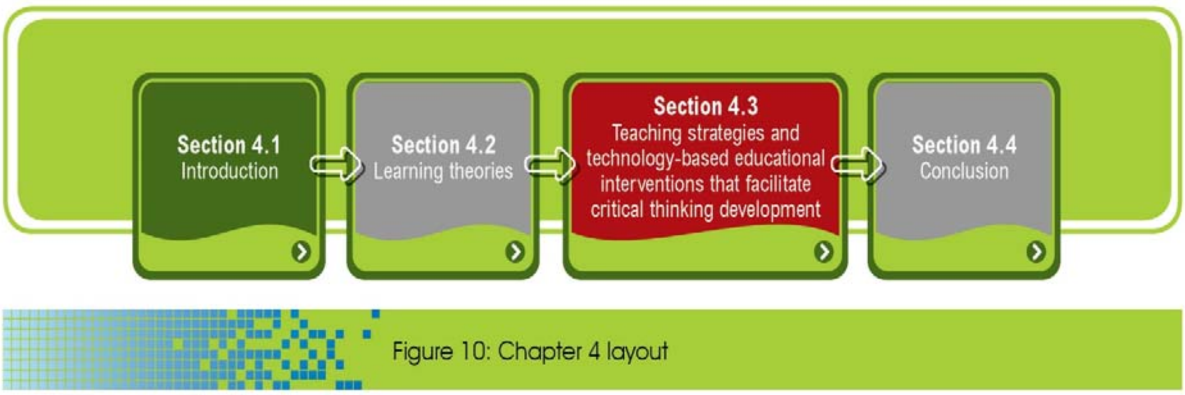


**Figure 10: Chapter 4 layout**
**Source:** Author

Section 4.2 reviews learning theories and their impact on teaching strategies and technology-based educational interventions that facilitate critical thinking development. The learning theories that educators adopt, even unconsciously, lay the foundation for how teaching strategies are designed and implemented (Harasim 2012: 4–8). Learning theories are strongly associated with specific educational practices, teaching strategies and technologies suited to them (Harasim 2012: 4–29). Proven and sound learning theories should thus form the basis of the design of educational interventions (Alessi & Trollip 2001: 41). The educator should therefore have a proper understanding of learning theories to select the most suitable teaching strategies and technologies (Mohamed 2004: 6).

## 4.2 LEARNING THEORIES

Learning theories define how learning occurs and how knowledge is acquired (Duke, Harper & Johnston 2013: 5). How individuals learn, however, is considered a complex matter. As researchers focus on different aspects of learning, different learning theories have emerged (Bransford et al. 2005: 2–3). Behaviourism, cognitivism and constructivism are seen as established learning theories (Harasim 2012: 9; McHaney 2011: 165). An overview of each of these theories is provided in sections 4.2.1 to 4.2.3.

### 4.2.1 Behaviourism

During the middle of the 20th century, principles of behaviourism dominated learning. Pavlov’s work on classical conditioning and stimuli-response was central during this period, as was the work of Thorndike and Skinner (McHaney 2011: 165; Alessi & Trollip 2001: 16). Behaviourism is focused on changes in observable human behaviour as a result of events in the environment rather than human thoughts, beliefs or emotions. It is concerned with shaping a student's behaviour. Behaviourist learning theories highlight that the mind is seen as a ‘black box’ and behavioural changes in students occur as a result of a response to environmental stimuli that can be measured quantitatively. The thought process taking place in the mind is largely ignored (Alzaghoul 2012: 27–28; Mohamed 2004: 8).

### 4.2.2 Cognitivism

As a result of the limitations of behaviourism, principles of cognitive psychology started to expand behaviourism during the 1970s (Alessi & Trollip 2001: 16). In general, cognitivism asserts that a complete explanation of human learning also involves consideration of non-observable cognitive constructs which include memory, attitude, thinking, reflection, metacognition and motivation (Alzaghoul 2012: 28; Mohamed 2004: 7–8). Cognitivists are interested in understanding what is in the ‘black box’ of the mind and how an individual makes sense of the world (Harasim 2012: 11–12). Cognitivism is aimed at the development of higher order learning. Students are encouraged to develop cognitive skills such as application, synthesis and evaluation. These cognitive skills relate to the main levels of learning in the cognitive domain as described in Bloom’s taxonomy, which is widely used to classify types of educational objectives and activities (Ssemugabi 2006: 19–22). Chapter 2 (section 2.2), however, stressed that Bloom’s taxomony does not provide adequate guidance for how critical thinking should be developed.

### 4.2.3 Constructivism

During the 1980s, constructivism started influencing education and instructional design (Alessi & Trollip 2001: 16–17). It can be traced back to the work of Piaget and Vygotsky (Harasim 2012: 12). Constructivism is considered the dominant learning theory of the last decade (Karagiorgi & Symeou 2005: 17). Examples of the constructivist learning can be found in, among others, active learning, experiential learning, self-directed learning and reflective practices. One of the foundations of constructivism is learning through experience (McHaney 2011: 184; Mödritscher 2006: 8). Constructivism is defined as a process of active construction of new knowledge (Harasim 2012: 12). The main idea behind constructivism is that an individual constructs his or her own idea of reality, based on previous experience and then applies it to the real world. How an individual interprets the world is thus central to this learning theory. Learning is considered to be a journey and not an outcome (Alzaghoul 2012: 28–29; Mohamed 2004: 18–22; Alessi & Trollip 2001: 17).

Van Erp (2008: 22) emphasises that the literature generally indicates that a constructivist environment is the most effective for critical thinking development. Lai (2011: 2) also asserts that educators are encouraged to use teaching strategies grounded in constructivism when they want to develop critical thinking in students. Constructivism is thus considered ideal for creating an active learning evironment for the development of critical thinking, as:

- One of the main aims of constructivism is the development of critical thinking through experiences (Kwan & Wong 2014: 192). Constructivism focuses on active learning (Alessi & Trollip 2001: 32). This includes application in practical scenarios, personal interpretation of content and group discussion (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21);
- Constructivist learning environments support the construction of knowledge by the student (Alessi & Trollip 2001: 16–17). The instructor merely provides guidance (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21). Constructivist educators take on the role of facilitators. They do not impose their ideas on students but rather facilitate the exploration of information by students (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21).
- Teaching strategies for this learning theory are interactive and student-centred (McHaney 2011: 183). Constructivist educators should develop interactive learning activities to promote higher order thinking (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21). Constructivists believe that learning is better supported through interactive learning environments such as discussion forums, podcasts, wikis, blogs, games, simulations, virtual worlds and virtual learning environments (VLEs) as they believe that these technologies facilitate the exploration of information by students and allow them to apply their own individual learning styles (McHaney 2011: 182–184);
- It uses cooperative or collaborative learning activities (Alessi & Trollip 2001: 32). Collaboration with other students provides real-life experiences and improvement of metacognitive skills. Learning styles and student expertise should be taken into account (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21);
- It uses purposeful or authentic learning activities that are relevant to the student (Alessi & Trollip 2001: 32). Students take ownership of a problem when the

situation is authentic. Instruction should be designed to recreate and simulate real-life situations and problems (Karagiorgi & Symeou 2005: 19–21);

- It supports student reflection (Alessi & Trollip 2001: 32). Students should be provided with sufficient time as well as opportunity to reflect on content. This can be facilitated through embedded questions (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21).

#### 4.2.4 Conclusion on learning theories

From the discussion in section 4.2.3, it would seem that principles of constructivism are ideal for critical thinking development. Constructivism:

- Promotes active learning;
- Uses authentic learning through real-world simulated situations and problems;
- Encourages cooperative or collaborative learning;
- Facilitates learning through experience;
- Is characterised by a student-centred approach; and
- Is characterised by students constructing their own ideas of reality or knowledge based on previous experiences.

One of the key features of constructivism is the promotion of active learning. Constructivism also supports authentic learning, which is ideal for critical thinking development. Constructivism aims to develop critical thinking through experience and constructivist teaching strategies are in essence both interactive and student-centred.

Section 4.2.3 indicated that constructivist learning environments are ideal for interactive technology-based educational interventions such as discussion forums, podcasts, wikis, blogs, games, simulations, virtual worlds and VLEs. Section 4.3 provides an overview of some of these teaching strategies and technology-based educational interventions that facilitate the development of critical thinking in students as many of these incorporate principles of constructivism.

## 4.3 TEACHING STRATEGIES AND TECHNOLOGY-BASED EDUCATIONAL INTERVENTIONS THAT FACILITATE CRITICAL THINKING DEVELOPMENT

As mentioned in the introduction to this chapter, certain characteristics of instruction are believed to develop critical thinking in students. Most of these characteristics align with principles of constructivism as mentioned in section 4.2.3. The characteristics of instruction that develop critical thinking are those which (Ten Dam & Volman 2004: 370):

- Promote active learning;
- Follow a problem-based curriculum;
- Utilise real-world problems; and
- Stimulate interaction between students.

Ten Dam and Volman (2004: 359) as well as Rudman and Terblanche (2012: 57) assert that to develop critical thinking in students, students should actively participate in the learning process. For this, an active learning environment with active learning strategies is essential. Chapter 3 (section 3.5.2) provided more detail on active learning and active learning strategies as factors that may influence students' critical thinking.

Ten Dam and Volman (2004: 370) note that problems or scenarios presented to students should be purposely ill-defined, disorganised and complex to develop their critical thinking. Most researchers believe that this should take place within domain-specific subject matter. Ten Dam and Volman (2004: 359) as well as Rudman and Terblanche (2012: 57), mention that content should be applied using real-world settings to develop critical thinking in students. Using real-world contexts is a key element in 21$^{st}$ century education. For critical thinking to be transferable to other settings, including workplace environments, real-world activities should be used to develop critical thinking (Halpern 1998: 451). When critical thinking activities in the educational setting are based on real-world situtations, the chances of the student using critical thinking skills beyond the educational environment increases (Jordan D'Ambrisi 2011: 55). Lai (2011: 2) supports this view and asserts that critical thinking educational assessments should be based on real-world, authentic contexts with ill-structured problems, as this forces students to move beyond the mere recall of technical knowledge.

Chapter 3 (section 3.5.2) indicated that case studies, PBL and simulations are among the active learning strategies most commonly used to develop critical thinking. The majority of these strategies embody most, if not all, the characteristics of instruction that develop critical thinking as mentioned by Ten Dam and Volman (2004: 370) and are rooted in the principles of constructivism.

Sections 4.3.1 to 4.3.3 provide an overview of case studies, PBL and simulations as active learning strategies. These examine the advantages, disadvantages, as well as the design features of these active learning strategies. Section 4.3.4 furthermore provides a brief overview of other teaching strategies and technologies that develop critical thinking.

### 4.3.1 Case studies

Case studies are also referred to as cases, discussion methods, case methods, case study methods, scenario-based learning or simulated cases. They refer to a description of a problem, issue or situation that needs analysis (West, Usher & Delaney 2012: 577; Popil 2011: 205; McDade 1995: 9). Case studies are often used by educators to demonstrate complex real-life problems. The learning outcomes are not as much focused on the transfer of facts or content, but on the critical thinking process itself. With a long history of success in the fields of business, accounting, law, social sciences, nursing and health care, to only name a few (Popil 2011: 204–207; Grupe & Jay 2000: 123–124; Dowd & Davidhizar 1999: 1), case studies can lay the foundation for other teaching strategies which include simulations, role-plays and written assignments (Popil 2011: 205; McDade 1995: 9).

Case studies present students with the opportunity to think about certain problems or experiences before encountering possible similar situations in the real world. Students learn from experiences (real or simulated) by applying theoretical concepts to practical problems. The problems presented in case studies could be solved in multiple ways as there are no simple or explicit answers. In this way, students' critical thinking is developed (Dowd & Davidhizar 1999: 1). In Chapter 3 (section 3.5.2) various researchers also found a significant correlation between the use of case studies and higher critical thinking scores (Kaddoura 2011: 1–18; Burbach et al. 2004: 482–492; Kunselman & Johnson 2004: 87–

92). Case study methodology is rooted in constructivism and is believed to facilitate the development of critical thinking in students, as it:

- Promotes active learning (Kaddoura 2011: 1; Popil 2011: 206; Mayo 2004: 141).
- Follows a problem-based learning approach (Mayo 2004: 141);
- Simulates real-world problems or situations (Weil, Oyelere & Rainsbury 2004: 139) in a non-threatening environment (Popil 2011: 205–206; McDade 1995: 9–10);
- Is often analysed during class discussions, but can also lay the foundation for other teaching strategies which include simulations, role-plays and written assignments (Popil 2011: 205; McDade 1995: 9)
- Enables students to learn from experiences (real or simulated) by applying theoretical concepts to practical problems through critical thinking (Dowd & Davidhizar 1999: 1);
- Allows the student to take on the role of knowledge creator while the educator takes on the role of facilitator (Mayo 2004: 141); and
- Provides student-centred instruction (Popil 2011: 206).

Brooke (2006: 142) asserts that as universities are faced with technological innovations, case studies can be altered to suit the e-learning environment and virtual classrooms to develop critical thinking. Case studies in an e-learning environment promote student-centred learning where the students have to take responsibility for their own learning while the educator can focus on developing their critical thinking. Unfolding case studies are considered to be an innovative problem-based e-learning strategy for the development of critical thinking. The unfolding case study is written as a story, consisting of several problems evolving over time. It requires students to be actively involved in solving these problems through the application of their knowledge and critical thinking. They differ from traditional case studies insofar as students are required to make interpretations and take decisions prior to receiving all the information. Problems could have more than one correct answer. Unfolding case studies have been used effectively in face-to-face settings, simulations as well as e-learning settings (Yousey 2013: 22).

From an accounting education perspective, Weil *et al.* (2004: 139) note that the use of case studies as a teaching strategy has increased substantially. Case studies have been added to the examinations of many accountancy professional bodies (Hassall & Milne 2004: 135). This is indeed the format used by SAICA in its professional exams as well the SAICA-accredited programme providers in their academic programmes in South Africa. Both the Initial Test of Competence (ITC) and the Assessment of Professional Competence (APC) are in the form of simulated, multi-disciplinary case studies (South African Institute of Chartered Accountants 2014a: 3–26, b: 1).

Table 14 shows the advantages and disadvantages of case studies as a teaching strategy. It also indicates certain design features of case studies.

## Table 14: Overview of case studies

| Advantages | Disadvantages | Design features of case studies |
|---|---|---|
| • Develop critical thinking (De Villiers 2015: 86; Knyvienė 2014: 161)<br>• Improve problem identification and problem-solving skills (De Villiers 2015: 86; Knyvienė 2014: 158)<br>• Improve communication skills (De Villiers 2015: 86; Knyvienė 2014: 158)<br>• Increase analytical skills (De Villiers 2015: 86; Knyvienė 2014: 158)<br>• Increase understanding of complex issues (De Villiers 2015: 86; Grupe & Jay 2000: 123)<br>• Increase knowledge retention (De Villiers 2015: 86)<br>• Improve skills to relate theory to practice (Knyvienė 2014: 161–162)<br>• Improve judgement skills (Knyvienė 2014: 161–162)<br>• Enhance understanding of what was studied (Knyvienė 2014: 161–162)<br>• Improve insight into real-world business situations (Grupe & Jay 2000: 123).<br>• Improve ability to deal with situations of uncertainty or ambiguity (Knyvienė 2014: 161–162)<br>• Improve ability to make decisions with incomplete information (Knyvienė 2014: 161–162) | • Can be time-consuming to develop (De Villiers 2015: 86)<br>• Frustrating for less-prepared students (De Villiers 2015: 86)<br>• Overwhelming to some students (De Villiers 2015: 86)<br>• Frustrating to students who prefer passive learning strategies (De Villiers 2015: 86)<br>• Require knowledge about the topic that is applied in the case (De Villiers 2015: 86)<br>• Can include author biases. Author can try to guide the students' thinking into believing what the author thinks the 'right' answer is (Grupe & Jay 2000: 123)<br>• Can be limited in scope as they often are merely summaries of background information, problems or situations (Grupe & Jay 2000: 124)<br>• Students often evaluate a case study from a neutral observer perspective as opposed to viewing themselves as a participant in the study. They could struggle to make relevant connections (Grupe & Jay 2000: 124)<br>• Proper feedback is not always provided to students (Grupe & Jay 2000: 124) | Trujillo-Jenks (2014: 1) recommends a three-part case study design when utilising case studies in the development of students' critical thinking:<br>• A scenario-based story with specific focus on a theoretical real-life problem(s). This can be in the form of an intricate scenario with several problems, a short one- or two- sentence scenario or even a video/news story<br>• Literature that supports the main theme of the story. This can be in the form of text or other supplemental material<br>• Guiding questions that assist the student in applying critical thinking skills. These questions should guide the students to evaluate different outcomes of the scenario and to prepare for facing these problems in the real-world<br>Kim *et al*. (2006: 867–876) believe that the correct design of the structure and format of case studies is crucial, especially in e-learning environments where learning takes place without the direct involvement of the educator. These researchers developed a conceptual framework, from various disciplines and settings, with guidelines for case study development. Case studies should all have five core attributes. They should be:<br>• Relevant: Case studies should target the appropriate level of students, match the content with instructional goals as well as objectives and make the setting of the narrative explicit<br>• Realistic: Case studies should approximate real-world settings. Material should be authentic, they should include both relevant information as well unnecessary information to simulate the real-world and there should be gradual disclosure of content<br>• Engaging: Case studies should include rich as well as adequate content that allows several levels of analysis and interpretation by the student. They should present various perspectives. They should provide opportunities for students to conclude on the outcome(s) of the case study<br>• Challenging: Case studies can be made more difficult by increasing the difficulty of content. Case studies that are considered more unusual can be included. The structure of case studies can be changed by introducing information in different ways. Multiple case studies in a series can be considered<br>• Instructional: Case studies should assist in building up students' prior knowledge. They can be utilised to assess students' knowledge and skills as well as providing feedback to students. They offer the opportunity for embedding several different teaching strategies to support student learning |

| Advantages | Disadvantages | Design features of case studies |
|---|---|---|
| • Enhance ability to identify relevant data in unstructured problems (Knyvienė 2014: 161–162)<br>• Improve ability to integrate knowledge from other subjects (Knyvienė 2014: 161–162)<br>• Improve ability to think conceptually and consider multiple perspectives (Knyvienė 2014: 161–162)<br>• Improve ability to distinguish facts and opinions (Knyvienė 2014: 161–162)<br>• Increase awareness of multiple solutions (Knyvienė 2014: 161–162) | | |

**Source:** Author

From the discussion in section 4.3.1, it would seem that case studies are ideal for critical thinking development. However, another active learning strategy that can be used to develop critical thinking is PBL. The main difference between case studies and PBL is addressed by Milne and McConnell (2001: 66–67). With case studies, the problem is aimed at students applying their existing knowledge to approach the problem. The problem in PBL is aimed at the acquisition of new knowledge. Students should thus not have sufficient prior knowledge to be able to deal with the problem immediately. The difference is thus not as much in the materials used, but more in the aims of the two approaches. PBL is discussed further in section 4.3.2

### 4.3.2 Problem-based learning (PBL)

PBL has been used effectively in various disciplines such as medicine, nursing, law, engineering, social work, management, science, business and economics (Heagy & Lehmann 2015: 221; Stanley & Marsden 2012: 267; Milne & McConnell 2001: 62–63). PBL should preferably be used with other teaching strategies to provide a holistic approach (Şendağ & Odabaşi 2009: 132).

PBL is an active learning strategy, effective in developing critical thinking (Choi et al. 2014: 52–53). It is considered the ideal teaching strategy for 21st century education as it develops critical thinking, communication, collaboration and creativity (Scott 2015: 5). In Chapter 3 (section 3.5.2), numerous researchers found a significant correlation between the use of PBL and higher critical thinking scores (Carter et al. 2016: 209–218; Kong et al. 2014: 458–469; Kowalczyk 2011: 120–132; Şendağ & Odabaşi 2009: 132–141; Ozturk et al. 2008: 627–632; Yuan, Kunaviktikul, et al. 2008: 70–76; Tiwari et al. 2006: 547–554). PBL is rooted in the constructivist learning theory (Martins, Dos Santos & Frezatti 2015: 418; Tan 2006: 7) and is believed to develop critical thinking, as it:

- Promotes active learning (Şendağ & Odabaşi 2009: 133; Tan 2006: 7). It encourages the student to be active in the teaching and learning process (Martins et al. 2015: 418);
- Uses unstructured (Tan 2006: 7), contextualised, real-world, ill-structured problems (Şendağ & Odabaşi 2009: 133; An 2006: 5);

- Uses real-life problems which are contextualised for the development of critical thinking and problems solving skills (Martins et al. 2015: 418). Real-world problems are the starting point of PBL (Martins et al. 2015: 418; Tan 2006: 7);
- Stimulates work in cooperative groups (Martins et al. 2015: 418; An 2006: 7). Students work in small groups, communicate with one another in the group and then present a solution to the problem as a group. Critical thinking is thus developed through group discussions (Yuan, Williams, et al. 2008: 658);
- Encourages students to connect prior knowledge, prior experience, theory, new ideas, other perspectives and real-world contexts (Tan 2006: 11). Problem-solving abilities are developed through experience (Tan 2006: 2). PBL attempts to approximate the theory to practice and allow students to learn how to learn (Martins et al. 2015: 418);
- Encourages students to construct their own knowledge as opposed to knowledge being conveyed by the educator (Martins et al. 2015: 418; Stanley & Marsden 2012: 269); and
- Is highly structured and student-centred (Martins et al. 2015: 418; Lin, Lu, Chung & Yang 2010: 374; An 2006: 6; Tan 2006: 7).

PBL is also supported by ICTs. An (2006: 13–15) states that the internet facilitates the implementation of PBL in e-learning environments with distributed problem-based learning. An e-learning environment is favourable for PBL as it provides students with more time to analyse problems and think about their responses. Şendağ and Odabaşı (2009: 132–141) also found that principles of constructivism and PBL in e-learning environments can effectively be implemented in distance education to develop critical thinking in students. They studied the effects of an e-learning PBL course on content knowledge acquisition and critical thinking development. MOODLE, a learning management system freely accessible on the internet, was utilised to implement the e-learning activities. The researchers conclude that PBL in e-learning environments can effectively be implemented in distance education to improve critical thinking in students.

The literature shows limited use of PBL in accounting education (Heagy & Lehmann 2015: 228; Stanley & Marsden 2012: 270). A possible issue that could arise when implementing

PBL into accounting education is the large numbers of students, as the ideal group size is considered six to twelve students (Milne & McConnell 2001: 61–82). Stanley and Marsden (2012: 267–289), however, examined the effects of PBL implemented in a final-year accountancy course. Principles of PBL were utilised to assist students in solving accounting problems, as opposed to providing case studies, as is generally done in accounting education. Results indicate that the use of PBL can be successfully incorporated into accounting education. Martins *et al.* (2015: 417–438) examined the effect of PBL on management accounting students. Findings indicate that PBL is suitable for millennial students as it incorporates collaboration and communication in an interactive environment.

Table 15 provides an overview of the advantages and disadvantages of the use of PBL as a teaching strategy. It also provides certain design features of PBL.

**Table 15: Overview of PBL**

| Advantages | Disadvantages | Design features of PBL |
|---|---|---|
| • PBL can offer stimulating experiences for students (Milne & McConnell 2001: 73)<br>• Students take responsibility for developing their own knowledge (Milne & McConnell 2001: 63)<br>• PBL has a positive influence on students' higher order thinking skills which include creative thinking, logical thinking, problem-solving, critical thinking and decision-making (Şendağ & Odabaşi 2009: 133)<br>• Self-directed learning skills are developed. Students are taught to be life-long learners where they can solve complex problems in their personal and professional life (An 2006: 11)<br>• PBL develops content knowledge (An 2006: 11) | • The development and implementation of PBL can be time-consuming (Stanley & Marsden 2012: 286)<br>• PBL could make students feel threatened or insecure without adequate encouragement and support (Milne & McConnell 2001: 73)<br>• Too much interference from educators can negatively impact on students' self-directed learning (Milne & McConnell 2001: 73)<br>• Students might be used to traditional lectures and might thus initially feel uncomfortable and frustrated with the change to PBL (Milne & McConnell 2001: 73)<br>• Educators might also initially feel uncomfortable relinquishing some control of the learning process to students (Milne & McConnell 2001: 73)<br>• Educators might not fully understand what the PBL strategy entails. Training of educators is needed in this regard. (Milne & McConnell 2001: 73)<br>• It is also unsure whether the case study materials currently available to accounting educators are suitable for PBL (Milne & McConnell 2001: 75)<br>• Different student learning mean that some students may find it difficult to adapt to the PBL environment or | Students should preferably be divided into smaller groups of approximately six to twelve students. These smaller groups meet to discuss the problem. Tutors or educators facilitate the small group sessions. These sessions could generally last two to three hours. Students then part to do self-directed study (Milne & McConnell 2001: 63).<br>An (2006: 77–88) developed guidelines for designing and implementing collaborative PBL in online environments. The main steps include:<br>• Decide when to use PBL;<br>• Select or create a problem;<br>• Form groups;<br>• Build readiness;<br>• Facilitate the problem-solving process; and<br>• Facilitate learning after problem-solving.<br>Tan (2006: 7–8) also highlights certain characteristics of PBL which are necessary for its successful implementation in accounting education according to Stanley and Marsden (2012: 270). These characteristics include:<br>• The use of a real-life problem is the starting point of learning where multiple perspectives are required;<br>• The problem challenges students' current knowledge, attitudes and competencies, thus calling for new areas of learning;<br>• The problem is unstructured and is meant to be as authentic as possible;<br>• The problem calls for multiple perspectives with the use of cross-disciplinary knowledge;<br>• Self-directed learning is the primary focus where students assume primary responsibility for the acquisition of information and knowledge;<br>• Use of a variety of knowledge sources and the use as well as evaluation of information resources;<br>• Learning is collaborative, communicative and cooperative, with students working in small groups with a high level of interaction for peer learning, peer teaching and group presentations;<br>• Development of inquiry and problem-solving skills is as important as content knowledge for the solution of a problem;<br>• Finalisation of the process includes synthesis and integration of learning; and |

| | | |
|---|---|---|
| | working within a group (Martins et al. 2015: 418) | • Concludes with an evaluation and review of the student's experience and the learning processes.<br><br>PBL consists of five steps (Lin et al. 2010: 375):<br>1. Analysis of problems;<br>2. Establishment of learning objectives;<br>3. Collection of information;<br>4. Summarising; and<br>5. Reflection.<br><br>Stanley and Marsden (2012: 273) developed their own steps for accounting education which they refer to as the FIRDE problem-solving methodology which can be applied to PBL. Their steps include:<br>• **F**acts: Defining the problem - gather the facts and ask relevant probing questions;<br>• **I**deas: Generate ideas and consider alternatives;<br>• **R**esearch: Research each issue pertaining to the problem;<br>• **D**ecide: Collaborate, share ideas and make a decision; and<br>• **E**xecute: Communicate the decision to the client and/or execute the chosen option. |

**Source:** Author

Irrespective of the possible disadvantages of PBL as shown in Table 15, the significant advantages of PBL and the potential it has in developing critical thinking clearly outweigh the disadvantages of this teaching strategy. The literature on the use of PBL in accounting education is, however, limited. Another teaching strategy that has great potential in developing critical thinking is simulations. Simulations are discussed in section 4.3.3.

### 4.3.3 Simulations

Simulations are seen as artificial environments that are designed to manage a person's experience of reality (Bell, Kanar & Kozlowski 2008: 5). They are considered to be realistic reproductions of real-life scenarios (Sauve, Renaud, Kaufman & Marquis 2007: 251; Medley & Horne 2005: 31). These simulations reproduce real-life situations where students can experiment with aspects of reality in a controlled environment (Sauve et al. 2007: 251). Simulations have been utilised in the medical and nursing fields for educational purposes for years and include simulated case studies, simulation games, computer-assisted instruction, standardised patients, virtual reality (virtual patients) as well as human patient simulators (high-fidelity manikins) (Allaire 2015: 1083; Nehring & Lashley 2009: 528). Harder (2010: 24) and Cant and Cooper (2010: 4) explain that simulation techniques used in teaching and learning range from low fidelity to high fidelity. This depends on the degree to which the simulation matches reality.

Ranchhod *et al.* (2014: 76) note that 'simulations' and 'educational / simulation games' are regularly used as interchangeable terms although they both have certain distinguishing features that impact their pedagogical use. Games that enable students to apply prior knowledge to different situations to develop deeper levels of learning are known as simulation games. A simulation game has the characteristics of both a simulation and a game and seeks to replicate a real-world situation (Peddle 2011: 647–649). These simulation games can be simple class activities where students complete tasks in teams. They can also be more complex, virtual, multi-player, two- and three-dimensional (3D) worlds. Simulation games can develop students' content knowledge, non-technical skills and certain affective domains.

Virtual reality is also considered a low to medium fidelity simulation that conceptually overlaps with the term ‘simulation’. According to Van Wyk and De Villiers (2008: 276), simulated real-world environments can be provided through virtual reality training tools. This can be done without the associated risks. Virtual reality systems are considered real-time computer simulations of the real world. They include visual realism, object behaviour and user interaction. Computer-generated, 3D, artificial worlds are often referred to as virtual environments (VE), (Van Wyk & De Villiers 2009: 53). Three types of virtual reality systems exist according to these researchers, namely, non-immersive or desktop, semi-immersive and immersive. Immersion is the impression that the user gets of truly being in the virtual world (Van Wyk & De Villiers 2008: 278).

Simulations-based training has been widely used in medical education, with a large body of research in support of this teaching strategy (Steenkamp & Von Wielligh 2011: 11). Simulations create a platform for the development of critical thinking, problem-solving and decision-making abilities in a safe, experiential learning environment (Weatherspoon et al. 2015: 127; Powell 2012: 22). Salleh *et al.* (2012: 373) also assert that many studies have proven the effectiveness of web-based simulations in the development of critical thinking. In Chapter 3 (section 3.5.2) it was noted that various researchers indeed found a significant correlation between the use of simulations as an active learning strategy and higher critical thinking scores (Cone et al. 2016: 5; Lovelace et al. 2016: 100–121; Shin et al. 2015: 537–542; Weatherspoon et al. 2015: 126–133; Goodstone et al. 2013: 159–162; Salleh et al. 2012: 372–381; Cant & Cooper 2010: 3–15). Simulations are rooted in the constructivist learning theory (McHaney 2011: 184) and facilitate critical thinking as they:

- Are based on adult learning principles and thus support an active and engaging learning environment (Peddle 2011: 648). Simulations facilitate active learning (Ranchhod et al. 2014: 75);
- Facilitate problem-based learning (Ranchhod et al. 2014: 75);
- Offer realistic reproductions of real-life scenarios (Sauve et al. 2007: 251; Medley & Horne 2005: 31) and aim to replicate a real-world situation (Peddle 2011: 647).

Simulated real-world working conditions can be provided by virtual reality-based training tools (Van Wyk & De Villiers 2008: 276);

- Provide the opportunity for cooperative learning to facilitate effective learning (Peddle 2011: 648);
- Facilitate experiential learning (Ranchhod et al. 2014: 75; Peddle 2011: 648). Simulations create realistic, experiential learning environments (Bell et al. 2008: 2);
- Are rooted in the constructivist learning theory which is a key driver in simulation games where the student creates his or her own knowledge through interaction with the environment (Peddle 2011: 648);
- Support learning that is student-centred (Ranchhod et al. 2014: 75; Peddle 2011: 648).

Rush *et al.* (2008: 501–508) found that simulations have the ability to overcome the geographical challenges associated with learning. These researchers further state that although e-learning might pose some practical challenges with regards to the use of simulations, lower fidelity simulations can develop critical thinking in students in a way not possible with other teaching strategies. However, when the simulation does not approximate reality according to the students' own reality, the learning and critical thinking development may be compromised. Immediate feedback should be incorporated into the simulation to increase students' sense of active participation and interaction. This can be facilitated in an e-learning environment through interactive questions through online discussions. Lovelace *et al.* (2016: 101) define web-based simulations as *"internet-based, synthetic learning environments where decisions are made within a complex as well as dynamic setting and where students experience real-time information and feedback"*. Examples of computer-based simulations are shown in Figure 11.


**Figure 11: Computer-based simulations**
**Source:** (ForgeFX Simulations 2018: 1; Laerdal 2018: 1)

Simulations provide students with the opportunity to develop the higher order thinking required by the accountancy profession. Steenkamp and Von Wielligh (2011: 11), however, assert that there are a limited number of studies on audit simulations both locally and internationally. Arens, May and Dominiak (1970: 573–578) developed a simulated case study for audit education with narrative descriptions and simulated documentation. Although accounting records and source documents were produced by this computer simulation, it was restricted by the technology available at that particular time. Another audit simulation, Norwood Office Supplies Incorporated, uses Audit Command Language (ACL) audit software. The simulation focuses on risk assessment in the audit with technological adeptness as well as strategic and critical thinking development being the aims of the simulation. Overall, students gave positive feedback with regards to the simulation (Gelinas, Levy & Thibodeau 2001: 603–636).

A team-based simulation of an audit, that resembles all phases of a mock audit, was also developed by Massey, Poli and Proctor (2002: 1–37). The active and cooperative learning environment created by the simulation was well-received by students (Massey et al. 2002: 1–37). Springer and Borthick (2004: 277–303) developed a business simulation for an introductory accounting course. The students had to use their accounting knowledge and critical thinking skills to evaluate the explicit and implicit information in the simulation. Class discussions took place after the simulations were viewed online by students in groups of four or five. Steenkamp and Rudman (2007: 23–41) also developed an audit simulation. The aim of the simulation was to incorporate auditing content knowledge with IT skills and to expose auditing students to a real-life auditing environment. The majority of the students specified that they had learnt and remembered more from the simulation compared to any other teaching strategies that they have been exposed to previously.

Schatzel (2015a: 1) developed Real Audit, a multi-media, interactive financial auditing e-learning simulation game with a branching storyline. It has since been adopted by Certified Public Accountants (CPA) educators in over 19 states in the United States and Canada. Students are required to obtain audit evidence, collaborate with the fictitious audit client through the use of a multiple choice dialogue engine, apply appropriate audit procedures and make audit adjustments accordingly (Schatzel 2008: 3). Figure 12 shows images of the Real Audit simulation.

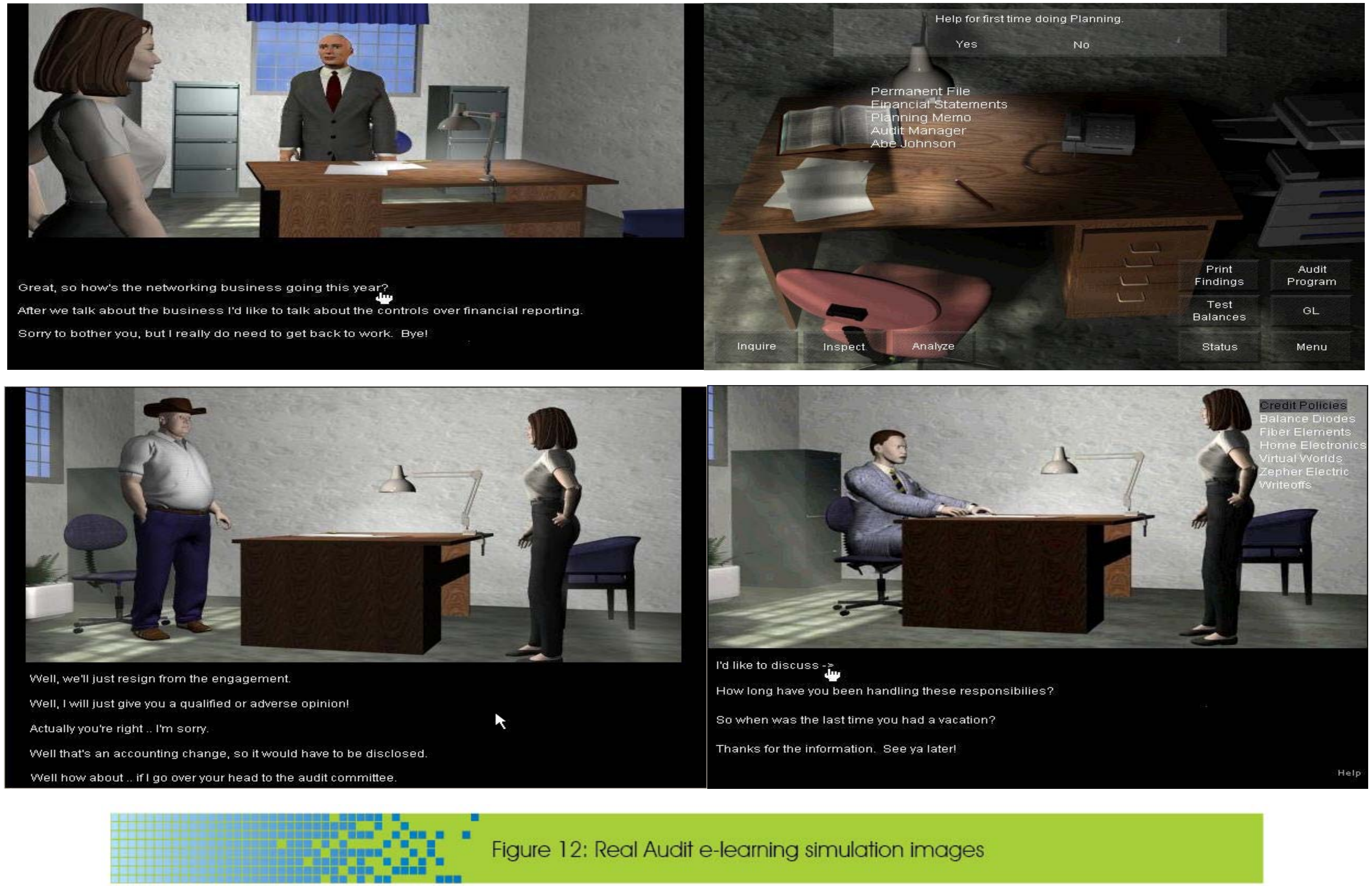


**Figure 12: Real Audit e-learning simulation images**
**Source:** (Schatzel 2015a: 1, b: 1)

An audit simulation was also developed by De Villiers (2015: 199) as an active learning strategy with various forms of visual aids (Prezi, flyers and banners), actual documents (for example, fictitious audit client invoices) and videos created in Go Animate. The simulation also included a case study element as it was based on a fictitious client. Cooperative learning techniques were utilised as auditing students had to work in teams. Both quantitative and qualitative results of the study indicated that the audit simulation had a positive effect on students' perceived competence levels as well as their pervasive skills that were tested in the study. The simulation had a greater impact on their understanding of auditing as opposed to only receiving lectures, and it actively involved students in the learning process (De Villiers 2015: 21). BEAN audit training is another digital e-learning simulated audit designed for students and audit trainees. This interactive e-learning tool is accessible via a modularised virtual desktop application that allows students to work through the modules at their own pace (W Technical Consulting 2016: 1).

Table 16 provides an overview of the advantages and disadvantages of the use of simulations as a teaching strategy. It also indicates certain design features of simulations, as evident from the literature.

## Table 16: Overview of simulations

| Advantages | Disadvantages | Design features of simulations |
|---|---|---|
| • Develop critical thinking (Weatherspoon et al. 2015: 127; Powell 2012: 22; Nehring & Lashley 2009: 536)<br>• The simulation game provides opportunity for immediate feedback to students as well as cooperative learning (Peddle 2011: 648–649)<br>• Develop content knowledge and communication skills (Nehring & Lashley 2009: 537)<br>• Teaching and learning can occur anywhere and anytime providing flexibility (Bell et al. 2008: 3)<br>• Students are immersed into an experience (Bell et al. 2008: 3)<br>• Simulations offer realistic experiences of tasks that are considered to be dangerous or happen infrequently in real life (Bell et al. 2008: 4)<br>• Could help to engage millennial students who grew up with rich and interactive learning environments (Bell et al. 2008: 4)<br>• Inspires the student to get involved in the | • The fixed costs relating to the development of a simulation are relatively high (Bell et al. 2008: 1430)<br>• Simulation games, especially virtual simulation games, can be very expensive and time-consuming to develop and implement. Costs and resources, which include trained simulation staff, simulation platforms and continuing support, have to be well budgeted for (Peddle 2011: 648–649)<br>• Individual assessment is sometimes also difficult with team-based simulation games (Peddle 2011: 648–649)<br>• Students with an assimilator learning style could find simulation games difficult to work with as they prefer passive lectures (Peddle 2011: 648–649)<br>• Some students might also not like the competitiveness of a simulation game and may feel embarrassed if they do not perform well in a group setting (Peddle 2011: 648–649)<br>• Time-consuming to develop (De Villiers 2015: 185; Zelin II 2010: 12) | The following are characteristics of simulations which should guide the design of the simulation:<br>• **Dynamic:** Simulations are dynamic as they can reproduce, to a certain extent, the behaviour of a real system through movement of its components in real-time. An effective simulation places a student in a realistic situation where he or she can act and make decisions to obtain real-time feedback from the simulation. Immediate feedback from others supports students in understanding problems from other individuals' standpoints (Sauve et al. 2007: 247–256; Goldenberg, Andrusyszyn & Iwasiw 2005: 310–314);<br>• **Simplified:** A simulation is a simplified version of reality but should still capture the essential characteristics of reality. In an educational simulation, the designer needs to capture these essential characteristics of reality and simplify other elements to achieve the desired learning objectives for which the simulation was intended. The simulation is thus a simplified mock-up of reality (Sauve et al. 2007: 247–256; Medley & Horne 2005: 31–34);<br>• **Realistic:** Despite being simplified, the simulation should realistically simulate a real-life scenario. This is especially true for educational simulations. The simpler a simulation, the less realistic it will be, which could distort reality (Sauve et al. 2007: 247–256; Medley & Horne 2005: 31–34).<br><br>Van Wyk (2015: 200–208) developed an evaluation framework for desktop virtual reality training applications. This evaluation framework can serve as a set of design guidelines to inform the design of virtual reality training systems or as an evaluation tool as it consists of criteria to assess the effectiveness of the design of such systems. This evaluation framework was developed for the mining industry but holds valuable guidelines that could be useful in this particular study. The guidelines are summarised below:<br>• **Category 1: Instructional design:**<br>o Clear goals, objectives or outcomes<br>o Instructional assessment<br>o Feedback to user responses<br>o Motivation and creativity<br>o Differences between individual users<br>o Reduction of extraneous processing in working memory<br>o Fostering of germane cognitive load (load devoted to the processing, construction and automation of mental schemas) |

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|---|---|---|
| learning process (De Villiers 2015: 185)<br>• Simulations provide opportunities for integration and application (De Villiers 2015: 185)<br>• Provides an element of reality (De Villiers 2015: 185)<br>• Decreases elements of slacking that are associated with traditional lectures (De Villiers 2015: 185)<br>• Soft skills can be developed through teamwork, collaboration and interpersonal social skills (De Villiers 2015: 185)<br>• Improves students' ability to recall content knowledge (De Villiers 2015: 185) | • Students are sometimes confused in terms of what is expected of them (De Villiers 2015: 185; Zelin II 2010: 12)<br>• Students can feel that the simulation is too difficult to understand or complete (Zelin II 2010: 12)<br>• Technical difficulties can frustrate students and facilitators (De Villiers 2015: 186)<br>• Lecturer feedback and facilitation is difficult when simulation is not in a classroom setting (De Villiers 2015: 186)<br>• The design of web-based simulations is particularly complex, time-consuming and expensive. They also need a high level of commitment from the developer or educator (Salleh et al. 2012: 377) | o Appropriate intrinsic cognitive load<br>• **Category 2: General usability heuristic or criterion:**<br>o Functionality<br>o User guidance<br>o Consistency<br>o Error correction<br>o System status<br>o Error prevention<br>o Aesthetics<br>o Interactivity<br>• **Category 3: Virtual reality system design**<br>o User control<br>o Multi-modal system output or feedback<br>o Presence<br>o Orientation<br>o Navigation<br>o Object interaction – selection and manipulation<br>o Fidelity<br>o Variety in user modes<br>• **Category 4: Context-specific criteria**<br>o Authentic tasks<br>o Appropriate reference materials<br>o Comprehensive scope<br>o Adaptive design<br>o Relevant subject matter<br>o Trainee preparedness<br>o Appropriate record keeping<br>o Understandable and meaningful symbolic representation<br><br>Lovelace *et al.* (2016: 104) also advise that the four instructional design features or considerations of computer-based simulations of Bell *et al.* (2008: 1424–1430) should be taken into account when web-based simulations are designed for critical thinking development in students. These researchers also applied these four features or considerations in their own study. These include:<br><br>• **Content:** This feature is concerned with the richness with which the simulation presents basic information. Text is the most basic form and is fairly low in information richness. Still images or graphics, video, sound and special effects could be added to content information to enhance the learning experience. Simulations generally utilise a selection of multi-media features through images and sound in a realistic context and can now offer video game quality graphics. This multi-media richness increases students' attention and interest in content as well as recall of knowledge. Cognitive skills are also improved; |

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| | | • **Immersion or fidelity:** This feature focuses on the sense of realism. Higher levels of immersion or fidelity offered by simulations provide students with the feeling of presence or being part of the environment. 3D simulations offer physical, high fidelity features through which the student is immersed in a realistic experience. Lovelace *et al.* (2016: 104) also note that being emotionally involved in a simulation experience has been shown to increase learning;<br>• **Interactivity or collaboration:** This feature is concerned with the degree and type of interaction or collaboration among the user, the system, educator and peer learning groups amongst others. Lovelace *et al.* (2016: 104) assert that critical thinking within a team has the potential to increase students' interest in the learning process and that millennials prefer fast-paced, interactive learning environments;<br>• **Communication:** This feature refers to factors influencing communication richness or bandwidth. Distributed learning systems such as web-based simulations often depend on asynchronous (temporally lagged) communication. Limited communication through audio and text is often required as face-to-face, dynamic interaction is not always possible. Simulations offer, over and above multiple choice options, natural language processing technology as well as voice recognition technology. Other features which increase communication richness are discussion boards and chatrooms that can be incorporated into simulation-based training to improve interactivity.<br><br>Salleh *et al.* (2012: 372–381) created a web-based simulation learning framework for the development of students' critical thinking. This framework integrates the elements of an iterative simulation as set out by Alessi and Trollip (2001: 48–85), principles of the social constructivist learning theory and the APA's elements of critical thinking (Facione 1990a: 1–19). |

**Source:** Author

According to De Villiers (2015: 186), the advantages of simulations clearly outweigh the disadvantages. From Table 16 it is evident that simulations create an ideal platform for the development of students' critical thinking. Section 4.3.4 provides an overview of other teaching strategies and technology-based educational interventions that facilitate the development of critical thinking.

### 4.3.4 Other teaching strategies and technology-based educational interventions that facilitate critical thinking development

Although case studies, PBL and simulations are often used for developing students' critical thinking, the literature also refers to a diverse range of other strategies and technologies that could be used for this purpose. This section provides a brief overview of some of these.

Concept maps can be utilised by both educators and students to visually determine what students have learned. In the construction of a concept map, concepts are arranged in a hierarchy with general topics at the top and more specific topics at the lower end. Cross-links explain relationships between concepts. New concepts can be added into existing maps by identifying new relationships (Lee et al. 2013: 1219). Concept mapping is thus in essence a representation of a person's own thoughts which are visually interpreted in a diagrammatical format (Tseng et al. 2011: 41). Students discover and assimilate new knowledge when they are actively involved in creating concept maps or interpreting these maps. Various disciplines such as medicine, nursing, education, science, engineering, business, physical therapy, dentistry and psychology have effectively used concept mapping as a teaching strategy and in the development of students' critical thinking (Latif, Mohamed, Dahlan & Mat Nor 2016: 69; Wheeler & Collins 2003: 340). It is an active learning strategy that develops critical thinking in students by engaging the student in the process of actively searching for relationships between concepts (Latif et al. 2016: 72). In Chapter 3 (section 3.5.2), it was indicated that various researchers found a significant correlation between concept mapping and higher critical thinking scores in students (Carter et al. 2016: 209–218; Lee et al. 2013: 1219–1223; Atay & Karabacak 2012: 233–239; Tseng et al. 2011: 41–46; Wheeler & Collins 2003: 339–346).

According to Walker (2003: 263–266), various types of questioning methods can be used to develop critical thinking. These include reciprocal peer questioning, reader's questions and Socratic questioning. Socratic questioning entails disciplined questioning which is used to explore certain complex issues and to analyse certain problems (Paul & Elder 1997: 7–8). With Socratic questioning, the focus is on the question and not so much on the correct answers. Being a highly systematic, deep and disciplined process, the aim of the Socratic questioning is to develop critical thinking capabilities. This is done by following up answers with more questions that advance the discussion in a responsible manner. The educator acts as facilitator, asking stimulating questions which fuel discussion between the educator and the student as well as between the students themselves (Yang et al. 2005: 164; Paul & Elder 1997: 7–8). In Chapter 3 (section 3.5.2), it was noted that some researchers indeed found a significant correlation between questioning techniques, used as an active learning strategy, and higher critical thinking scores in students (Yang 2008: 241–264; Yang et al. 2005: 163–181; Burbach et al. 2004: 482–492; Allegretti & Frederick 1995: 46–48). However, the questioning was used together with other active learning strategies in these studies.

Collaboration and asynchronous online discussions (AODs) can also develop critical thinking in students. Collaboration is a key principle of social constructivism and focuses on the idea that a person constructs knowledge by negotiating meanings with others. Different viewpoints are shared and challenged (Harasim 2012: 72). Collaboration is *"an instructional approach in which a small number of learners interact together and share their knowledge and skills in order to reach a specific learning goal"* (So & Brush 2008: 5). In a collaborative learning environment, students work in groups of two or more in the search for solutions or when creating products (Scott 2015: 6–7). Harasim (2012: 72) recommends that collaboration should take place in a small group (of for example three to five students) or up to 20 students in a team for group discussions, debates or seminars. In a collaborative learning environment, students are exposed to other students' opinions and diverse backgrounds which prepares them for justifying their own opinions in real-life work situations. Collaboration also improves the development of metacognition, the formulation of ideas and the ability to engage in high level discussions (Scott 2015: 6–7).

Advances in IT have brought about changes in the way that communication takes place through interactive, text-based, computer-mediated communication tools (Yang 2008: 242). Computer-Supported Collaborative Learning is delivered via computers and the internet (Xia, Fielder & Siragusa 2013: 87). AODs are an example of a Computer-Supported Collaborative Learning tool. AODs or asynchronous discussion forums (ADFs) are regularly used as a teaching strategy in higher education (Ghodrati 2015: 88). This platform allows students to read other students' posts, form an opinion on them and then respond by supporting their views (Klisc, McGill & Hobbs 2009: 667). Rooted in the constructivist learning theory, AODs encourage students to interact, analyse posts in their own time and collaborate with others (Richardson & Ice 2010: 52). When students participate in discussion forums, active learning and collaborative problem-solving skills are promoted (Xia et al. 2013: 101). Discussion forums also promote peer interaction and collaborative learning (Xia et al. 2013: 98). The inherently collaborative nature of asynchronous discussions makes them suitable for the development of students' critical thinking.

Other teaching strategies and technology-based educational interventions that could be used to facilitate critical thinking in students include conference learning (Jordan D'Ambrisi 2011: 47), debates (Jordan D'Ambrisi 2011: 48–49; Van Erp 2008: 26–27), reflective writing (Carter et al. 2016: 216; Van Erp 2008: 27), reflective logs or journals (Jordan D'Ambrisi 2011: 52; Van Erp 2008: 27; Burbach et al. 2004: 485), Vee diagrams (Jordan D'Ambrisi 2011: 52), role play (Van Erp 2008: 25–26), modelling (Van Erp 2008: 23–24) and videotaped vignettes (Carter et al. 2016: 216).

## 4.4 CONCLUSION

The objective of Chapter 4 was to obtain an understanding of how critical thinking is most effectively developed, with a specific focus on the teaching strategies and technology-based educational interventions. The chapter examined learning theories in general, with a specific emphasis on learning theories that facilitate critical thinking development. The review identified various teaching strategies that can be used in the development of students' critical thinking. These strategies should, however, be constructed in such a way as to support learning theories. A thorough understanding of learning theories is thus needed before teaching strategies can be selected. It is also clear that the principles of constructivism are ideal for critical thinking development. This is because constructivism supports active and authentic learning through real-world situations or problems as well as collaborative learning.

Chapter 4 also explored teaching strategies and technology-based educational interventions which are considered effective in developing critical thinking. It is generally believed that critical thinking is best acquired through a variety of teaching strategies. The most effective strategies are those which promote active learning, are problem-based, use real-world problems and stimulate interaction between students. Against this backdrop and the principles of constructivism, three key teaching strategies were evaluated, namely, case studies, PBL and simulations.

Chapter 4 thus provided insights into several key constructs, concepts, assumptions, beliefs and theories related to teaching strategies and technology-based educational interventions which are most effective in critical thinking development. Possible relationships between these concepts were also explored. Chapter 4 also identified gaps in existing literature, further highlighting the need for a robust conceptual framework. I was unable to source a comprehensive conceptual framework guiding the development of critical thinking through technology-based educational interventions, together with relevant learning theory principles or teaching strategies specific to critical thinking.

Chapter 5 synthesises the information contained in Chapters 2, 3 and 4 and presents the preliminary conceptual framework for critical thinking development in auditing students through technology-based educational interventions.

# CHAPTER 5
# PRELIMINARY CONCEPTUAL FRAMEWORK

## 5.1 INTRODUCTION

Chapter 2 provided information on what critical thinking is, its definition, dimensions and how it can be measured. Chapter 3 offered more insights into factors that may influence students' critical thinking and their critical thinking scores, as measured by critical thinking measurement instruments. Chapter 4 focused on how critical thinking can effectively be developed through teaching strategies and technology-based educational interventions. Collectively, Chapters 2, 3 and 4 provided more insights into key constructs, concepts, assumptions, beliefs and theories related to the conceptualisation of critical thinking and how it can be developed. These chapters also provided insight into possible relationships that may exist between these concepts. They also demonstrated that a working theory is needed to address the gaps in the existing literature. These insights therefore provide the theoretical framework which will serve as the foundation for a preliminary, literature-based, conceptual framework. The objective of Chapter 5 is thus to propose such a framework, based on existing literature, for the development of auditing students' critical thinking through technology-based educational interventions. This would therefore address secondary research objective A4 and secondary research question B4.

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| **Secondary research objective A4** | To propose a preliminary, literature-based, conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions. |
| **Secondary research question B4** | Which concepts and the relationships between these concepts, should be considered when critical thinking is developed in auditing students through technology-based educational interventions, as evident from the literature? |

## 5.2 PRELIMINARY CONCEPTUAL FRAMEWORK

Up to this point in the study, it has become evident that the task of developing students' critical thinking is not an easy one. To facilitate the development of critical thinking, an integrated framework is essential (Dwyer et al. 2014: 49–50). More research is therefore needed to create a robust framework aimed at the development of critical thinking (Abrami et al. 2015: 305). There is thus an undisputed need for a reliable, integrated framework or model to guide the development of critical thinking in auditing students through technology-based educational interventions. This study addresses this need and, step-by-step, unfolds an original theoretical contribution to the body of knowledge on critical thinking and conceptual frameworks.

A conceptual framework is a system of concepts, assumptions, beliefs and theories that support research. It is either presented graphically or narratively and sets out key constructs, factors and/or variables together with the relationships between them (Maxwell 2013: 39–60). A concept map is a tool often used to visually display the conceptual framework of a study. Concepts as well as the relationships between them are visually represented in such a concept map. This can be achieved through circles or boxes together with arrows or lines that indicate the interrelationships (Maxwell 2013: 39–60). With a conceptual framework, a tentative theory of that which is being researched is created as a model or conception. The aim of this conceptual framework is to inform the design of the study being performed. A conceptual framework is constructed by the researcher based on knowledge obtained from other sources on the subject (Maxwell 2013: 39–60). One of the main sources of conceptual frameworks is prior theory and research. The researcher should thus have a proper understanding of existing theories and key research on the subject to form a thorough understanding of the topic at hand (Maxwell 2013: 39–60). If the research problem cannot meaningfully be investigated without taking into account several theories or concepts related to that theory, the researcher should integrate the existing views in the conceptual framework (Imenda 2014: 189).

Throughout the literature, various researchers have attempted to provide frameworks for critical thinking (Atabaki et al. 2015: 93–102; Dwyer et al. 2014: 43–52; Nair & Stamler 2013: 131–138; Vieira et al. 2011: 43–54; Simpson & Courtney 2007: 56–63; Bailin et al. 1999a: 285–302; Colucciello 1997: 236–245). However, these existing frameworks focus mainly on specific aspects, elements and/or dimensions of critical thinking as opposed to providing a holistic view on the topic.

The foundation for this study's preliminary conceptual framework was derived from established critical thinking concepts, existing theories, conceptualisations of critical thinking and critical thinking development, as set out in Chapters 2 to 4. Key concepts on critical thinking, its measurement and development were inductively and deductively derived from the body of knowledge set out in these chapters. I identified the following key concepts:

- Critical thinking dimensions (cognitive skills and dispositions) (section 2.2 in Chapter 2 – discussed further in section 5.2.8);
- Assessment or measurement of critical thinking (section 2.3 in Chapter 2 - discussed further in sections 5.2.2 and 5.2.9 as pre- and post-intervention assessments or measurements);
- Auditing content, auditing content knowledge and its understanding (section 2.2.1.3 – discussed further in section 5.2.7 and 5.2.10 as both an input into the educational intervention and an outcome of the intervention);
- Auditing tests and assessments (section 2.2.1.3 – discussed further in section 5.2.11);
- Student-related factors that may influence critical thinking (section 3.3 in Chapter 3 – discussed further in section 5.2.1);
- Educator-related factors that may influence critical thinking (section 3.4 in Chapter 3 – discussed further in section 5.2.6);
- Critical thinking instructional approaches (section 3.5.1 in Chapter 3 – discussed further in section 5.2.4);
- The intervention: Teaching strategies and technology-based educational interventions that facilitate critical thinking development (section 3.5.2 in Chapter 3 and section 4.3 in Chapter 4 – discussed further in section 5.2.3) and
- Constructivism and characteristics of critical thinking instructions (sections 4.1 and 4.2 of Chapter 4 – discussed further in section 5.2.5).

After establishing these key concepts, the interrelationships between these key concepts were also identified. These are described further in sections 5.2.1 to 5.2.11. Figure 13 illustrates the preliminary, literature-based, conceptual framework proposed in this study.

Annexure N summarises the key concepts and relationships in this framework, together with the relevant literature references.

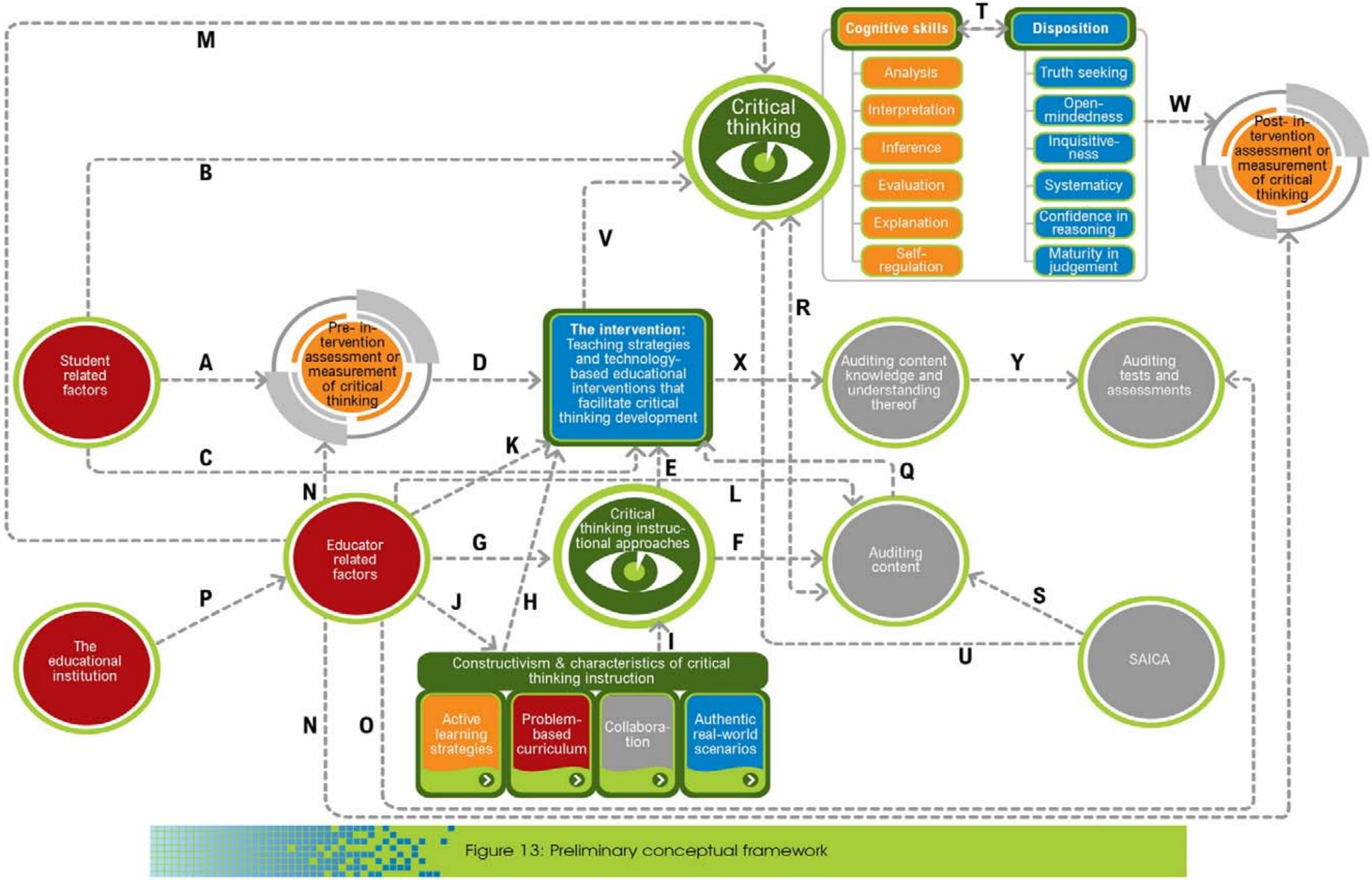


**Figure 13: Preliminary conceptual framework**
**Source:** Author

### 5.2.1 Student-related factors

It was established in Chapter 3 that various student-related factors may have an influence on students' critical thinking. Some of these factors include:

- Age;
- Gender;
- Academic performance;
- Prior knowledge or experience;
- Type of academic programme or field of study;
- Academic grade or level;
- Student learning styles; and
- Other student-related factors which include self-concept, feelings, culture, personal characteristics, nationality, ethnicity, type of high school attended, income level of parents, mother's educational level, native English language, reading ability and others.

Although the literature is not consistent as to the exact influence of these factors on critical thinking (Mortellaro 2015: 12; Purvis 2009: 70), their influence should nonetheless be considered as part of the preliminary framework. The framework thus commences with these student-related factors as many of these are inherent to the student. The following relationships were also identified:

- ***Relationship A:*** Chapter 3 indicated that certain factors related to the student may influence critical thinking scores as evaluated by critical thinking measurement instruments (Facione 1990b: 1). It was, for example, mentioned that a significant correlation was found between age and critical thinking scores (Günaydin & Barlas 2015: 4; Shinnick & Woo 2013: 1065; Martin 2002: 246). Although the literature is not consistent in this regard, these factors should still be considered. This influence is depicted in Figure 13 as relationship A.
- ***Relationship B:*** It was furthermore noted in Chapter 3 that students' critical thinking in general (Rubenfeld & Scheffer 2015: 59–76) as well as its development (Mortellaro 2015: 33–47) may be influenced by these factors. These mostly inherent student-related factors may thus impact students' critical thinking cognitive skills and dispositions, even when an effective educational

intervention is introduced. This influence is illustrated in Figure 13 as relationship B.

- ***Relationship C:*** In Chapter 3, it was also stated that the effectiveness of critical thinking educational interventions may be affected by student-related factors (Tiruneh et al. 2014: 6–10). Student learning styles could be one such factor to consider. Individual students' preferred style of thinking, learning and problem-solving differ and this may have an influence on the effectiveness of the technology-based educational intervention. If a student, for example, is not an active or visual learner, he or she may not find an audit simulation stimulating or interesting. The influence of student-related factors on the effectiveness of the technology-based educational intervention is illustrated in Figure 13 as relationship C.

The influence of student-related factors on critical thinking scores, as measured by critical thinking measurement instruments, was discussed in this section and is illustrated as relationship A in Figure 13. Section 5.2.2 provides further insight into the pre-intervention assessment or measurement of critical thinking that could be performed.

### 5.2.2 Pre-intervention assessment or measurement of critical thinking

Chapter 2 indicated that critical thinking and its development can be validly and reliably measured. The chapter also provided insights into standardised and non-standardised measurement instruments. Standardised instruments are mostly commercially available and focus on measuring the main aspects of critical thinking. Non-standard instruments are mainly those developed by the researcher or educator.

It is important to measure students' critical thinking capabilities so that any issues in their cognitive capacities or ineffective critical thinking teaching strategies can be identified (Carter et al. 2015: 864). Critical thinking measurement instruments are also regularly used to evaluate the effectiveness of critical thinking instruction and educational interventions (Tiruneh et al. 2014: 3–8). When there is improvement from pre-intervention to post-intervention scores and external factors or variables were kept constant, it can reasonably be assumed that the scores increased as a result of the critical thinking educational intervention.

For the purposes of this study's preliminary framework, I concluded from the literature that it is preferable for a pre-intervention critical thinking assessment or measurement to be performed. It would be difficult to state whether technology-based educational interventions are effective or not without assessing their effectiveness in some way. By introducing critical thinking measurement instruments and assessing students' pre-intervention and post-intervention scores, the educator would thus be in a better position to evaluate the effectiveness of instruction. The educator would then also be able to determine whether students are progressing through the six stages of critical thinking development, as discussed in Chapter 2.

The following relationship between the pre-intervention assessment and the actual technology-based educational intervention was thus identified:

- ***Relationship D:*** The pre-intervention assessment or measurement can be performed prior to the introduction of the technology-based eductional intervention. It is advisable to obtain pre-intervention critical thinking scores through standardised measurement instruments as these are ideal for use in research studies and educational settings (California Academic Press 2016a: 1, b: 1). These instruments allow comparison over time (Carter et al. 2015: 865). Their reliability and validity have also been tested by researchers over many years (Carter et al. 2015: 865). Through this pre-intervention assessment or measurement, students' critical thinking scores or stage of critical thinking development can be determined. This is shown in Figure 13 as relationship D.

Following the pre-intervention critical thinking assessment or measurement is the actual intervention which is discussed in section 5.2.3.

### 5.2.3 The intervention: Teaching strategies and technology-based educational interventions that facilitate critical thinking development

In Chapter 1 it was stated that the WEF considers technology-based educational innovations as ideal platforms for developing 21st century skills, including critical thinking. It was also noted that more research is needed to identify the most effective technology-based educational interventions to develop these skills. Educational technologies are, furthermore, most effective when they are linked to suitable teaching strategies (World Economic Forum 2015: 1–8).

Chapter 4 consequently provided an overview of teaching strategies and technology-based educational interventions that facilitate critical thinking development. Case studies, PBL and simulations were discussed in detail as they are mostly used in the development of critical thinking. Other teaching strategies and technology-based educational interventions that facilitate critical thinking development include concept maps, Socratic questioning, AODs, debates, conference learning, role plays, modelling and video vignettes. The suitability of many of these teaching strategies and technology-based educational interventions in e-learning environments and virtual classrooms was also discussed in Chapter 4, as most universities are faced with technological innovations.

Various influences and relationships must be considered with regards to the intervention. The following relationships were thus identified between the intervention and:

- Student-related factors. This relationship is discussed in section 5.2.1.
- Pre-intervention assessment or measurement of critical thinking. This relationship is discussed in section 5.2.2.
- Critical thinking instructional approaches. This relationship is discussed in section 5.2.4.
- Constructivism and characteristics of critical thinking instruction. This relationship is discussed in section 5.2.5.
- Educator-related factors. This relationship is discussed in section 5.2.6.
- Auditing content. This relationship is discussed in section 5.2.7.
- Critical thinking cognitive skills and dispositions. This relationship is discussed in section 5.2.8.
- Post-intervention assessment or measurement of critical thinking. This relationship is discussed in section 5.2.9.
- Auditing content knowledge and its understanding. This relationship is discussed in section 5.2.10.
- Auditing tests and assessments. This relationship is discussed in section 5.2.11.

### 5.2.4 Critical thinking instructional approaches

Instructional factors, which include critical thinking instructional approaches and critical thinking teaching strategies, may influence the effectiveness of critical thinking instruction and educational interventions (Tiruneh et al. 2014: 2). Chapter 3 discussed such instructional approaches which include the general, infusion, immersion and mixed approaches (Ennis 1989: 4–6). The choice of instructional approach should be given careful consideration to determine whether the technology-based educational intervention should be introduced as part of the auditing course or as part of a separate stand-alone course. The choice also influences whether auditing content should form part of the educational intervention. The following relationships were thus recognised:

- ***Relationships E and F:*** The instructional approach influences the technology-based educational intervention (Relationship E) and auditing content (Relationship F) in the following ways:
  - **General or stand-alone approach:** In this approach, critical thinking skills are acquired independently from subject or discipline content. These skills can thus be developed in a separate class which solely teaches critical thinking principles and excludes auditing content. The focus of the intervention will thus be on explicitly teaching critical thinking principles separate from auditing content.
  - **Infusion or embedded approach:** In this approach, critical thinking is explicitly taught as part of the discipline. The technology-based educational intervention will thus include both auditing content and critical thinking teaching strategies.
  - **Immersion approach:** In this approach, critical thinking is integrated into auditing content, but is not explicitly taught. The educational intervention delivers auditing content in a manner that stimulates critical thinking, however, the students are not explicitly exposed to critical thinking principles.
  - **Mixed approach:** This is a mixture of the general approach together with either the infusion or the immersion approach. Students can be introduced to an educational intervention in a separate course or class that instils general critical thinking skills and dispositions. These students

should also be exposed to auditing content and critical thinking instruction (with either explicit or implicit critical thinking instruction).

- ***Relationships G:*** In general, the educator decides which instructional approach to follow. This is illustrated in Figure 13 as relationship G.

In Chapter 2 it was noted that whether critical thinking is developed separately or whether it is embedded within content is of less importance (Abrami et al. 2008: 1121). What is more imporant is that critical thinking outcomes and requirements should be made explicit and form part of the course design, as critical thinking is better developed when these objectives and requirements are made explicit.

The instructional approach alone does not determine the overall effectiveness of a critical thinking educational intervention (Tiruneh et al. 2014: 8). The principles of constructivism and characteristics of critical thinking instruction also have to be considered in the development of critical thinking in students. Section 5.2.5 examines these principles and characteristics and their influence on the intervention.

### 5.2.5 Constructivism and characteristics of critical thinking instruction

In Chapter 4 it was established that a constructivist learning environment is ideal for critical thinking development. The principles of constructivism also align with the characteristics of instruction that develop critical thinking (Ten Dam & Volman 2004: 370), namely:

- Active learning;
- Problem-based curriculum;
- Interaction or collaboration between students; and
- Authentic real-world scenarios.

It was furthermore noted that concerns have been raised about the lack of active learning strategies, cooperative learning environments and the use real-world examples in accounting education (Massey et al. 2002: 1). Educators in accounting education have thus been encouraged to incorporate active learning strategies into their courses and to integrate this with appropriate technologies (Fratto 2011: 13).

Taking this into account, the following relationships have been identified:

- ***Relationship H:*** In Chapter 4 it was noted that learning theories are strongly associated with specific educational practices, teaching strategies and technologies suited to them (Harasim 2012: 4–29). Learning theories lay the foundation for how teaching strategies are designed and implemented (Harasim 2012: 4–8). Established learning theories also form the basis of the design of educational interventions (Alessi & Trollip 2001: 41). It was also noted that constructivism forms the ideal foundation for designing educational interventions aimed at critical thinking development. Principles of constructivism, that align with the characteristics of critical thinking instruction, thus inform the teaching strategies and technology-based educational interventions for critical thinking development. This is illustrated in Figure 13 as relationship H. Simulations, PBL and case studies were mentioned as part of the teaching strategies and technology-based educational interventions in section 5.2.3. These embody most, if not all, the characteristics of instruction that develop critical thinking and are rooted in the principles of constructivism.
- ***Relationship I:*** Principles of constructivism also provide the ideal foundation for critical thinking instructional approaches. Jones and Brader-Araje (2002: 4) also assert that constructivism offers instructional approaches that are consistent with present-day research on teaching and learning. This is illustrated in Figure 13 as relationship I.
- ***Relationship J:*** The educator should have a thorough understanding of learning theories to select the most suitable strategy and technology (Mohamed 2004: 6). The educator should thus be familiar with these principles and characteristics to make informed decisions. This is illustrated in Figure 13 as relationship J.

It is clear from relationship G and relationship J, that the educator plays a significant role in selecting appropriate teaching strategies, instructional approaches and interventions aimed at critical thinking development. The role of the educator and the influence of educator-related factors are discussed in more detail in section 5.2.6.

### 5.2.6 Educator-related factors

In Chapter 3, it was stated that the educator plays a vital role in imparting critical thinking to students (Chan 2013: 239; Van Erp 2008: 114–116). Van Erp (2008: 114–116) found that the educator's efforts were the most important factor that influenced students' critical thinking development. The following relationships have been identified with regards to the educator:

- ***Relationship G:*** The influence of the educator on the choice of instructional approach was discussed in section 5.2.4.
- ***Relationship J:*** The relationship between the educator, principles of constructivism and characteristics of critical thinking instruction was discussed in section 5.2.5.
- ***Relationship K:*** The educator generally influences the selection or design of the teaching strategies and educational interventions. With a sound understanding of constructivism and characteristics of critical thinking instruction (see relationships G and J), the educator is better-equipped to select or design suitable teaching strategies and technology-based educational interventions that facilitate critical thinking development.
- ***Relationship L:*** The SAICA competency framework sets out the professional competencies that chartered accountants should possess when they enter the profession. The framework places the responsibility of teaching and assessing these competencies on the SAICA-accredited programme providers, and thus the educators, at these institutions. The framework is not prescriptive, however, and does not specify how the teaching and assessment should be done (South African Institute of Chartered Accountants 2010: 3–16). The educator can thus decide how auditing content is incorporated into the educational intervention. This is illustrated in Figure 13 as relationship L.
- ***Relationship M:*** The following educator-related factors may influence critical thinking and were identified in Chapter 3:
  - Whether the educator is trained in critical thinking instruction;
  - The educator's prior experience in critical thinking instruction;
  - The educator's attributes, characteristics, teaching philosophy, attitude and values; and
  - The educator's ability to model critical thinking.

These factors all play a crucial role in the development of critical thinking in students (relationship M) and can influence the effectiveness of the teaching strategies and the technology-based educational intervention (relationship K). These relationships are illustrated in Figure 13.

- ***Relationship N:*** Chapter 3 stated that educators play a critical role in assessing or measuring students' critical thinking. The educator generally selects the instrument through which the students' critical thinking will be measured pre- and post-intervention and is also involved in evaluating the results of these assessments. The educator should thus have a proper understanding of critical thinking instruction (Chan 2013: 239), measurement instruments and how the results should be interpreted. This is illustrated in Figure 13 as relationship N.
- ***Relationship O:*** The educator generally has an influence on the evaluation methods that are used to assess students' auditing knowledge. Most educators set these tests, assignments and examinations and thus have a significant influence on the content that is included in these assessments. They can therefore decide whether these assessments should form part of the technology-based educational intervention or whether they should be conducted separately. This is illustrated in Figure 13 as relationship O.
- ***Relationship P:*** In Chapter 3 it was noted that educational institutions should support educators in the development of critical thinking for it to be effectively taught (Paul & Elder 2007: 5). An educational institution thus has a responsibility to aid educators in understanding how to teach critical thinking and allow them time to achieve this goal (Van Erp 2008: 114–116). Management should create a support system for educators and allow them to collaborate with others (Gharib et al. 2016: 274). Educators could thus receive training and attend workshops, which could be facilitated by the educational institution. The association between the educator and the educational institution is illustrated in Figure 13 as relationship P.

The relationship between the educator and auditing content was discussed in this section and is illustrated as relationship L in Figure 13. Section 5.2.7 provides more insight into the relationships with regards to auditing content.

### 5.2.7 Auditing content

Auditing forms part of specific competencies prescribed by the SAICA competency framework (South African Institute of Chartered Accountants 2014a: 2) and should be well-developed in chartered accountants by the time they enter the profession (South African Institute of Chartered Accountants 2014a: 9–24).

The following relationships have been identified:

- ***Relationship Q:*** Although auditing technical knowledge is a basis for competency development, it was stated in Chapter 2 that understanding auditing content is vital and there is thus a move away from rote learning and memorisation of pure facts. Critical thinking is an active process (Mortellaro 2015: 17–18) and is thus best acquired through active learning strategies (Mortellaro 2015: 122–123). To foster a thorough understanding of auditing content and effectively develop critical thinking, auditing content should be delivered through active learning strategies and technology-based educational interventions. This is illustrated in Figure 13 as relationship Q.
- ***Relationship R:*** It was also mentioned in Chapter 3 that the experts in the APA Delphi study believe that critical thinking is not bound to one specific subject or discipline (Facione 1990a: 4–5). When students have acquired critical thinking skills, they are likely to transfer those skills and use them in various personal and professional situations (Nair & Stamler 2013: 132). Although critical thinking is transferable between subjects and disciplines, it is also believed that the most effective way of developing this skill is within the context of a specific subject or discipline. Knowledge about a specific subject or discipline's methods, techniques, contexts, criteria, theories and principles assists in teaching students to think critically and make sound judgements (Facione 1990a: 17, 2000: 65). The problems or scenarios presented to students should thus preferably take place within domain-specific subject matter as critical thinking requires content to think about. On the other hand, content cannot be further developed, analysed or transformed without the application of critical thought. The relationship between critical thinking and auditing content is illustrated in Figure 13 as relationship R.

- ***Relationship S:*** It was mentioned that SAICA, through its framework, prescribes the competencies that chartered accountants should possess when they enter the profession. SAICA thus has a significant influence on the auditing content prescribed and the level of competence required of chartered accountants in South Africa. SAICA is a member of IFAC and thus prescribes the ISAs issued by the IAASB (International Federation of Accountants 2014: 4). This influence is illustrated in Figure 13 as relationship S.

In this section, the relationship between auditing content and critical thinking (relationship R) was recognised. In section 5.2.8, critical thinking, its definition, dimensions and influence on other elements in the preliminary framework are explored.

### 5.2.8 Critical thinking cognitive skills and dispositions

Chapter 2 provided an overview of existing theories on critical thinking, critical thinking definitions and important concepts. The APA's Delphi study offers the most comprehensive conceptualisation of critical thinking for instructional and educational purposes over various disciplines. It was thus concluded in Chapter 2 that the consensus statement on critical thinking and the ideal critical thinker, the skills, sub-skills and dispositions, as arrived at by the APA's panel of experts, would serve as a foundation for this study's preliminary framework. Critical thinking is defined as *"purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation and inference, as well as explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgement is based"* (Facione 1990a: 2). The development of the skills, sub-skills and dispositions associated with critical thinking is one of the main aims of the teaching strategies and technology-based educational interventions, in this particular study's framework. Increased critical thinking skills and dispositions are thus one of the main outcomes of these strategies and interventions.

The following relationships were identified:

- ***Relationship M:*** The influence of educator-related factors on students' critical thinking was discussed in section 5.2.6.
- ***Relationship R:*** The relationship between auditing content and critical thinking was discussed in section 5.2.7.
- ***Relationship T:*** In Chapter 2 it was established that critical thinking consists of a cognitive skills dimension and a dispositions dimension. A person uses some or all of the cognitive skills (shown in Figure 13) when engaged in critical thinking. Irrespective of the importance of these cognitive skills, a person should also have the keenness of mind to apply them. A good critical thinker should thus also display a positive attitude and willingness to use these skills, referred to as dispositions (shown in Figure 13). Without an eagerness to use these skills and a critical spirit, these skills will remain untapped. A good critical thinker must thus possess both cognitive skills and dispositions as one cannot function without the other. The conceptualisation of and relationship between these two dimensions of critical thinking is illustrated in Figure 13 as relationship T.
- ***Relationship U:*** It was stated in Chapter 2 that the SAICA competency framework also prescribes the pervasive qualities and skills that chartered accountants in South Africa should possess when they enter the profession. Pervasive qualities and skills include professional skills. Critical thinking falls under the professional skills in the competency framework. Chartered accountants are expected to demonstrate all pervasive qualities and skills at the highest level of proficiency, namely level X, when they enter the profession. Critical thinking is currently defined and described in the SAICA competency framework. SAICA thus plays a role in how this skill is currently understood in the auditing profession. This is illustrated in Figure 13 as relationship U.
- **Relationship V:** In Chapters 3 and 4, the main types of teaching strategies and technology-based educational interventions that facilitate critical thinking were identified as case studies, PBL, simulations, questioning techniques (including Socratic questioning), AODs, concept mapping, written assignments, reflective writing, logs, journals and modelling. It was also established that there is often a strong correlation between these teaching strategies (and technology-based educational interventions) and critical thinking scores. The majority of these

active learning strategies embody most, if not all, of the characteristics of instruction that develop critical thinking and are rooted in the principles of constructivism. They are thus considered ideal for critical thinking development. This is illustrated in Figure 13 as relationship V.

- ***Relationship W:*** It was noted in section 5.2.2. that is important to measure students' critical thinking capabilities to pinpoint any issues in their cognitive capacities and identify any ineffective critical thinking teaching strategies or interventions. This is illustrated as relationship W in Figure 13 and is further discussed in section 5.2.9 as part of the post-intervention assessment.

### 5.2.9 Post-intervention assessment or measurement of critical thinking

Section 5.2.2. provided a detailed explanation of pre-intervention and post-intervention critical thinking assessment or measurement. This is done not only to identify problems in students' cognitive capabilities, but to evaluate the effectiveness of teaching strategies and technology-based educational interventions. It was noted in section 5.2.2. that if there is improvement from pre-intervention to post-intervention scores and external factors or variables were kept constant, it can be reasonably assumed that the scores increased as a result of the educational intervention. The instrument used for the pre- and post-intervention assessment or measurement should preferably be the same to ensure comparable results.

The following relationship was thus identified between the intervention, critical thinking skills and dispositions on the one hand and the post-intervention critical thinking assessment or measurement on the other:

- ***Relationship W:*** In my view a post-intervention critical thinking assessment or measurement is necessary to evaluate the effectiveness of the teaching strategies and technology-based educational interventions. The educator is then also in a position to determine students' progression through the six stages of critical thinking. When a student reaches stage six, I posit that this student would have become the ideal critical thinker. According to the APA, "*the ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgements, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the* *selection of criteria, focused in inquiry and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit"* (Facione 1990a: 2). This is illustrated in Figure 13 as relationship W.

#### 5.2.10 Auditing content knowledge and its understanding

It is important for teaching strategies and technology-based educational interventions to increase students' understanding of auditing content. This is also considered one of the outcomes of the teaching strategies and technology-based educational interventions in this study's framework. It was stated in section 5.2.7 that critical thinking should preferably be developed within the context of a subject or discipline as it requires content to think about. The following relationship has thus been identified:

- ***Relationship X:*** Students should not be encouraged to memorise auditing content but rather to understand what they learn. Active learning strategies are ideal for this as they stimulate cognitive processes and critical thinking. Teaching strategies and technology-based educational interventions should thus focus on students' understanding of auditing content which would improve educational outcomes. This is illustrated in Figure 13 as relationship X.

#### 5.2.11 Auditing tests and assessments

Various critical thinking teaching strategies and interventions were discussed in Chapter 4. Many of these strategies and interventions can also be used to assess audit content knowledge. SAICA, for example, uses case studies in its professional exams to assess students. Both the ITC and the APC examinations of SAICA are in the form of simulated, multi-disciplinary case studies. Many SAICA-accredited programme providers also use case studies in their academic programmes (South African Institute of Chartered Accountants 2014a: 3–26, b: 1). The following relationship has thus been identified:

- ***Relationship Y:*** Students' auditing content knowledge and understanding should be assessed. Most of the teaching strategies and technology-based educational interventions aimed at critical thinking use unstructured, contextualised, real-world problems and scenarios that can integrate auditing content. Auditing tests and assessments could thus be integrated into the teaching strategies and technology-based educational interventions. This is illustrated in Figure 13 as relationship Y.

## 5.3 CONCLUSION

Chapter 5 proposed a preliminary, literature-based, conceptual framework for the development of critical thinking in auditing students through technology-based educational interventions. This framework, with its critical thinking concepts, dimensions, key role players and various other important elements, was depicted in Figure 13. The relationships between the key concepts were also represented in Figure 13 and disussed in more detail in the chapter. Annexure N summarised the key concepts and relationships of the framework, together with a summary of the relevant literature references. This preliminary framework laid the foundation for the final conceptual framework presented in Chapter 8. Chapter 6 which follows, describes the methodological underpinnings of the study.

# CHAPTER 6
# RESEARCH DESIGN AND METHODOLOGY

## 6.1 INTRODUCTION

Chapters 2 to 4 provided the context of this study through a review of the literature. These chapters focused on the concept of critical thinking, its definition, dimensions and how it can be measured. The chapters also provided an overview of factors that may influence students' critical thinking and their critical thinking scores as measured by critical thinking measurement instruments. Teaching strategies and technology-based educational interventions that develop critical thinking, were also explored. Chapters 2 to 4 provided the theoretical framework which laid the foundation for the preliminary conceptual framework for critical thinking development in auditing students through technology-based educational interventions, as provided in Chapter 5.

To validate this preliminary framework, the perspectives of three groups of participants were obtained on concepts that should be considered when critical thinking is developed in auditing students through technology-based educational interventions. These perspectives were also used to determine any additional concepts and relationships that should be included in the final framework. To this end, the principles of Interactive Qualitative Analysis (IQA), as described by Northcutt and McCoy (2004: xi-441), were followed.

Chapter 6 provides the methodological underpinnings of the study. The IQA research flow followed in this study is described as well as the procedures to analyse IQA data. The chapter then examines the roles of those involved in the research and qualitative rigour. The layout and structure of Chapter 6 is largely in line with that proposed by Northcutt and McCoy (2004: 299) for a typical IQA methodology chapter.

## 6.2 RESEARCH ORIENTATION AND INTERACTIVE QUALITATIVE ANALYSIS (IQA)

Creswell (2014: 5-6) highlights the importance of researchers having to think through their philosophical worldview assumptions and the research design that is related to this worldview. This worldview is a set of beliefs that provide guidance for action. Worldviews are also referred to as paradigms, epistemologies, ontologies or a general philosophical orientation about the world. Creswell (2014: 5-9) identifies four worldviews, namely, postpositivism, constructivism, transformative and pragmatism. The worldview I considered to be most appropriate for this specific study, was that of constructivism. Constructivism is an approach to qualitative research and constructivist researchers aim to make sense, or interpret, the meanings others have abou the world or a phenomenon. The idea behind constructivism as a worldview is to rely as much as possible on the meanings that are socially constructed by human beings (Creswell 2014: 5-9). IQA is rooted in systems theory (Northcutt & McCoy 2004: xxi) and specifically focuses on social systems where human interpretation of meaning is involved (Northcutt & McCoy 2004: 40). These systems represent a reality that is socially constructed (Northcutt & McCoy 2004: 40). IQA was thus considered the ideal research design for this particular study.

IQA data collection and analysis techniques are based on Total Quality Management (TQM) literature (Northcutt & McCoy 2004: xiii). A key assumption of TQM is that individuals who are closest to a job are best suited to address problems experienced in that job (Northcutt & McCoy 2004: 81). IQA data collection techniques are also structured on this premise. The main purpose of an IQA is to examine a particular phenomenon by identifying the components (or 'affinities') of a system and the perceived relationships between these components (Northcutt & McCoy 2004: xxi). IQA also facilitates comparisons between different systems (Northcutt & McCoy 2004: 66). The final product of an IQA study is *"a visual represenation of a phenomenon prepared according to rigorous and replicable rules for the purpose of achieving complexity, simplicity, comprehensiveness and interpretability"* (Northcutt & McCoy 2004: 41).

IQA is furthermore considered a structured approach to qualitative research (Northcutt & McCoy 2004: xxi). According to Creswell (2014: 4), a qualitative research approach is followed when the researcher aims to explore and understand how individuals or groups view a specific social or human phenomenon. The views and perspectives of participants are thus represented in a qualitative study (Yin 2016: 9). Saunders *et al.* (2016: 168) also assert that one of the main characteristics of qualitative research is to obtain participants' meanings of a particular phenomenon as well as the relationships between these meanings. This can be done to develop a conceptual framework and/or a theoretical contribution. IQA allows a group of participants as well as individual participants within the group, to construct their own interpretation of a particular phenomenon. These two levels of meaning provide a foundation for interpretation by the researcher. IQA thus systematically facilitates group discussion and discourse (Northcutt & McCoy 2004: 43). This allows the researcher to explore and understand how the individual participants and the group view the phenomenon being studied.

To understand how individuals or groups view a specific phenomenon, IQA relies on focus groups (Northcutt & McCoy 2004: 47). Focus groups are generally categorised under interviews as a qualitative data collection method. They are typically described as group interviews or group discussions, where the researcher decides to interview several participants at the same time (Saunders et al. 2016: 416; Creswell 2014: 191; Leedy & Ormrod 2005: 146). The main idea is to encourage discussion amongst participants for them to share ideas on a given topic in a safe setting. Participant interaction is thus crucial (Saunders et al. 2016: 420). Group interaction thus explicitly forms part of this method where participants are encouraged to engage with one another, share their experiences, ask questions and voice their opinions on a particular matter (Kitzinger 1995: 299). Focus groups are widely used for market research as well as for academic purposes (Saunders et al. 2016: 420). Salkind (2009: 211–212) describes the four main functions of focus groups:

- Gather information from relatively large numbers of individuals in a short period of time;
- Generate an understanding of topics about which little was known previously;
- Examine how participants in the focus group reach their conclusions; and
- Encourage group interaction which is ideal for obtaining more than one point of view.

According to Leedy and Ormrod (2005: 146), focus groups are useful when time is limited (a focus group only requires one to two hours), participants feel more at ease in a group and the interaction in the group provides more insightful information than individual interviews would have provided. As reality or meaning is socially constructed (Bargate & Maistry 2015: 41; Northcutt & McCoy 2004: 69), IQA is anchored in the constructivist research paradigm (Bargate & Maistry 2015: 41; Nienaber 2013: 151; Du Preez & Du Preez 2012: 121). According to Creswell (2014: 8–9), constructivism is associated with qualitative research. Social constructivists believe that *"individuals seek understanding of the world in which they live and work"* (Creswell 2014: 8). Subjective meanings of experiences are formed by individuals and the constructivist researcher aims to explore the complexity of these views. Meanings are generally constructed in a social setting through interaction with other individuals. The constructivist researcher is also interested in the specific contexts in which these individuals live and work to explore the phenomenon. Questions posed to individuals should preferably be open-ended to allow for different perspectives. The main aim of a constructivist researcher is thus to explore or interpret the meanings individuals have about a particular phenomenon (Creswell 2014: 8). The current study was thus a qualitative study informed by the main beliefs of constructivism.

## 6.3 IQA RESEARCH FLOW

IQA research flow generally has four phases, namely, IQA research design, IQA focus groups, IQA interviews and IQA reporting (Northcutt & McCoy 2004: 44). The research flow was slightly adapted from Northcutt and McCoy (2004: 45) in this particular study to exclude IQA interviews, as illustrated in Figure 14. The decision to exclude IQA interviews is explained in more detail in section 6.6. Each of the IQA research flow phases is discussed in more detail in sections 6.4 to 6.7.

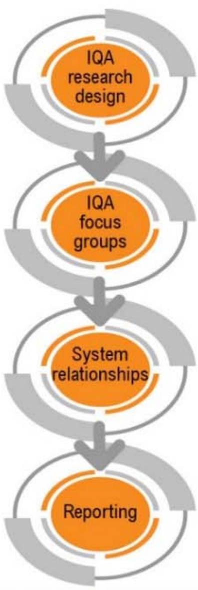


Figure 14: IQA research flow
Source: (Northcutt & McCoy 2004: 44) - adapted

**Figure 14: IQA research flow**
**Source:** (Northcutt & McCoy 2004: 44) - adapted

## 6.4 IQA RESEARCH DESIGN

The research design is considered to be the overall plan of how the researcher will answer the research questions (Saunders et al. 2016: 163) and the IQA research design is the first phase of the IQA research flow. IQA research design is not a linear process but rather circular in nature. This recursive process allows for refinements of the constituencies (groups of people with a shared understanding of the phenomonon), the classification of constituencies, the issue, the research questions and the problem statement (Northcutt & McCoy 2004: 71–72). This recursive IQA research design is illustrated in Figure 15.

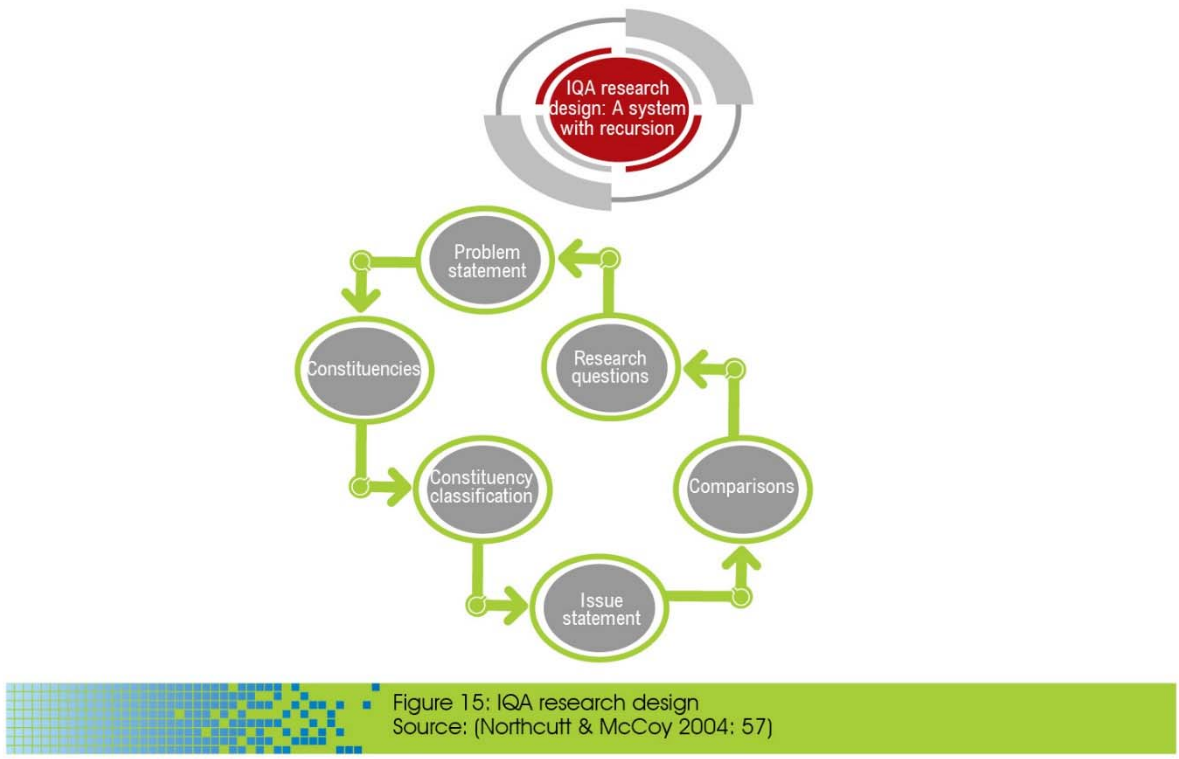


**Figure 15: IQA research design**
**Source:** (Northcutt & McCoy 2004: 57)

### 6.4.1 Identification of the problem statement

An IQA research design starts with the identification of a problem (Northcutt & McCoy 2004: 44). The research problem in this particular study was stated in Chapter 1. It was noted that students' current level of critical thinking remains inadequate for solving important problems within their discipline and indeed, in solving problems experienced in life in general (Tiruneh et al. 2014: 1; Van Gelder 2005: 41). Technology-based educational interventions could provide ideal platforms for the development of critical thinking, but more research is needed (World Economic Forum 2015: 1–8). There is also a need for robust frameworks that focus on the development of critical thinking (Abrami et al. 2015: 305). Although frameworks for critical thinking development could be identified in the literature, I was unable to find a robust, holistic framework for critical thinking development in auditing students through technology-based educational interventions.

### 6.4.2 Identification and classification of constituencies

To address this research problem, I had to identify individuals who were knowledgeable about the phenomenon. Constituencies should consist of participants with something in common and/or with a similar type of understanding of the phenomenon. A group of individuals with a shared understanding of the phenomenon is referred to as a constituency (Northcutt & McCoy 2004: 46). Constituencies should be classified according to their power over the phenomenon and their distance from it. This is referred to as a power/distance analysis (Northcutt & McCoy 2004: 76–80).

#### *6.4.2.1 Power/distance analysis*

Different constituencies may have different views on a particular problem based on their distance from or power over the phenomenon. I needed to determine how close the constituencies were to the phenomenon (extent to which they directly experienced the phenomenon) and how much power they had over it. The guidelines prescribed by Northcutt and McCoy (2004: 76–77) were followed to classify constituencies, as described in Table 17. For ease of reference, the three groups are presented in the following colours throughout:

| |
|---|
| **Group 1 (learning designers)** |
| **Group 2 (educators)** |
| **Group 3 (students)** |

### Table 17: Power/distance analysis

| Constituency | Power | Distance |
|---|---|---|
| **Group 1 (learning designers)** | Some power to effect change in auditing students' critical thinking: these experts are knowledgeable on current 21st century ICTs that influence teaching and learning practices. They are also involved in the design and development of technology-based educational interventions in e-learning environments | Furthest from the phenomenon: these experts have insight into e-learning environments, education in 21st century teaching and learning practices, simulations and instructional design. Critical thinking development is not necessarily a specific aim of these experts but could be a by-product of their interventions |
| **Group 2 (educators)** | Most power to effect change in auditing students' critical thinking: SAICA is the professional body that governs chartered accounts in South Africa and accredits programme providers that offer chartered accountancy programmes in South Africa. SAICA also prescribes the competency framework that programme providers should adhere to. Lecturers at the SAICA programme providers are responsible for the implementation of the competency framework and thus the development of critical thinking in students. Critical thinking forms part of the professional skills in the competency framework. It was established in Chapters 3 and 4 that educators' teaching strategies and educational interventions have an impact on students' critical thinking development. The participants of group 2 (educators) were thus considered to have the most power over the phenomenon of critical thinking development | Some distance from the phenomenon: should have a good understanding of critical thinking instructional strategies and learning theories best suited for critical thinking development. Their own teaching and beliefs could influence students' critical thinking development |
| **Group 3 (students)** | Students have relatively limited influence on how their critical thinking is developed through teaching strategies, the curriculum or technology-based educational interventions | Students are closest to the phenomenon as it is their critical thinking that the teaching strategies and educational interventions aim to develop. Critical thinking development of auditing students is the focus of this study |

**Source:** Author

Using the power/distance criteria, careful consideration should be given to the number of constituencies as this has a direct influence on the number of comparisons that have to be done (Northcutt & McCoy 2004: 69). The number of constituencies selected for this particular study is discussed in section 6.4.2.2.

#### 6.4.2.2 The number of constituencies

Various researchers have used IQA focus groups in their studies and the number of constituencies varies noticeably. Nienaber (2013: 18–19) collected data from four constituencies while du Preez (2015: 16) only used one constituency. Plant (2015: 20) had four constituencies while Robertson (2015: 96–97) had two. Northcutt and McCoy (2004: 46) note that it is preferable to select more than one constituency as different constituencies have different views on a phenomenon. They also note that a power/distance analysis should guide this selection process (Northcutt & McCoy 2004: 70). Based on the power/distance analysis, three groups of participants were selected to conduct IQA focus groups within this particular study (refer to Table 17 in section 6.4.2.1).

Kitzinger (1995: 300) indicates that most studies only include a small number of focus groups. The number of focus groups is largely dependent on the aims of the study as well as the resources available. Connelly (2015: 369) recommends three to five focus groups. Krueger and Casey (2009: 21) as well as Saunders *et al.* (2016: 419) recommend three to four focus groups as the accepted rule of thumb. Limitations in resources, including time and funds, could necessitate fewer groups (Krueger & Casey 2009: 24). The number also depends on when the point of saturation is reached (when the researcher is no longer receiving new information on the topic) (Saunders et al. 2016: 419; Krueger & Casey 2009: 21).

The three constituencies identified in Table 17 were deemed adequate, given these guidelines, the time limitations, financial constraints and the level of saturation. Section 6.4.2.3 discusses the number of participants in each focus group and how they were selected.

#### 6.4.2.3 The number, selection and sampling of participants in each constituency

Kitzinger (1995: 301) asserts that the ideal number of participants in a focus group is four to eight. Northcutt and McCoy (2004: 87) advise that a focus group should include between twelve and twenty participants. They note that groups smaller than twelve are not a serious concern during the affinity production in the IQA process but that smaller groups have the potential to distort data during the theoretical coding phase.

They indicate, however, that it could be difficult to find a minimum of twelve participants to participate in a focus group discussion given the length of focus group discussions. Leedy and Ormrod (2005: 146) advise that a number of between ten and twelve participants is desirable for a focus group whilst Krueger and Casey (2009: 68) are in favour of a group with five to eight people. Silverman (2013: 213) recommends a small group of individuals of between six and eight who should share a certain characteristic. Connelly (2015: 369) also maintains that a focus group should be small, consisting of six to ten participants. Saunders *et al*. (2016: 417) emphasise that focus groups should include between four and twelve participants, depending on the nature of the participants, the topic and the facilitator's skills. They advise that when the topic is more intricate, a smaller number of participants should be selected.

I planned to include between eight and fifteen participants in each focus group, based on the arguments presented in this section. For the IQA focus group discussions conducted as part of this study, group 1 (learning designers) comprised nine participants (refer Table 18), group 2 (educators) contained thirteen participants (refer Table 19) and group 3 (students) had nine participants (refer Table 20). The number of participants in each group was thus considered adequate, given the arguments presented in this section.

**Table 18: Group 1 (learning designers) participants**

| No | Institution | Area of specialisation | Participant (group no and participant no) |
|---|---|---|---|
| 1 | Unisa | E-learning educational consultant | G1-1 |
| 2 | | Online e-learning designer | G1-2 |
| 3 | | Professional development | G1-3 |
| 4 | | Instructional technologist | G1-4 |
| 5 | | Instructional technologist | G1-5 |
| 6 | | Senior analyst developer | G1-6 |
| 7 | | Graphic designer | G1-7 |
| 8 | | Learning developer | G1-8 |
| 9 | | Business analyst | G1-9 |

**Source:** Author

### Table 19: Group 2 (educators) participants

| No | Institution | Area of specialisation | Participant (group no and participant no) |
|---|---|---|---|
| 1 | SAICA | Professional Development | G2-1 |
| 2 | University of Pretoria | Senior lecturer: 2nd year auditing students | G2-2 |
| 3 | | Senior lecturer: postgraduate auditing students | G2-3 |
| 4 | University of Johannesburg | Senior lecturer: 2nd year auditing students | G2-4 |
| 5 | | Senior lecturer: 3rd year auditing students | G2-5 |
| 6 | | Senior lecturer: postgraduate auditing students | G2-6 |
| 7 | Unisa | Senior lecturer: 2nd year auditing students | G2-7 |
| 8 | | Senior lecturer: 3rd year auditing students | G2-8 |
| 9 | | Senior lecturer: 3rd year auditing students | G2-9 |
| 10 | | Senior lecturer: postgraduate auditing students | G2-10 |
| 11 | | Senior lecturer: postgraduate auditing students | G2-11 |
| 12 | | Senior lecturer: postgraduate auditing students | G2-12 |
| 13 | | Senior lecturer: postgraduate auditing students | G2-13 |

**Source:** Author

### Table 20: Group 3 (students) participants

| No | Institution and qualification registered for in 2017 | Area of registration/residence | Participant (group no and participant no) |
|---|---|---|---|
| 1 | Unisa: Postgraduate Diploma in Applied Accounting Sciences (AUE4862) | Pretoria, Silver Lakes | G3-1 |
| 2 | | Pretoria | G3-2 |
| 3 | | Pretoria, Riviera | G3-3 |
| 4 | | Pretoria, Pierre van Ryneveld | G3-4 |
| 5 | | Pretoria, Daspoort | G3-5 |
| 6 | | Pretoria, Birch Acres | G3-6 |
| 7 | | Keiskammahoek | G3-7 |
| 8 | | Evander | G3-8 |
| 9 | | Pretoria, Vista View | G3-9 |

**Source:** Author

Table 18 contains a summary of the institution, area of specialisation as well as the participant number assigned to each of the nine participants in group 1 (learning designers). The participant numbers are a combination of the group number (for example group 1 is G1) and the number of participants in the group. The participants in group 1 (learning designers) were thus assigned participant numbers from G1-1 to G1-9 as there were nine participants in this group. Table 19 contains a summary of the institution, area of specialisation and participant number assigned to the thirteen participants of group 2 (educators). The participant numbers for group 2 (educators) range from G2-1 to G2-13. Group 3 (students) consisted of a sample of students, all registered for Applied Auditing (AUE4862) in 2017. This auditing module forms part of the Postgraduate Diploma in Applied Accounting Sciences (qualification code 98255), offered at Unisa. Table 20 provides more detail on the participants of group 3 (students), including the participant number assigned to each participant. Participant numbers for group 3 (students) ranged from G3-1 to G3-9.

Focus group participants can be selected using non-probability sampling (Saunders et al. 2016: 417). Non-probability sampling techniques involve an element of judgement (Saunders et al. 2016: 295). Purposive sampling is one example of non-probability sampling. Purposive sampling is used when the researcher applies their own judgement to select participants that are believed to be best-suited to answer the research question (Saunders et al. 2016: 301). Carey and Asbury (2016: 30) note that focus group participants should be selected based on their experience in a particular topic. Purposive sampling allows the researcher to explore a phenomenon, but not to generalise results to an entire population (Saunders et al. 2016: 301; Carey & Asbury 2016: 30).

I was involved in the Young Academics Programme of Unisa in 2015. During this programme, I was introduced to various specialists at Unisa. These included instructional designers, online learning designers, educational technologists, teaching and learning consultants as well as experts in e-learning environments at Unisa. This network of professionals provided the platform for the selection of participants for group 1 (learning designers). Various instructional designers and e-learning specialists from other institutions and universities, mainly in the Gauteng area, were also invited to take part in the study. Participants for group 1 (learning designers) were selected through purposive sampling. Participants were recruited via the networking site LinkedIn, university websites and Google searches. A total of 57 invitations was sent out. Many individuals indicated their willingness to partake, but were unable to do so due to prior commitments.

As I have been an auditing lecturer for several years, I have managed to build a network of professionals in the field of auditing. These professionals include individuals from SAICA and SAICA-accredited programme providers, especially those located in Gauteng. Participants for group 2 (educators) were thus selected through purposive sampling and included auditing lecturers involved in auditing courses (related to chartered accountancy training) at South African universities. SAICA representation in this group was also selected through purposive sampling, based on involvement in professional development and standard setting at SAICA. Participants for group 2 (educators) were recruited via university websites, personal contact details as well as SAICA's website.

Participants for group 3 (students) were also selected through purposive sampling, based on registration for Applied Auditing (AUE4862) in 2017. Ethical clearance was obtained from the RPSC of the Unisa SRIPCC to obtain a list of the myLife Unisa e-mail addresses (academic e-mail addresses) of the target populations – students registered for AUE 4862 in 2017. According to the Protection of Personal Information Act No. 4 of 2013, cellphone numbers of students are classified as personal information and this could not be supplied by Unisa. E-mail invitations were thus sent to the myLife Unisa e-mail addresses of a 155 students. I found that many students did not read their myLife e-mails, as read-receipts were in many instances not received. I also found it difficult to find students willing to participate in a two- to three-hour focus group session on the main campus. The participants in all three constituencies were older than 18 and younger than 60 years of age.

Another example of non-probability sampling is haphazard sampling where participants are selected without any obvious principles. Convenience sampling is a form of haphazard sampling where participants are mainly selected because of the ease or convenience of their availability (Saunders et al. 2016: 304). Convenience sampling was also used to select the participants for groups 1 to 3. They were mainly selected from the Gauteng area, as it was anticipated that they would most likely attend a three-hour focus group discussion conducted at the Unisa main campus in Pretoria.

Based on the selection and sampling process described in this section, potential participants were invited to take part in the study. A participant information sheet and formal invitation with logistical information (date, time and venue of focus group discussion) were communicated participants. Refer to Annexure G for the particant information sheet and Annexure H for the invitation letter.

### 6.4.3 Identification of the issue statement

An issue statement should capture the nature of the problem (Northcutt & McCoy 2004: xii) and set the scene for affinity production as well as analysis (Northcutt &

McCoy 2004: 87). Taking into account the problem statement, research questions and the nature of the constituencies, the following issue statement was posed to all three IQA focus groups: *'Thinking about a technology-based educational intervention to develop critical thinking in auditing students, what comes to mind?'* My supervisors as well as the independent facilitator for the IQA focus groups, approved this issue statement.

### 6.4.4 Comparisons and the identification of research questions

The need for a comparison between constituencies, provide the foundation for the research questions. The primary research question that this study aims to address is: *Which concepts, and relationships between these concepts*, *should be considered when critical thinking is developed in auditing students through technology-based educational interventions?* (B). Northcutt and McCoy (2004: 28) also advise three research questions for an IQA research design, namely:

- *What are the components of the phenomenon?* These components are referred to as affinities and are considered to be the primary product of an IQA research study. For the purposes of this study, this question was stated as secondary research question B5: *Which concepts should be considered when critical thinking is developed in auditing students through technology-based educational interventions?*
- *How do the components relate to one another in a system?* Participants provide their own perspectives on the perceived relationships among affinities. For the purposes of this study, this question was stated as secondary research question B6: *How are these concepts related to one another?*
- *How do the different systems compare?* Different constistuencies' systems are compared to obtain insight into the phenomenon. For the purposes of this study, this question was stated as secondary research question B7: *How do the concepts as identified by the three groups, and the systems of the three groups, compare to one another?*

The next phase of the IQA research flow is the IQA focus groups. This phase is discussed in more detail in section 6.5.

## 6.5 IQA FOCUS GROUPS

In terms of the IQA research flow followed for this particular study, the next phase was the IQA focus groups. Figure 14 indicates where this phase fits into the IQA research flow adapted for this study.

IQA studies generally start with one or more focus groups. The following sections provide more detail on the location, date and duration of these focus group discussions. They also provide information on the role, selection and preparation of the IQA focus group facilitator. These sections furthermore focus on how affinities were produced.

### 6.5.1 Focus group setting, location, date and duration

Saunders *et al.* (2016: 418) advise that the researcher should carefully consider the location and setting of the focus group discussion. Focus group discussions should be in a relaxed and comfortable setting (Kitzinger 1995: 301). Salkind (2009: 211) notes that the setting in which the focus group discussion takes place should encourage open discussions. The focus group should preferably be conducted in a neutral setting for participants to feel more comfortable. Disruptions should be minimised and participants should not feel like their discussions can be overheard (Saunders et al. 2016: 418). Seating should preferably be in a circle for participants to easily take part in the discussion (Saunders et al. 2016: 418; Kitzinger 1995: 301). Refreshments can be made available to participants (Kitzinger 1995: 301).

Kitzinger (1995: 301) notes that focus group discussions often last between one and two hours but that they could continue for an entire day or several meetings when the need arises. Leedy and Ormrod (2005: 146) advise that participants should discuss the particular problem or phenomenon for approximately one to two hours. An IQA focus group session can take three to four hours to complete (Northcutt & McCoy 2004: 87). Saunders *et al.* (2016: 419), however, note that it is not advisable to conduct more than one focus group discussion on a single day as data might get lost or disorganised between groups.

Taking these guidelines into account, a boardroom located on the Unisa main campus in Pretoria was used to conduct all three of the focus groups. The focus group discussion for group 1 (learning designers) was conducted on Thursday 23 March

2017 from 09:00 to 12:00. The focus group discussion for group 2 (educators) was conducted on Wednesday 29 March 2017 from 09:00 to 12:00. The last focus group discussion for group 3 (students), was conducted on Friday 31 March 2017 from 09:00 to 12:00. All three focus group discussions thus took place on separate days and did not exceed three hours. The boardroom was considered appropriate for these focus group discussions as it presented a professional, relaxed and comfortable setting. The boardroom was furnished with boardoom chairs and tables. There was sufficient space for participants to move around when required to do so. The boardroom thus provided an effective facility for the focus group discussions and I could not identify any influences relating to the venue that could have negatively impacted on the group dynamics.

The Unisa main campus is also located close to the Pretoria Gautrain station, public train station, bus stations and taxi ranks. This made accessibility to the campus more convenient to participants arriving from other areas. I also pre-arranged parking for participants close to the boardroom on the main campus. Participants received a detailed map of the Unisa main campus (via e-mail), with indications of where the boardroom was located, prior to the focus group discussions. I made use of professional catering services to provide refreshments to participants.

The attendance of those participants who indicated their willingness to take part in the focus groups, was vital. Apart from the initial invitation letter (Annexure H), I also sent out a reminder e-mail to all participants to remind them of the date, time and venue of the focus group discussion. I also took into account participants' busy periods when the dates of the discussions were selected. Test dates, examination dates, school holidays and puplic holidays were considered.

### 6.5.2 Recording of the focus group discussions

Focus group discussions should ideally be recorded (Connelly 2015: 369; Northcutt & McCoy 2004: 87; Kitzinger 1995: 301) to enable the researcher to analyse data after the focus group discussions (Connelly 2015: 369). All three focus group discussions were recorded and participants were made aware of the recordings at the start of the discussions. No objections were received from participants.

It was noted in section 6.2 that the main objective of an IQA is to obtain an understanding of a particular phenomenon by identifying the affinities of a system and the perceived relationships that exist between these affinities (Northcutt & McCoy 2004: xxi). The following section describes the procedures that were followed in this study, in line with those advised by Northcutt and McCoy (2004: 81–145), to arrive at the system elements (affinities) presented in Chapter 7 (section 7.2).

### 6.5.3 System element (affinity) production

With the identification of the problem, constituencies, the issue statement and research questions, the scene is set for the identification of the system elements, also referred to as affinity production. These affinities are the building blocks that are used to create a mindmap of the phenomenon being studied (Northcutt & McCoy 2004: 81). Affinities are "*sets of textual references that have and underlying common meaning or theme, synonymous to factors or topics"* (Northcutt & McCoy 2004: 81). Affinity production takes place during the focus group discussions. Sections 6.5.3.1 to 6.5.3.5 provide an overview of how affinities were produced in this study.

#### *6.5.3.1 Warm-up exercise and silent nominal brainstorming phase*

In each of the three focus group discussions, I introduced myself to the participants. I briefly explained the process that the participants would be taking part in. I indicated to the groups that the discussions were recorded. I furthermore briefly highlighted the importance of the research and the significance of each of the participants' input. I asked all participants to sign the pre-printed attendance register as well as a pre-printed informed consent form (Annexure I).

A warm-up exercise was then performed by the independent facilitator in each of the three focus groups. The warm-up exercise was meant to clear the minds of the participants so that they could focus only on the phenomenon being discussed (Northcutt & McCoy 2004: 88). The facilitator presented the group with a focus group information sheet (Annexure J). This sheet contained the research question, the aim or purpose of the study as well as the definition of critical thinking (as defined by the APA) selected for the purposes of this study. Some of the information had also been provided to participants in the information sheet (as part of the invitation e-mail) prior to the focus group discussion (Annexure G).

Following this warm-up exercise, the independent facilitator invited the participants in each of the three focus groups to take part in a silent brainstorming session (Northcutt & McCoy 2004: 91). Each participant was provided with note cards and a black marker. The facilitator requested participants to silently write as many thoughts, words, phrases, feelings and ideas on the issue statement on individual note cards, but only one thought per card. Participants were allowed to produce as many note cards as they desired (Northcutt & McCoy 2004: 91). The facilitator remained independent during this silent brainstorming phase to avoid influencing the contents of the note cards. The brainstorming session was conducted in complete silence so that participants would not influence one another. The facilitator monitored and ended this phase (after approximately 20 to 30 minutes) when it seemed that participants had exhausted their ideas on the topic.

#### *6.5.3.2 Clarification of meaning phase*

Following the silent nominal brainstorming phase, the facilitator requested participants to silently tape their note cards to an open wall in the boardroom. The facilitator guided a group discussion to clarify the meanings of the note cards. The purpose of the clarification process was to ensure that each note card has a socially constructed, shared meaning that was arrived at by the group (Northcutt & McCoy 2004: 94). Any ambiguity or unclear meanings were sorted out to achieve consensus on each note card. Opportunity was then given to participants to write down any additional ideas on note cards which were taped to the wall as well. Further clarification was done on these note cards where necessary.

#### *6.5.3.3 Affinity grouping (inductive coding)*

The facilitator then requested participants to silently review the note cards on the wall and to cluster them into groups of similar themes, named affinities. This identification of affinity process is referred to as inductive coding (Northcutt & McCoy 2004: 98). No specific criteria was provided to participants to sort the note cards and participants were allowed to freely move around the cards, sorting them into affinities. The facilitator then guided each group in discussions so that consensus could be reached on the affinities.

#### 6.5.3.4 Affinity naming and revision (axial coding)

During axial coding, the affinites identified during inductive coding are named, clarified and refined (Northcutt & McCoy 2004: 98). The facilitator guided the participants in narrowing down the meanings of the affinities. Some affinities were combined and others were divided into sub-affinities. Group discussions and consensus on meanings guided this process of inductive and deductive coding. When participants reached consensus on the meanings of affinities, the affinities were then named. Header note cards, with the name given by the group to each affinity, were placed at the top of affinities.

The facilitator then asked each group to reflect on the issue statement and whether they believed the affinities and affinity names fairly represented the views of the group on the issue. The facilitator reminded participants of the importance of their continued participation in identifying the relationships among affinities. Participants were then thanked for their contribution to the focus group discussion.

#### 6.5.3.5 Affinity descriptions

*"It is important that each affinity is described clearly and directly, remaining faithful to the language used by focus group members and following the sense of what participants were saying"* (Northcutt & McCoy 2004: 100). The researcher or participants should write a paragraph, describing each affinity in the words of the group. The note cards produced during the focus group discussion as well as the transcript of the discussion should be used for this purpose. However, the description of affinities remains, by its very nature, interpretive (Northcutt & McCoy 2004: 100). For the purposes of this particular study, I used the note cards produced by the respective groups, together with the voice recordings of each discussion, to describe the affinities. The independent facilitator also worked through the note cards and the descriptions compiled by myself to ensure that they provided a true reflection of those produced by the groups. The participants were then sent an e-mail with the Detailed Affinity Relationship Table (DART) (Annexure K, L and M) for their group, which contained the affinities produced by their group together with the descriptions of these affinities. Participants then had an opportunity to make any changes to these descriptions.

Section 6.2 also notes the importance of obtaining an understanding of the perceived relationships that exist among these affinities (Northcutt & McCoy 2004: xxi). The following section describes the procedures that were followed in this study, in line with those advised by Northcutt and McCoy (2004: 147–195), to determine the perceived relationships that exist between the affinities, as presented in Chapter 7 (section 7.3).

## 6.6 SYSTEM RELATIONSHIPS

In terms of the IQA research flow followed for this particular study, the third phase is determing the system relationships. Refer to Figure 14 for an illustration of where this phase fits into the IQA research flow adapted for this study.

According to Northcutt and McCoy (2004: 149), theoretical coding refers to the process where the perceived cause-and-effect relationships between affinities, within a system, are determined. Theoretical coding is integral to the IQA methodology and *"in the focus group setting, this is accomplished by facilitating a systematic process of building hypotheses linking each possible pair of affinities"* (Northcutt & McCoy 2004: 149). IQA thus allows participants, through a formal protocol, to determine whether there are relationships and what these potential relationships between affinities are. The group Interrelationship Diagram (IRD) represents the summary of the group's theoretical coding.

To analyse the perceived relationships among all possible affinity pair relationships, I had the choice of using either an Affinity Relationship Table (ART) or a Detailed Affinity Relationship Table (DART). The simple ART is quick to complete but only provides the direction of relationships among affinities. The DART on the other hand, requires more time to complete as participants have to explain the direction of the relationship in their own words. Section 6.6.1 contains more detail on the DART and an example of a DART table.

### 6.6.1 Detailed Affinity Relationship Table (DART)

In the DART table, relationships between affinities are analysed by participants with "if…, then…" statements. This is referred to as hypothetical construction (Northcutt & McCoy 2004: 150–152). By completing these statements, participants provide the researcher with an opportunity to understand their reasoning and logic. Table 21 presents an example of a DART as suggested by Northcutt and McCoy (2004: 153).

**Table 21: Detailed Affinity Relationship Table (DART)**

| Detailed Affinity Relationship Table (DART) | | | |
|---|---|---|---|
| Affinity pair relationship | | | Example of the relationship either in natural language or in the form of an IF/THEN statement of relationship |
| 1 | | 2 | |

Source: (Northcutt & McCoy 2004: 153)

Possible relationships in Table 21 could then only be 1 → 2 (affinity 1 influences affinity 2), 1 ← 2 (affinity 2 influences affinity 1) or 1 < > 2 (there is no relationship between these affinities).

I opted for using DARTs in this particular study to obtain detailed reasoning and logic from each participant on the direction of relationships among affinities. As most of these participants are either professional individuals with busy work schedules or students busy with tests and examinations, participants were allowed the opportunity to complete the DARTs at their own convenience and in their own time. This gave participants the opportunity to complete the DARTs in more detail.

It was noted in section 6.3 that the IQA research flow was slightly adapted for this study as IQA interviews were excluded. According to Northcutt and McCoy (2004: 48–49), IQA interviews could be conducted to enhance the richness and depth of the description of affinities and allow for individual mindmaps to be formed. The three groups, however, provided rich affinity descriptions with adequate depth for purposes of this study. I did not believe that individual, semi-structured interviews would have further enhanced the richness and depth of these affinities. IQA interviews should, furthermore, serve to explore the perceived relationships between affinities and to facilitate effective analysis of the results (Northcutt & McCoy 2004: 199). Detailed reasoning and logic on the direction of the relationships among affinities were obtained from participants through the DARTs. I did not feel that IQA interviews would have provided additional insight into the direction of the relationships already obtained through these DARTs. Other researchers have also made use of either ARTs or DARTs, with or without IQA interviews, in their studies. Nienaber (2013: 1–509) used ARTs and did not include IQA interviews in his study. Du Preez (2015: 1–258) made use of DARTs and also did not conduct individual IQA interviews. Both Plant (2015: 1–386) and Robertson (2015: 1–263), however, made use of ARTs and conducted

IQA interviews in their studies. As an ART only provides the direction of the relationship and not a detailed explanation of the relationship, semi-structured IQA interviews could thus have provided more information in the case of these two studies.

I compiled a DART for groups 1 to 3 (refer to Annexures K, L and M). The DART for each group set out the affinities produced by the group, the affinity descriptions and each possibly affinity pair relationship. Participants were requested, via e-mail (sent out during April 2017), to complete the DART by indicating the nature of the relationship between all possible pairs of affinities together with a written "if…, then…" statement that reflected their own experiences or reasons why they indicated the specific directions of relationships among affinities (Northcutt & McCoy 2004: 152). The principle of independent coding was thus applicable during the completion of the DARTs by participants (Northcutt & McCoy 2004: 154).

Once the DARTs were completed by participants and returned to me, I had to determine the consensus of the group's analysis of relationships (Northcutt & McCoy 2004: 156). A group composite through a Pareto Protocol was performed. The Pareto Protocol was the statistical method followed in this study to determine the group consensus as set out in section 6.6.2.

### 6.6.2 Pareto protocol

The Pareto Protocol is a detailed, statistical method to create a group composite for documenting the degree of consensus in a focus group (Northcutt & McCoy 2004: 156–157). In terms of the Pareto Protocol, the frequency of each affinity pair relationship should be determined and recorded (Northcutt & McCoy 2004: 157). The Pareto principle states that *"something like 20% of the variables in a system will account for 80% of the total variation in outcomes"* (Northcutt & McCoy 2004: 156). Essentially, this means that the minority of the relationships accounts for the majority of the variation (Northcutt & McCoy 2004: 157). IQA uses this Pareto rule of thumb to achieve consensus in a focus group and to compose a statistical group composite.

The first step in the Pareto Protocol is to determine the frequency of each affinity pair relationship, as added from the individual DARTs and to record the frequency on a spreadsheet. The relationships should then be sorted in descending order of frequency (Northcutt & McCoy 2004: 157). The next step is to determine the following (Northcutt & McCoy 2004: 160):

- The cumulative frequency: This is the running total (each entry is the frequency of votes obtained for an affinity pair, added to the previous total).
- The cumulative percentage (relation): Calculated as the cumulative percentage, based on the total number of possible relationships.
- The cumulative percentage (frequency): Calculated as the cumulative percentage based on the total number of votes cast.
- Power: Represents the degree of optimisation of the system. It is calculated as the difference between the cumulative percentage (frequency) and the cumulative percentage (relation).

The cumulative percentage (frequency) and power are key in determining the optimal number of relationships to include in the group IRD. The goal is to include the fewest number of relationships that represent the greatest amount of variations in the system. Relationships that obtained very little or no votes in the DARTs are usually excluded from the group composite (Northcutt & McCoy 2004: 157). The MinMax criterion is thus applied where *"the composite should account for maximum variation in the system (cumulative percent[age] based upon frequency) while minimising the number of relationships in the interest of parsimony (cumulative percent[age] based on relations)"* (Northcutt & McCoy 2004: 160). The point where power reaches a maximum provides a defensible choice for inclusion or exclusion of affinity pair relationships in the IRD. Affinity pair relationships above this point can be included while the ones that fall below this point can be excluded in terms of the MinMax criterion. Chapter 7 (section 7.3.2) provides more detail on how the Pareto Protocol and the MinMax criterion were applied to the data of the three groups.

Cumulative frequencies are also used to resolve ambiguous relationships. These are relationships which have attracted votes in both directions (Northcutt & McCoy 2004: 157), where both directions have been included in the IRD. Such a relationship is usually resolved through the identification of an undetected feedback loop or an undetected common influence that only emerges after the creation of the Systems

Influence Diagram (SID). Ambiguous relationships identified as part of this study are dealt with in more detail in Chapter 7 (section 7.3.3).

### 6.6.3 Interrelationship Diagram (IRD)

The Pareto Protocol, with the MinMax criterion, was thus used to determine the optimal number of relationships to include in the group IRD. The group IRD is the first step in rationalising the system as it represents the output of the focus group hypothesis activity. The IRD provides a summary (presented as arrows) of the perceived cause and effect between affinities. This illustrates the direction of relationships. In the example of 1 → 2, 1 is the cause or influencing affinity and 2 is the effect or influenced affinity. Each relationship is recorded twice in the IRD, once with an up arrow and once with a left arrow. Thereafter all the up arrows are added as *outs* and the left arrows are added as *ins.* The *ins* are subtracted from the *outs* to determine the *deltas.* The table is then sorted in descending order in terms of *delta* order (Northcutt & McCoy 2004: 170–173).

The *deltas* are used to determine the drivers and the outcomes. An affinity with a high positive *delta* (only *outs*) is classified as a primary driver (sifnificant cause on other affinities but remains unaffected by others). An affinity with more *outs* than *ins* is classified as a secondary driver (relative cause on other affinities). An affinity with equal number of *ins* and *outs* is classified as a pivot or cilculator. An affinity with more *ins* than *outs* is classified as a secondary outcome (relatively affected by other affinities). An affinity with only *ins* is classified as a primary outcome (significantly affected by other affinities, but does not affect others). Chapter 7 (section 7.3.3) provides more detail on how the IRDs were compiled for the three groups. Once affinities have been classified as drivers or outcomes, the SID can be created as described in section 6.6.4.

### 6.6.4 System Influence Diagram (SID)

The SID is a visual representation of the entire system of influences and outcomes. It is created from the affinities and relationships between them, as set out in the IRD (Northcutt & McCoy 2004: 174). The SID is created by placing affinities on a screen in rough order, with primary drivers to the left of the screen and primary outcomes to the right of the screen. The secondary drivers and secondary outcomes are then placed in the middle of these primary drivers and outcomes on the screen according to their classification. The affinity numbers are placed in a circle or square and an arrow is drawn between each affinity indicating the direction of the relationship (as indicated on the IRD) (Northcutt & McCoy 2004: 176).

The first step is to create a cluttered SID. This version contains all possible relationships as indicated on the IRD. The cluttered SID is unfortunately saturated with all these links and is difficult to interpret. For this reason, the uncluttered SID is created (Northcutt & McCoy 2004: 176). All redundant links are eliminated in the uncluttered SID – *"…by eliminating links that skip over mediating affinities, we achieve a simpler, more interpretable mental mode – one that has optimum explanatory power"* (Northcutt & McCoy 2004: 177). Redundant links are removed according to their *delta* and SID assignments. Affinities on the far left and far right are compared (relationship between highest positive *delta* and highest negative *delta* is examined). If there is an alternative path between these affinities, other than the direct link, the direct link is removed as it is seen as redundant. Then, the relationship between the highest positive *delta* and the next highest negative *delta* is examined. Any redundant links are removed in the same manor. This process is continued until all redundant links have been removed. Chapter 7 (section 7.3.4) provides more detail on the cluttered and uncluttered SIDs for the three groups in this particular study.

## 6.7 THE ROLES OF THOSE INVOLVED

The specific roles of the individuals involved in the study need to be described in qualitative research. For this purpose, the roles of the researcher, the participants and the independent facilitator are described in sections 6.7.1 to 6.7.3.

### 6.7.1 The role of the researcher

I invited the participants to take part in the IQA focus groups. I also met with the facilitator prior to the IQA focus groups to discuss the topic, research problem, the participants of the three focus groups, problems experienced in the selection process of participants, dates, venues as well as other administrative details. Proper preparation of the facilitator ensured that the focus group sessions would be conducted more effectively. The facilitator thus had a basic understanding of the participants involved as well as the phenomenon to be discussed (Carey & Asbury

2016: 29). For this reason I provided the facilitator with electronic copies of selected literature chapters as well as the definition selected for critical thinking in this particular study.

I acted as a non-participating observer during the three IQA focus groups. One of the supervisors also acted as a non-participating observer during all three focus groups. During the focus groups, I recorded the sessions and observed in silence. After the focus group discussions, I (with the assistance of the independent facilitator) formulated the descriptions of the affinities. I compiled the DART and requested participants of each focus group (via e-mail) to articulate their own views of the perceived cause or effect relationships between the various affinities. I performed a Pareto Protocol for each group, compiled the IRDs and created the SIDs for each group. My main roles in the IQA process were thus that of data collection, analysis and interpretation of data.

### 6.7.2 The role of participants

The initial role of the participants was to produce note cards on which they wrote their own ideas or concepts (one per card) related to the issue statement. Thereafter, they were given the opportunity to silently group cards of meaning together, referred to as inductive coding. Axial coding was also performed by participants, where affinities were named. Subsequent to the focus group sessions, participants completed the DART (and sent it back via e-mail), to articulate their views of the perceived cause or effect relationships between the various affinities.

### 6.7.3 The role of the facilitator

The facilitator should have no vested interest in the outcome of the discussions and should remain neutral and objective (Northcutt & McCoy 2004: 93). I thus took a decision to use a skilled and experienced, independent facilitator. This also enhanced the credibility of the data.

The three IQA focus groups were run by the independent facilitator to enhance the objectivity of the results. The facilitator introduced the problem or phenomenon to be discussed (Leedy & Ormrod 2005: 146) as well as the issue statement. The facilitator provided the opportunity as well as environment for a silent brainstorming session whereafter he invited the participants to produce note cards with their own individual ideas or concepts on the topic. He continuously guided participants through the steps of the focus group session which included the grouping of the cards and the naming of affinities. The facilitator managed group discussions professionally and remained objective to ensure that all participants' views were taken into account. During the sessions the facilitator ensured that the groups remained focused to maximise participation from everyone in the group (Northcutt & McCoy 2004: 93). The facilitator had to ensure that no single participant dominated the focus group discussions and that participants were kept focused on the topic at hand (Salkind 2009: 211; Leedy & Ormrod 2005: 146).

After the focus group discussions the independent facilitator assisted me with the formulation of the descriptions of the affinities and the compilation the DART for each group. The independent facilitator confirmed and double-checked the DARTs, group composites, IRDs and SIDs compiled by myself for each group. This increased the rigour of the research.

The qualitative researcher should also always be concerned with strenthening the credibility of a qualitative study (Yin 2016: 85). The following section addresses qualitative rigour and how it was addressed in the study.

## 6.8 QUALITATIVE RIGOUR

A credible study provides assurance that the data was proporly collected and properly interpreted. The findings and conclusions should thus accurately reflect what was investigated (Yin 2016: 85). Quantitative studies generally address reliability, validity and generalisability. Qualitative studies generally address trustworthiness in terms of credibility, transferability, dependability and confirmability (Guba & Lincoln 1985: 289–331).

- Credibility: Prolonged engagement, referential adequacy, peer debriefing and member checks are used to establish credibility of research.
    - Prolonged engagement: This study was initiated in 2015 where I started doing research on critical thinking development for my PhD. I have, however, been actively involved in the education and training of students registered for the Postgraduate Diploma in Accounting Sciences at

Unisa since 2008, where critical thinking development forms part of the SAICA competency framework requirements.

- Referential adequacy: This approach is also referred to as triangulation which verifies or corroborates qualitative data or findings in different ways. I conducted three IQA focus groups to *"build a coherent justification for themes"* (Creswell 2014: 201). I also obtained DARTs from the participants in these three groups with rich descriptions in the form of "if…, then…" statements. The findings from these focus groups were used to validate the preliminary conceptual framework that was compiled from a detailed literature review (refer to Chapter 5).
- Peer debriefing: After each focus group discussion, one of my supervisors (who acted as a non-participating observer), the independent facilitator and I held a debriefing session with regards to the focus group discussion. We discussed possible factors that could have influenced group dynamics and the trustworthiness of affinities produced by the groups. Both supervisors were also continuously involved in discussions with myself with regard to the research process and methodology. The supervisors also reviewed and continuously examined the findings and their interpretations.
- Member checks: This refers to feedback obtained from participants to ensure that any misinterpretation was addressed (Yin 2016: 89). I e-mailed the DARTs for the respective groups to the participants to allow them to determine whether the affinities and the affinity descriptions were a true and accurate reflection of their views.
- Transferability: This approach depends on thick and/or rich descriptions that would allow other researchers to transfer the results to their own contexts. As part of the three IQA focus group discussions, participants provided thick and rich affinity descriptions with adequate depth. Participants also completed DARTs. Although this required more time to complete, it provided detailed reasoning and logic on the direction of the relationships between affinities from their perspectives, which were contextually situated. The affinity descriptions and the DARTs reflected the participants' voices. By also explicitly and methodically documenting how the topic of the study was selected, how participants were selected

and what the approach to data collection was, trustworthiness was also ensured (Yin 2016: 86). If a certain research protocol was used in a study, the quality of this protocol and how it was applied should also be documented to enhance trustworthiness (Yin 2016: 86). Chapter 6 provided details on the problem statement, the identification and classification of constituencies, the issue statement, research questions, as well as detail on the IQA focus groups and system relationships. The Pareto Protocol followed in this study was also documented in detail. The descriptions provided in Chapter 6 thus add to the transferability of the subsequent data and findings. Qualitative rigour is also specifically addressed by Northcutt and McCoy (2004: 38). Data collected and analysed, should be replicable, should not be dependent on the nature of the elements themselves and should be public. Rigour is addressed in IQA, by allowing participants to identify the affinities as well as the perceived relationships among affinities. Rigour is also addressed by following rules for rationalisation and guidelines for systems representation. Two different people analysing IQA data, should thus be able to come to the same system representations (Northcutt & McCoy 2004: 38). This is in line with considerations of the validity of the study and its findings as set out by Yin (2016: 88). Yin (2016: 88) also asserts that a study is valid when others can replicate the study, collect the same evidence and come to similar findings and conclusions. The independent facilitator confirmed and double-checked the DARTs, group composites, IRDs and SIDs which I had compiled for each group. This increased the rigour and transferablity of the research.

- Dependability and confirmability: An inquiry audit trail should be available to ensure dependability and confirmability of the data. The following inquiry audit trail exists for this study:
  - Raw data: IQA focus group discussion voice recordings, individual participant DARTs.
  - Data reconstruction and synthesis products: In the form of IRDs, cluttered SIDs, uncluttered SIDs, affinity reconciliation process, final conceptual framework.

- Process notes, material relating to intentions and dispositions: In the form of personal notes on the IQA focus group dynamics, personal notes on my own growth and critical thinking development, notes on the methodology used.

## 6.9 CONCLUSION

Chapter 6 provided the methodological underpinnings of this study. Greater detail was provided on the IQA research flow, which included the IQA research design, IQA focus groups and system relationships. This chapter also addressed the roles of those involved and qualitative rigour. The last phase of the IQA research flow, namely reporting, is addressed in Chapter 7, which presents the data from the three IQA focus groups.

# CHAPTER 7
# DATA PRESENTATION – FOCUS GROUPS 1 TO 3

## 7.1 INTRODUCTION

The preliminary, literature-based, conceptual framework was presented in Chapter 5. To validate the key constructs, concepts, assumptions, beliefs and theories related to critical thinking, as well as the relationships between them, proposed in this framework, the perspectives of three groups of participants were obtained. These perspectives also provided insight into additional concepts and possible relationships that exist between these concepts, that could be added to the final proposed conceptual framework (presented in Chapter 8).

This chapter represents the reporting phase of the IQA research flow as illustrated in Figure 14 (refer to Chapter 6). The data gathered from the focus groups is thus presented in the same colours used in Chapter 6.

| |
|---|
| **Group 1 (learning designers)** |
| **Group 2 (educators)** |
| **Group 3 (students)** |

A typical IQA report names and describes the elements or affinities of a system (Northcutt & McCoy 2004: 50). In this study, these affinities represent the concepts that should be considered when critical thinking is developed in auditing students through technology-based educational interventions. This chapter provides an overview of these concepts from the perspectives of three groups, thereby addressing secondary research objective A5 and secondary reseach question B5.

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| **Secondary research objective A5** | To obtain an understanding of the concepts that should be considered when critical thinking is developed in auditing students through technology-based educational interventions. |

| | |
|---|---|
| **Secondary research question B5** | Which concepts should be considered when critical thinking is developed in auditing students through technology-based educational interventions, from the perspective of:<br>• Instructional designers, online learning designers, educational technologists, teaching and learning consultants as well as experts in e-learning environments;<br>• Auditing lecturers at SAICA-accredited programme providers and SAICA representation; and<br>• Postgraduate auditing students at Unisa? |

A typical IQA report furthermore aims to explain the relationships that exist between these elements or affinities of a system (Northcutt & McCoy 2004: 50). An understanding of how the concepts identified through the focus groups relate to one another, is thus obtained and discussed in Chapter 7 to address secondary research objective A6 and secondary reseach question B6. This chapter provides the results of the theoretical coding performed in terms of the IQA process, a description of the overall placement of affinities in the SID for each group as well as the identification of possible feedback loops (Northcutt & McCoy 2004: 300). These results are presented in sections 7.3 to 7.6.

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| **Secondary research objective A6** | To obtain an understanding of how these concepts relate to one another. |
| **Secondary research question B6** | How are these concepts related to one another? |

A typical IQA report lastly compares the systems (Northcutt & McCoy 2004: 50). In Chapter 7 an understanding is thus obtained of how the concepts and the systems of the three groups compare to one another to address secondary research objective A7 and secondary reseach question B7. This comparison is provided in section 7.7.

| | |
|---|---|
| **Secondary research objective A7** | To obtain an understanding of how the concepts and the systems of the three groups compare to one another. |
| **Secondary research question B7** | How do the concepts as identified by the three groups, and the systems of the three groups, compare to one another? |

Section 7.2 provides an overview of the system elements or affinities, for each of the three groups. These affinities represent the concepts these three groups consider

important when critical thinking is developed in auditing students through technology-based educational interventions. The affinities discussed in this section, were produced in line with the procedures advised by Northcutt and McCoy (2004: 81–145), as set out in Chapter 6 (section 6.5.3). Section 7.2 also provides an overview of my reflection on the dynamics of each focus group.

## 7.2 SYSTEM ELEMENTS (AFFINITIES) FOR GROUPS 1 TO 3

The problem statement, the identification and classification of constituencies, the issue statement as well as the research questions were all addressed in Chapter 6 (sections 6.4.1 to 6.4.4). These set the scene for the identification of the system elements, also referred to as affinity production.

### 7.2.1 Identification of affinities and affinity descriptions: Groups 1 to 3

Affinities should be described from the group's point of view (Northcutt & McCoy 2004: 300). Nine participants took part in the discussion and generation of the affinities for group 1 (learning designers). This group produced 85 note cards which they grouped together into eleven affinities. The group named these eleven affinities as set out in Table 22.

**Table 22: Affinities produced by group 1 (learning designers)**

| Affinity no | Affinity name and description |
|---|---|
| 1 | **Design process**<br>With this affinity the focus group emphasised the importance of the design process. Principles of quality design must be evaluated and followed. This intervention should be user-friendly and based on knowledge creation. Industry leaders in software design must be consulted. Applications, databases, software as well as new technologies should be repurposed regularly and customised for specific needs and purposes. |
| 2 | **Enabling tools**<br>With this affinity the focus group indicated the importance of enabling tools such as blogs, forums, wikis, podcasts, jingles, animation and photo captions. The group highlighted the principle that these tools only enable teaching and do not teach themselves. |
| 3 | **Pure simulation**<br>The focus group indicated the significance of pure simulations. These pure simulations do not include gaming elements, yet include augmented reality, virtual reality and virtual worlds such as Second Life as examples of such interventions. |
| 4 | **Gaming for education → Gamification**<br>With this affinity the focus group indicated the importance of using gaming principles for educational purposes. User-friendly, interactive games could provide effective platforms for the development of critical thinking in students. Within auditing, they proposed games of deception as well as role play where the aim is to distinguish between claims that are true and those that are false. Gaming principles also provide the opportunity for peer versus peer interaction or competition. |

| | |
|---|---|
| 5 | **Soft skills and dispositions**<br>Through this affinity the focus group identified several soft skills and dispositions that can be associated with critical thinking. They highlighted metacognition (thinking about one's thinking) and also noted empathy, ethical behaviour, intrinsic motivation, a positive attitude and good communication skills. Within auditing, the ability to assess a situation and ask the right questions, were seen as vital critical thinking skills. |
| 6 | **Discipline-specific skills**<br>Through this affinity the focus group identified judgement as a core discipline-specific skill and related it to making informed decisions. Other auditing specific skills noted were the ability to make constant critical comparisons, to be systematic, to be organised and to follow certain standards. |
| 7 | **Learning process**<br>With this affinity the focus group highlighted the importance of changing old ways of thinking and adapting current learning processes in order to address the growing gap between basic and higher education. Authentic learning takes place where knowledge is applied in real-life contexts and situations and vital within the development of critical thinking. The transferability and application of knowledge in different settings should be a focus point. Collaborative learning, information sharing, creative thinking, interactivity, student engagement, progressive enquiry, autodidactic learning as well as rhizomatic learning are all important. The group also indicated that the intervention should avoid didactic or rote learning and emphasised deep learning approaches, considering the locus of control. |
| 8 | **Change in pedagogy**<br>With this affinity the focus group highlighted that most education fields including pedagogy, andragogy, heutagogy and paragogy have changed significantly over the last few years. In recent years the focus has shifted to students obtaining knowledge from peer students. The group raised the question of who teaches who and noted that the role of the educator has shifted significantly in recent years. |
| 9 | **Multi-linguistic environment**<br>The focus group indicated that the multi-linguistic environment within South Africa is an important aspect that should be considered. Cognisance should be taken of the language (first, second or third language) in which critical thinking is developed. Advanced machine translation software could be used to translate between languages in order to facilitate critical thinking within this environment. The group further noted that the power discourse within language should be considered. |
| 10 | **Cross-functionality**<br>The focus group highlighted that integration of interdisciplinary skills sets and collaboration among disciplines are important in the design of this educational intervention. Collaboration among IT experts, educational technologists and academics is required when an interdisciplinary educational intervention is being designed as this allows for effective systems integration. Supportive infrastructure should also lay the foundation for such intervention. |
| 11 | **Challenging conventions**<br>The focus group stressed the importance of using dialectic methods to challenge conventional ways of teaching auditing students. Alternative frameworks should be developed to adapt to the changing landscape in the auditing profession. The group mentioned that auditors might not be naturally inclined to think critically as a result of current didactical educational practices. If the auditing profession is to address the current skills gap, the focus of teaching should not only be on teaching explicit knowledge (content knowledge) but should also be on the development of implicit knowledge which includes skills such as critical thinking. Conventions should also be challenged by paying attention to other nuances which include gender and racial differences, language barriers, to name only a few. All students should thus be empowered through this intervention. |

**Source:** Author

Thirteen participants actively took part in the discussion and generation of the affinities for group 2 (educators). This group produced 117 note cards which they grouped together into twelve affinities. These twelve affinities were named by the group as set out in Table 23.

**Table 23: Affinities produced by group 2 (educators)**

| Affinity no | Affinity name and description |
|---|---|
| 1 | **Lecturer competence**<br>With this affinity the focus group emphasised the importance of overall lecturer competence in the use of technology and staying up to date with technological advancements, thus being technologically savvy. Lecturers should also receive the necessary training and skills development enabling them to effectively use technology-based educational interventions. Lecturers furthermore need to act as facilitators and mentors of students within these interventions, as they see it as a completely different platform of teaching which students might not be familiar with. |
| 2 | **Diverse student profile**<br>Through this affinity the focus group noted the importance of obtaining an understanding of the nature and diversity of the student body before developing educational interventions. A one-size fits all approach should not be followed, thus taking into account whether students have a residential (face-to-face) or a distance learning background. It should also not be assumed that all the younger generation students are technologically empowered, for students from rural areas might not have been exposed to technological advancements in the same way others have. |
| 3 | **Student readiness**<br>Through this affinity the focus group identified several challenges that may influence students' readiness when a technology-based educational intervention is introduced. Students might not 'buy-in' or see the benefits of such intervention and/or show resistance to it. Students might lack the required reading skills or IT skills required to effectively develop their critical thinking through such an intervention. Possible risks related to online exposure should be taken into account. In order to overcome some of these challenges, training should be provided to equip students with specific IT related skills. |
| 4 | **Technological challenges**<br>With this affinity the focus group identified various technological challenges that could be present when a technology-based educational intervention is introduced. Possible challenges include emerging problems during the initial implementation phase of the intervention; the university and its IT department that might lack sufficient resources or structures to successfully support the technology-based educational intervention; and how the effectivity of the intervention could be affected by students' lack of required resources to operate the intervention. The latter might include slow internet connections, internet downtime, a lack of personal computers and/or other required hardware. |
| 5 | **Technology enablers**<br>With this affinity the focus group identified technology enablers (hardware and software tools or resources) that could facilitate the critical thinking development process in students. These enablers include the internet, Google, social media, data sources, CaseWare, computer assisted audit techniques (CAATs), ULink, advanced Excel, software applications (including various student-related applications), ipads, laptops, etc. |
| 6 | **Intervention methods**<br>With this affinity the focus group consider simulations, gamification and case studies as effective intervention methods for critical thinking development in students, where all could be provided through computer based platforms. These intervention methods should contain real-life scenarios, case studies and examples to contextualise learning. Experiential learning principles and guidelines should also be considered. |
| 7 | **Interactive engagement**<br>With this affinity the focus group noted that communication, dialogue and discussions should form the foundation of an interactive learning environment where critical thinking is developed. This interactive engagement should not only take place between the lecturer and the student but also between the students themselves. Online interactive discussion forums, discussion groups, interactive communities and chat rooms all provide effective platforms for interactive |

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| | engagement between these parties. Students should be encouraged to share their thoughts and ask questions on these interactive platforms which could provide them with real-time feedback. Connectivity between students can also be promoted by providing them with assignments or podcasts that require online feedback and discussions. |
| 8 | **Tool design**<br>With this affinity the focus group indicated that the intervention design should be user-friendly with clear instructions and outcomes built into the software. The intervention should provide certain triggers which allow the students to progress through various levels of the learning process, as well as incorporating decision trees within the design. The intervention should enable students to reflect on their learning and should provide feedback to the student. Students should be exposed to technology-based educational interventions as early as possible, preferably from first year. |
| 9 | **Learning outcomes**<br>With this affinity the focus group indicated that once a student has developed their critical thinking abilities through the intervention, they should be able to think out of the box and adapt their thinking in different situations to come up with solutions to problems. Other learning outcomes associated with critical thinking development include pervasive skills, problems solving abilities, discretionary thinking, reflecting on one's own thinking, the ability to identify and deal with ethical issues as well as the ability to interrogate information. The ability to know how to use and apply new technologies should also be included as an ultimate learning outcome. |
| 10 | **Ethics**<br>With this affinity the focus group felt that ethical considerations should form an overarching theme in all aspects of critical thinking development, the design of educational interventions and in the use of technologies. Ethics are considered to be a pillar of the chartered accountancy profession and should drive the habits of the mind as well as the critical thinking skills of students. |
| 11 | **Stakeholder engagement**<br>Through this affinity the focus group noted that there should be collaboration and engagement among academia, professional bodies and practice to identify the demands in the workplace, to remain relevant and to identify the best possibly ways of addressing current challenges in the profession. |
| 12 | **Globalisation**<br>With this affinity the focus group accentuated the importance of a continuous comparison with global or international approaches and best practices to enhance the development of students' critical thinking. A process of benchmarking technology-based educational interventions aimed at developing students' critical thinking with international standards should be in place. |

**Source:** Author

In group 3 (students), nine participants were actively involved in all the stages. In total, this group produced 54 note cards. During the session, participants grouped these note cards into seven affinities as indicated in Table 24.

### Table 24: Affinities produced by group 3 (students)

| Affinity no | Affinity name and description |
|---|---|
| 1 | **Technical knowledge**<br>With this affinity the focus group prioritised technical knowledge specifically relating to controls as well as assertions. Segregation of duties within an IT division and controls over the storing of client data is important. Technical knowledge on the payroll and personnel cycle; revenue and receipt cycle, as well as the acquisition and payments cycle should be illustrated through videos. |
| 2 | **Consideration of diversity**<br>Through this affinity the focus group noted that the diversity of students should be considered. This may include students' prior knowledge, personal backgrounds (for example culture and ethnicity) and prior exposure to technology. Interventions should be inclusive and take the above mentioned into consideration. |

| | |
|---|---|
| 3 | **Implementation timing**<br>The focus group emphasised that the development of critical thinking in students is a process that should start as early as possible, preferably at undergraduate level. Students should be exposed to technology-based educational interventions aimed at this as early as possible. Leadership structures, which include lecturers and tutors, should create an environment where critical thinking can be cultivated in students already when they start their studies. |
| 4 | **Basic fundamentals**<br>Through this affinity the focus group emphasised that the technology-based educational intervention should focus on the basic audit fundamentals and principles of a business environment and expose students to these concepts. |
| 5 | **Teaching methodology**<br>With this affinity the focus group emphasised specific teaching methodologies as the platform through which the educational intervention can be delivered to the students. This includes lecture videos with questions and answers, computer-based auditing scenarios, technology-based audit tests, videos with audit simulations and workshops. Interventions should move away from memorising theory to encouraging critical thinking through testing scenarios with multiple outcomes. |
| 6 | **Interactive teaching simulation application**<br>Through this affinity the focus group indicated that the software for this audit application could be made available on smartphones, tablets and computers. It should preferably be available to students through the relevant application (app) stores. The interactive teaching simulation application could feature story boards of audit case studies or scenarios, questions and solutions. It could also include audit cartoons, training software and/or activity-based simulations. Students could also be encouraged to work individually or in teams through these applications. |
| 7 | **Development considerations**<br>With this affinity the focus group emphasised that the intervention should be adaptable, cost-effective, appealing, interesting and attractive to students, with built-in security measures, access settings and continuity controls. Furthermore, the design principles of virtual reality and virtual machines should be considered. |

**Source:** Author

Qualitative research also requires the researcher to reflect on the group's dynamics. Any negative influences caused by group dynamics should be considered as this could impact the trustworthiness of affinities produced by the group. My reflection on the group dynamics from groups 1 to 3 are provided in section 7.2.2.

### 7.2.2 Researcher's reflection on group dynamics: Groups 1 to 3

I considered how group members interacted or participated during the focus group discussions as well as possible dominant group members. I experienced group 1 (learning designers) as professional and insightful. Most of the participants in this group were familiar with one another and this relieved some of the initial tension of the focus group discussion. There were individuals in this group with stronger views than others, but the independent facilitator managed the group discussion in a very skilled manner.

Most of the participants in group 2 (educators) were also familiar with one another, with me and some, with the facilitator. I experienced the dynamics of this group as very relaxed. I believe that this comfortable environment allowed participants to feel less stressed about the discussion. I did not notice dominant participants in the group and I thus believe that all group participants made valuable contributions to the discussions.

I experienced group 3 (students) dynamics to be somewhat strained. One of the students spoke in Afrikaans at the beginning of the focus group although the group was conducted in English. I sensed frustration amongst some of the participants as a result. Another student had difficulty expressing himself in English, which caused frustrations amongst some of the other participants. The facilitator, however, did an excellent job of containing group dynamics and managing any tensions that arose. The facilitator did note in a debriefing session that it had been one of the most difficult sessions he had facilitated. Some introverted individuals did not partake as much during the discussions, but made excellent contributions through the note cards. The group was not dominated by any one individual as the facilator made sure all voices were heard during the discussion.

After each focus group discussion, one of my supervisors, the facilitator and I had a debriefing session on the discussions. We were unable to identify any influences on group dynamics that could have negatively impacted the trustworthiness of affinities produced by the groups.

The main aim of an IQA is to represent a phenomenon in terms of affinities and the perceived relationships that exist between these affinities (Northcutt & McCoy 2004: xxi). Section 7.3 presents the results of the perceived relationships between the affinities for the focus groups.

## 7.3 SYSTEM RELATIONSHIPS FOR GROUPS 1 TO 3

DARTs were compiled for each of the groups as described in Chapter 6 (section 6.6.1). Section 7.3.1 provides more detail on the response rate in terms of the returned DARTs for each group.

### 7.3.1 Detailed Affinity Relationship Table (DART): Groups 1 to 3

For group 1 (learning designers), seven of the nine participants (78% response rate), returned a completed DART via e-mail. Two participants specifically indicated that they did not wish to complete the DART. It took eight months to receive all completed DARTs from the participants of this group.

All thirteen participants of group 2 (educators) (100% response rate) returned a completed DART via e-mail. It took three months to receive all completed DARTs from this group.

All nine participants of group 3 (students) (100% response rate) returned a completed DART via e-mail. It took four months to receive all completed DARTs from the participants in this group.

The completed DARTs enabled me to continue with the frequency analysis of relationships and the Pareto Protocol as discussed in section 7.3.2.

### 7.3.2 Pareto Protocol for groups 1 to 3

A Pareto Protocol was performed to determine the degree of consensus of the group's analysis of affinity relationships. I analysed and summarised the DARTs for each group. For each of the three groups, the total number of votes for each affinity pair relationship was added. The number of votes per affinity relationship pair (frequency) was recorded on a Microsoft Excel spreadsheet in a *'Frequency in affinity pair order'* table. The affinity relationship pairs then had to be sorted in descending order of frequency according to the Pareto Protocol (Northcutt & McCoy 2004: 158–159). Affinity pairs with the highest number of votes were thus at the top of the table and those with the lowest, or no votes, at the bottom. The facilitator verified these calculations.

#### *7.3.2.1 Pareto Protocol: Group 1 (learning designers)*

Due to the fact that only seven of the nine participants returned their DARTs, each participant had a one in seven vote (14.3%). A total of 269 votes was cast for a possible 110 relationships. The affinities in descending order of frequency for this group are listed in Table 25.

**Table 25: Affinities in descending order of frequency - group 1 (learning designers)**

| No | Affinity pair relationship | Frequency sorted (descending) | Cumulative frequency | Cumulative percentage (relation) | Cumulative percentage (frequency) | Power |
|---|---|---|---|---|---|---|
| 1 | 1 < 6 | 6 | 6 | 0.9 | 2.2 | 1.3 |
| 2 | 1 < 9 | 6 | 12 | 1.8 | 4.5 | 2.7 |
| 3 | 2 > 5 | 6 | 18 | 2.7 | 6.7 | 4.0 |
| 4 | 7 < 8 | 6 | 24 | 3.6 | 8.9 | 5.3 |
| 5 | 1 > 3 | 5 | 29 | 4.5 | 10.8 | 6.3 |
| 6 | 1 < 8 | 5 | 34 | 5.5 | 12.6 | 7.1 |
| 7 | 2 > 3 | 5 | 39 | 6.4 | 14.5 | 8.1 |
| 8 | 2 > 4 | 5 | 44 | 7.3 | 16.4 | 9.1 |
| 9 | 2 > 7 | 5 | 49 | 8.2 | 18.2 | 10.0 |
| 10 | 4 > 5 | 5 | 54 | 9.1 | 20.1 | 11.0 |
| 11 | 4 > 7 | 5 | 59 | 10.0 | 21.9 | 11.9 |
| 12 | 1 < 2 | 4 | 63 | 10.9 | 23.4 | 12.5 |
| 13 | 1 > 7 | 4 | 67 | 11.8 | 24.9 | 13.1 |
| 14 | 1 < 11 | 4 | 71 | 12.7 | 26.4 | 13.7 |
| 15 | 2 > 6 | 4 | 75 | 13.6 | 27.9 | 14.3 |
| 16 | 2 > 8 | 4 | 79 | 14.5 | 29.4 | 14.9 |
| 17 | 2 > 11 | 4 | 83 | 15.5 | 30.9 | 15.4 |
| 18 | 3 > 5 | 4 | 87 | 16.4 | 32.3 | 15.9 |
| 19 | 3 < 6 | 4 | 91 | 17.3 | 33.8 | 16.5 |
| 20 | 3 > 7 | 4 | 95 | 18.2 | 35.3 | 17.1 |
| 21 | 3 < 8 | 4 | 99 | 19.1 | 36.8 | 17.7 |
| 22 | 4 > 6 | 4 | 103 | 20.0 | 38.3 | 18.3 |
| 23 | 4 > 9 | 4 | 107 | 20.9 | 39.8 | 18.9 |
| 24 | 5 > 7 | 4 | 111 | 21.8 | 41.3 | 19.5 |
| 25 | 6 > 7 | 4 | 115 | 22.7 | 42.8 | 20.1 |
| 26 | 7 < 11 | 4 | 119 | 23.6 | 44.2 | 20.6 |
| 27 | 8 < 11 | 4 | 123 | 24.5 | 45.7 | 21.2 |
| 28 | 1 > 4 | 3 | 126 | 25.5 | 46.8 | 21.3 |
| 29 | 1 < 4 | 3 | 129 | 26.4 | 48.0 | 21.6 |
| 30 | 1 > 5 | 3 | 132 | 27.3 | 49.1 | 21.8 |
| 31 | 1 > 10 | 3 | 135 | 28.2 | 50.2 | 22.0 |
| 32 | 1 < 10 | 3 | 138 | 29.1 | 51.3 | 22.2 |
| 33 | 1 > 11 | 3 | 141 | 30.0 | 52.4 | 22.4 |
| 34 | 2 > 9 | 3 | 144 | 30.9 | 53.5 | 22.6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 35 | 4 < 8 | 3 | 147 | 31.8 | 54.6 | 22.8 |
| 36 | 4 > 11 | 3 | 150 | 32.7 | 55.8 | 23.1 |
| 37 | 5 < 8 | 3 | 153 | 33.6 | 56.9 | 23.3 |
| 38 | 5 > 9 | 3 | 156 | 34.5 | 58.0 | 23.5 |
| 39 | 5 > 10 | 3 | 159 | 35.5 | 59.1 | 23.6 |
| 40 | 5 > 11 | 3 | 162 | 36.4 | 60.2 | 23.8 |
| 41 | 6 < 8 | 3 | 165 | 37.3 | 61.3 | 24.0 |
| 42 | 7 > 9 | 3 | 168 | 38.2 | 62.5 | 24.3 |
| 43 | 7 > 10 | 3 | 171 | 39.1 | 63.6 | 24.5 |
| 44 | 8 > 9 | 3 | 174 | 40.0 | 64.7 | 24.7 |
| 45 | 9 > 10 | 3 | 177 | 40.9 | 65.8 | 24.9 |
| 46 | 9 > 11 | 3 | 180 | 41.8 | 66.9 | 25.1 |
| 47 | 1 > 2 | 2 | 182 | 42.7 | 67.7 | 25.0 |
| 48 | 1 < 3 | 2 | 184 | 43.6 | 68.4 | 24.8 |
| 49 | 1 < 5 | 2 | 186 | 44.5 | 69.1 | 24.6 |
| 50 | 1 < 7 | 2 | 188 | 45.5 | 69.9 | 24.4 |
| 51 | 2 < 7 | 2 | 190 | 46.4 | 70.6 | 24.2 |
| 52 | 2 < 8 | 2 | 192 | 47.3 | 71.4 | 24.1 |
| 53 | 2 > 10 | 2 | 194 | 48.2 | 72.1 | 23.9 |
| 54 | 3 > 4 | 2 | 196 | 49.1 | 72.9 | 23.8 |
| 55 | 3 < 5 | 2 | 198 | 50.0 | 73.6 | 23.6 |
| 56 | 3 > 6 | 2 | 200 | 50.9 | 74.3 | 23.4 |
| 57 | 3 < 7 | 2 | 202 | 51.8 | 75.1 | 23.3 |
| 58 | 3 < 10 | 2 | 204 | 52.7 | 75.8 | 23.1 |
| 59 | 4 < 5 | 2 | 206 | 53.6 | 76.6 | 23.0 |
| 60 | 4 > 8 | 2 | 208 | 54.5 | 77.3 | 22.8 |
| 61 | 4 > 10 | 2 | 210 | 55.5 | 78.1 | 22.6 |
| 62 | 4 < 11 | 2 | 212 | 56.4 | 78.8 | 22.4 |
| 63 | 5 > 6 | 2 | 214 | 57.3 | 79.6 | 22.3 |
| 64 | 5 < 6 | 2 | 216 | 58.2 | 80.3 | 22.1 |
| 65 | 5 < 7 | 2 | 218 | 59.1 | 81.0 | 21.9 |
| 66 | 6 < 7 | 2 | 220 | 60.0 | 81.8 | 21.8 |
| 67 | 6 > 8 | 2 | 222 | 60.9 | 82.5 | 21.6 |
| 68 | 6 > 9 | 2 | 224 | 61.8 | 83.3 | 21.5 |
| 69 | 6 > 10 | 2 | 226 | 62.7 | 84.0 | 21.3 |
| 70 | 6 < 10 | 2 | 228 | 63.6 | 84.8 | 21.2 |
| 71 | 6 > 11 | 2 | 230 | 64.5 | 85.5 | 21.0 |
| 72 | 6 < 11 | 2 | 232 | 65.5 | 86.2 | 20.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 73 | 7 > 11 | 2 | 234 | 66.4 | 87.0 | 20.6 |
| 74 | 8 > 11 | 2 | 236 | 67.3 | 87.7 | 20.4 |
| 75 | 10 > 11 | 2 | 238 | 68.2 | 88.5 | 20.3 |
| 76 | 10 < 11 | 2 | 240 | 69.1 | 89.2 | 20.1 |
| 77 | 1 > 8 | 1 | 241 | 70.0 | 89.6 | 19.6 |
| 78 | 1 > 9 | 1 | 242 | 70.9 | 90.0 | 19.1 |
| 79 | 2 < 5 | 1 | 243 | 71.8 | 90.3 | 18.5 |
| 80 | 2 < 6 | 1 | 244 | 72.7 | 90.7 | 18.0 |
| 81 | 2 < 9 | 1 | 245 | 73.6 | 91.1 | 17.5 |
| 82 | 2 < 10 | 1 | 246 | 74.5 | 91.4 | 16.9 |
| 83 | 2 < 11 | 1 | 247 | 75.5 | 91.8 | 16.3 |
| 84 | 3 < 4 | 1 | 248 | 76.4 | 92.2 | 15.8 |
| 85 | 3 > 8 | 1 | 249 | 77.3 | 92.6 | 15.3 |
| 86 | 3 > 9 | 1 | 250 | 78.2 | 92.9 | 14.7 |
| 87 | 3 < 9 | 1 | 251 | 79.1 | 93.3 | 14.2 |
| 88 | 3 > 10 | 1 | 252 | 80.0 | 93.7 | 13.7 |
| 89 | 3 > 11 | 1 | 253 | 80.9 | 94.1 | 13.2 |
| 90 | 3 < 11 | 1 | 254 | 81.8 | 94.4 | 12.6 |
| 91 | 4 < 6 | 1 | 255 | 82.7 | 94.8 | 12.1 |
| 92 | 4 < 7 | 1 | 256 | 83.6 | 95.2 | 11.6 |
| 93 | 4 < 9 | 1 | 257 | 84.5 | 95.5 | 11.0 |
| 94 | 4 < 10 | 1 | 258 | 85.5 | 95.9 | 10.4 |
| 95 | 5 > 8 | 1 | 259 | 86.4 | 96.3 | 9.9 |
| 96 | 5 < 9 | 1 | 260 | 87.3 | 96.7 | 9.4 |
| 97 | 5 < 10 | 1 | 261 | 88.2 | 97.0 | 8.8 |
| 98 | 5 < 11 | 1 | 262 | 89.1 | 97.4 | 8.3 |
| 99 | 6 < 9 | 1 | 263 | 90.0 | 97.8 | 7.8 |
| 100 | 7 < 9 | 1 | 264 | 90.9 | 98.1 | 7.2 |
| 101 | 7 < 10 | 1 | 265 | 91.8 | 98.5 | 6.7 |
| 102 | 8 > 10 | 1 | 266 | 92.7 | 98.9 | 6.2 |
| 103 | 8 < 10 | 1 | 267 | 93.6 | 99.3 | 5.7 |
| 104 | 9 < 10 | 1 | 268 | 94.5 | 99.6 | 5.1 |
| 105 | 9 < 11 | 1 | 269 | 95.5 | 100.0 | 4.5 |
| 106 | 1 > 6 | 0 | 269 | 96.4 | 100.0 | 3.6 |
| 107 | 2 < 3 | 0 | 269 | 97.3 | 100.0 | 2.7 |
| 108 | 2 < 4 | 0 | 269 | 98.2 | 100.0 | 1.8 |
| 109 | 7 > 8 | 0 | 269 | 99.1 | 100.0 | 0.9 |
| 110 | 8 < 9 | 0 | 269 | 100.0 | 100.0 | 0.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Total Frequency** | **269** | | | | |

**Source:** Author

The cumulative frequency column is the running total of votes, as it takes the number of votes for an affinity pair and adds it to the previous total. The cumulative percentage (relation) column is calculated as each affinity pair as a percentage of the total number of possible affinity relationships (in this case 110). For group 1 (learning designers), the cumulative percentage (relation) is calculated as one out of 110 which equates to 0.9%. The cumulative percentage (frequency) column is calculated as the number of votes cast per affinity pair divided by the total number of votes (in this case 269) and the total is then added to the previous total. The power column refers to the degree of optimisation of the system and is calculated as the difference between the cumulative percentage (frequency) column and the cumulative percentage (relation) column (Northcutt & McCoy 2004: 160).

The last two columns, namely the cumulative percentage (frequency) and cumulative percentage (relation) assist in determining which relationships should be included or excluded from the IRD of the group. The MinMax criterion of the Pareto Protocol is used to make this decision. The group composite should account for the maximum variation in the system (cumulative percentage based on frequency) whilst minimising the number of relationships for the sake of parsimony (cumulative percentage based on relationships) (Northcutt & McCoy 2004: 160). At affinity pair 46 (which is highlighted in orange), power reached its maximum point of 25.1. Power thus reaches a maximum at 46 relationships which account for 66.9% of the variation in the system for group 1 (learning designers). The first 46 relationships are thus a defensible choice for inclusion in the IRD of this group as it is considered an optimal number in terms of the MinMax criterion (Northcutt & McCoy 2004: 160). Relationships hightligned in blue represent ambiguous relationships. These ambiguous relationships are further discussed in section 7.3.3.

#### *7.3.2.2 Pareto Protocol: Group 2 (educators)*

For group 2 (educators), all thirteen participants returned their DARTs which gave each participant a one in thirteen vote (7.7%). A total of 617 votes was cast for a possible 132 relationships. The affinities in descending order of frequency for this group are listed in Table 26.

**Table 26: Affinities in descending order of frequency - group 2 (educators)**

| No | Affinity pair relationship | Frequency sorted (descending) | Cumulative frequency | Cumulative percentage (relation) | Cumulative percentage (frequency) | Power |
|---|---|---|---|---|---|---|
| 1 | 1 > 7 | 13 | 13 | 0.8 | 2.1 | 1.3 |
| 2 | 1 > 6 | 12 | 25 | 1.5 | 4.1 | 2.6 |
| 3 | 2 > 3 | 12 | 37 | 2.3 | 6.0 | 3.7 |
| 4 | 1 > 9 | 11 | 48 | 3.0 | 7.8 | 4.8 |
| 5 | 4 > 6 | 11 | 59 | 3.8 | 9.6 | 5.8 |
| 6 | 5 > 6 | 11 | 70 | 4.5 | 11.3 | 6.8 |
| 7 | 6 > 7 | 11 | 81 | 5.3 | 13.1 | 7.8 |
| 8 | 1 > 8 | 10 | 91 | 6.1 | 14.7 | 8.6 |
| 9 | 1 < 12 | 10 | 101 | 6.8 | 16.4 | 9.6 |
| 10 | 2 > 6 | 10 | 111 | 7.6 | 18.0 | 10.4 |
| 11 | 4 > 7 | 10 | 121 | 8.3 | 19.6 | 11.3 |
| 12 | 5 > 7 | 10 | 131 | 9.1 | 21.2 | 12.1 |
| 13 | 2 > 4 | 9 | 140 | 9.8 | 22.7 | 12.9 |
| 14 | 2 > 7 | 9 | 149 | 10.6 | 24.1 | 13.5 |
| 15 | 3 > 8 | 9 | 158 | 11.4 | 25.6 | 14.2 |
| 16 | 4 > 5 | 9 | 167 | 12.1 | 27.1 | 15.0 |
| 17 | 4 > 8 | 9 | 176 | 12.9 | 28.5 | 15.6 |
| 18 | 5 > 8 | 9 | 185 | 13.6 | 30.0 | 16.4 |
| 19 | 7 > 9 | 9 | 194 | 14.4 | 31.4 | 17.0 |
| 20 | 3 > 9 | 8 | 202 | 15.2 | 32.7 | 17.5 |
| 21 | 6 > 9 | 8 | 210 | 15.9 | 34.0 | 18.1 |
| 22 | 8 < 11 | 8 | 218 | 16.7 | 35.3 | 18.6 |
| 23 | 9 < 10 | 8 | 226 | 17.4 | 36.6 | 19.2 |
| 24 | 9 < 11 | 8 | 234 | 18.2 | 37.9 | 19.7 |
| 25 | 1 > 2 | 7 | 241 | 18.9 | 39.1 | 20.2 |
| 26 | 2 > 5 | 7 | 248 | 19.7 | 40.2 | 20.5 |
| 27 | 3 < 6 | 7 | 255 | 20.5 | 41.3 | 20.8 |
| 28 | 3 > 7 | 7 | 262 | 21.2 | 42.5 | 21.3 |
| 29 | 6 > 8 | 7 | 269 | 22.0 | 43.6 | 21.6 |
| 30 | 7 < 8 | 7 | 276 | 22.7 | 44.7 | 22.0 |
| 31 | 8 < 9 | 7 | 283 | 23.5 | 45.9 | 22.4 |
| 32 | 8 < 10 | 7 | 290 | 24.2 | 47.0 | 22.8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 33 | 8 < 12 | 7 | 297 | 25.0 | 48.1 | 23.1 |
| 34 | 9 < 12 | 7 | 304 | 25.8 | 49.3 | 23.5 |
| 35 | 11 < 12 | 7 | 311 | 26.5 | 50.4 | 23.9 |
| 36 | 1 > 5 | 6 | 317 | 27.3 | 51.4 | 24.1 |
| 37 | 1 < 11 | 6 | 323 | 28.0 | 52.4 | 24.4 |
| 38 | 2 > 8 | 6 | 329 | 28.8 | 53.3 | 24.5 |
| 39 | 2 > 9 | 6 | 335 | 29.5 | 54.3 | 24.8 |
| 40 | 3 < 4 | 6 | 341 | 30.3 | 55.3 | 25.0 |
| 41 | 3 > 5 | 6 | 347 | 31.1 | 56.2 | 25.1 |
| 42 | 3 > 6 | 6 | 353 | 31.8 | 57.2 | 25.4 |
| 43 | 5 > 9 | 6 | 359 | 32.6 | 58.2 | 25.6 |
| 44 | 6 < 10 | 6 | 365 | 33.3 | 59.2 | 25.9 |
| 45 | 6 < 11 | 6 | 371 | 34.1 | 60.1 | 26.0 |
| 46 | 6 < 12 | 6 | 377 | 34.8 | 61.1 | 26.3 |
| 47 | 10 < 11 | 6 | 383 | 35.6 | 62.1 | 26.5 |
| 48 | 1 < 4 | 5 | 388 | 36.4 | 62.9 | 26.5 |
| 49 | 1 < 5 | 5 | 393 | 37.1 | 63.7 | 26.6 |
| 50 | 1 > 10 | 5 | 398 | 37.9 | 64.5 | 26.6 |
| 51 | 1 < 10 | 5 | 403 | 38.6 | 65.3 | 26.7 |
| 52 | 1 > 11 | 5 | 408 | 39.4 | 66.1 | 26.7 |
| 53 | 2 < 5 | 5 | 413 | 40.2 | 66.9 | 26.7 |
| 54 | 2 < 10 | 5 | 418 | 40.9 | 67.7 | 26.8 |
| 55 | 2 < 12 | 5 | 423 | 41.7 | 68.6 | 26.9 |
| 56 | 3 < 5 | 5 | 428 | 42.4 | 69.4 | 27.0 |
| 57 | 3 < 7 | 5 | 433 | 43.2 | 70.2 | 27.0 |
| 58 | 4 > 12 | 5 | 438 | 43.9 | 71.0 | 27.1 |
| 59 | 6 > 11 | 5 | 443 | 44.7 | 71.8 | 27.1 |
| 60 | 7 > 10 | 5 | 448 | 45.5 | 72.6 | 27.1 |
| 61 | 7 < 10 | 5 | 453 | 46.2 | 73.4 | 27.2 |
| 62 | 8 > 9 | 5 | 458 | 47.0 | 74.3 | 27.3 |
| 63 | 1 < 2 | 4 | 462 | 47.7 | 74.9 | 27.2 |
| 64 | 2 > 10 | 4 | 466 | 48.5 | 75.5 | 27.0 |
| 65 | 3 < 10 | 4 | 470 | 49.2 | 76.2 | 27.0 |
| 66 | 3 < 12 | 4 | 474 | 50.0 | 76.8 | 26.8 |
| 67 | 4 > 9 | 4 | 478 | 50.8 | 77.5 | 26.7 |
| 68 | 5 < 12 | 4 | 482 | 51.5 | 78.1 | 26.6 |
| 69 | 6 < 8 | 4 | 486 | 52.3 | 78.8 | 26.5 |
| 70 | 6 < 9 | 4 | 490 | 53.0 | 79.4 | 26.4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 71 | 6 > 10 | 4 | 494 | 53.8 | 80.1 | 26.3 |
| 72 | 7 > 8 | 4 | 498 | 54.5 | 80.7 | 26.2 |
| 73 | 7 > 11 | 4 | 502 | 55.3 | 81.4 | 26.1 |
| 74 | 7 < 12 | 4 | 506 | 56.1 | 82.0 | 25.9 |
| 75 | 10 < 12 | 4 | 510 | 56.8 | 82.7 | 25.9 |
| 76 | 1 > 3 | 3 | 513 | 57.6 | 83.1 | 25.5 |
| 77 | 1 < 3 | 3 | 516 | 58.3 | 83.6 | 25.3 |
| 78 | 2 < 8 | 3 | 519 | 59.1 | 84.1 | 25.0 |
| 79 | 2 < 9 | 3 | 522 | 59.8 | 84.6 | 24.8 |
| 80 | 2 < 11 | 3 | 525 | 60.6 | 85.1 | 24.5 |
| 81 | 3 > 11 | 3 | 528 | 61.4 | 85.6 | 24.2 |
| 82 | 3 > 12 | 3 | 531 | 62.1 | 86.1 | 24.0 |
| 83 | 4 < 8 | 3 | 534 | 62.9 | 86.5 | 23.6 |
| 84 | 5 < 8 | 3 | 537 | 63.6 | 87.0 | 23.4 |
| 85 | 5 < 9 | 3 | 540 | 64.4 | 87.5 | 23.1 |
| 86 | 5 > 10 | 3 | 543 | 65.2 | 88.0 | 22.8 |
| 87 | 5 > 11 | 3 | 546 | 65.9 | 88.5 | 22.6 |
| 88 | 5 < 11 | 3 | 549 | 66.7 | 89.0 | 22.3 |
| 89 | 5 > 12 | 3 | 552 | 67.4 | 89.5 | 22.1 |
| 90 | 7 < 9 | 3 | 555 | 68.2 | 90.0 | 21.8 |
| 91 | 7 < 11 | 3 | 558 | 68.9 | 90.4 | 21.5 |
| 92 | 8 > 10 | 3 | 561 | 69.7 | 90.9 | 21.2 |
| 93 | 9 > 10 | 3 | 564 | 70.5 | 91.4 | 20.9 |
| 94 | 9 > 11 | 3 | 567 | 71.2 | 91.9 | 20.7 |
| 95 | 9 > 12 | 3 | 570 | 72.0 | 92.4 | 20.4 |
| 96 | 1 > 4 | 2 | 572 | 72.7 | 92.7 | 20.0 |
| 97 | 1 > 12 | 2 | 574 | 73.5 | 93.0 | 19.5 |
| 98 | 2 < 4 | 2 | 576 | 74.2 | 93.4 | 19.2 |
| 99 | 2 < 7 | 2 | 578 | 75.0 | 93.7 | 18.7 |
| 100 | 2 > 11 | 2 | 580 | 75.8 | 94.0 | 18.2 |
| 101 | 3 > 4 | 2 | 582 | 76.5 | 94.3 | 17.8 |
| 102 | 3 < 8 | 2 | 584 | 77.3 | 94.7 | 17.4 |
| 103 | 3 < 9 | 2 | 586 | 78.0 | 95.0 | 17.0 |
| 104 | 4 < 5 | 2 | 588 | 78.8 | 95.3 | 16.5 |
| 105 | 4 > 11 | 2 | 590 | 79.5 | 95.6 | 16.1 |
| 106 | 5 < 6 | 2 | 592 | 80.3 | 95.9 | 15.6 |
| 107 | 6 < 7 | 2 | 594 | 81.1 | 96.3 | 15.2 |
| 108 | 6 > 12 | 2 | 596 | 81.8 | 96.6 | 14.8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 109 | 8 > 11 | 2 | 598 | 82.6 | 96.9 | 14.3 |
| 110 | 10 > 12 | 2 | 600 | 83.3 | 97.2 | 13.9 |
| 111 | 11 > 12 | 2 | 602 | 84.1 | 97.6 | 13.5 |
| 112 | 1 < 6 | 1 | 603 | 84.8 | 97.7 | 12.9 |
| 113 | 1 < 8 | 1 | 604 | 85.6 | 97.9 | 12.3 |
| 114 | 2 < 3 | 1 | 605 | 86.4 | 98.1 | 11.7 |
| 115 | 2 < 6 | 1 | 606 | 87.1 | 98.2 | 11.1 |
| 116 | 2 > 12 | 1 | 607 | 87.9 | 98.4 | 10.5 |
| 117 | 3 > 10 | 1 | 608 | 88.6 | 98.5 | 9.9 |
| 118 | 3 < 11 | 1 | 609 | 89.4 | 98.7 | 9.3 |
| 119 | 4 < 6 | 1 | 610 | 90.2 | 98.9 | 8.7 |
| 120 | 4 < 7 | 1 | 611 | 90.9 | 99.0 | 8.1 |
| 121 | 4 > 10 | 1 | 612 | 91.7 | 99.2 | 7.5 |
| 122 | 4 < 11 | 1 | 613 | 92.4 | 99.4 | 7.0 |
| 123 | 4 < 12 | 1 | 614 | 93.2 | 99.5 | 6.3 |
| 124 | 5 < 7 | 1 | 615 | 93.9 | 99.7 | 5.8 |
| 125 | 8 > 12 | 1 | 616 | 94.7 | 99.8 | 5.1 |
| 126 | 10 > 11 | 1 | 617 | 95.5 | 100.0 | 4.5 |
| 127 | 1 < 7 | 0 | 617 | 96.2 | 100.0 | 3.8 |
| 128 | 1 < 9 | 0 | 617 | 97.0 | 100.0 | 3.0 |
| 129 | 4 < 9 | 0 | 617 | 97.7 | 100.0 | 2.3 |
| 130 | 4 < 10 | 0 | 617 | 98.5 | 100.0 | 1.5 |
| 131 | 5 < 10 | 0 | 617 | 99.2 | 100.0 | 0.8 |
| 132 | 7 > 12 | 0 | 617 | 100.0 | 100.0 | 0.0 |
| | **Total Frequency** | **617** | | | | |

**Source:** Author

For group 2 (educators), the cumulative percentage (relation) was one out of a total 132 relationships (0.8%). The cumulative percentage (frequency) for this group was calculated as the number of votes cast per affinity pair as a cumulative percentage of the total number of votes, in this case 617. The power column is again calculated as the difference between the values in the cumulative percentage (relation) column and the cumulative percentage (frequency) column. For group 2 (educators), power reaches a maximum at 62 relationships. At affinity pair 8>9, power reaches a maximum of 27.3 (highlighted in orange) which implies that the first 62 relationships account for 74.2% of the variation in this system. The first 62 relationships of Table 26 were thus included in the IRD of this group in terms of the MinMax criterion (Northcutt & McCoy 2004: 160). Relationships hightlighed in blue, represent ambiguous relationships. These ambiguous relationships are further discussed in section 7.3.3.

#### *7.3.2.3 Pareto Protocol: Group 3 (students)*

For group 3 (students), all nine participants returned their completed DARTs. Each participant had a one in nine vote (11.1%) which limited the data distortion risk associated with smaller groups. In total, 149 votes were cast creating a total of 42 possible relationships. The affinities in descending order of frequency for this group are listed in Table 27.

**Table 27: Affinities in descending order of frequency - group 3 (students)**

| No | Affinity pair relationship | Frequency sorted (descending) | Cumulative frequency | Cumulative percentage (relation) | Cumulative percentage (frequency) | Power |
|---|---|---|---|---|---|---|
| 1 | 3 > 5 | 8 | 8 | 2.4 | 5.4 | 3.0 |
| 2 | 1 < 4 | 7 | 15 | 4.8 | 10.1 | 5.3 |
| 3 | 1 < 6 | 6 | 21 | 7.1 | 14.1 | 7.0 |
| 4 | 2 > 5 | 6 | 27 | 9.5 | 18.1 | 8.6 |
| 5 | 3 > 4 | 6 | 33 | 11.9 | 22.1 | 10.2 |
| 6 | 4 > 6 | 6 | 39 | 14.3 | 26.2 | 11.9 |
| 7 | 1 < 2 | 5 | 44 | 16.7 | 29.5 | 12.8 |
| 8 | 1 > 5 | 5 | 49 | 19.0 | 32.9 | 13.9 |
| 9 | 2 > 3 | 5 | 54 | 21.4 | 36.2 | 14.8 |
| 10 | 2 > 6 | 5 | 59 | 23.8 | 39.6 | 15.8 |
| 11 | 2 > 7 | 5 | 64 | 26.2 | 43.0 | 16.8 |
| 12 | 4 > 5 | 5 | 69 | 28.6 | 46.3 | 17.7 |
| 13 | 4 > 7 | 5 | 74 | 31.0 | 49.7 | 18.7 |
| 14 | 1 > 3 | 4 | 78 | 33.3 | 52.3 | 19.0 |
| 15 | 1 < 5 | 4 | 82 | 35.7 | 55.0 | 19.3 |
| 16 | 1 > 7 | 4 | 86 | 38.1 | 57.7 | 19.6 |
| 17 | 3 > 6 | 4 | 90 | 40.5 | 60.4 | 19.9 |
| 18 | 4 < 5 | 4 | 94 | 42.9 | 63.1 | 20.2 |
| 19 | 5 > 6 | 4 | 98 | 45.2 | 65.8 | 20.6 |
| 20 | 6 > 7 | 4 | 102 | 47.6 | 68.5 | 20.9 |
| 21 | 6 < 7 | 4 | 106 | 50.0 | 71.1 | 21.1 |
| 22 | 1 > 2 | 3 | 109 | 52.4 | 73.2 | 20.8 |
| 23 | 1 < 3 | 3 | 112 | 54.8 | 75.2 | 20.4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 24 | 1 > 6 | 3 | 115 | 57.1 | 77.2 | 20.1 |
| 25 | 2 > 4 | 3 | 118 | 59.5 | 79.2 | 19.7 |
| 26 | 3 < 7 | 3 | 121 | 61.9 | 81.2 | 19.3 |
| 27 | 4 < 6 | 3 | 124 | 64.3 | 83.2 | 18.9 |
| 28 | 5 > 7 | 3 | 127 | 66.7 | 85.2 | 18.5 |
| 29 | 1 < 7 | 2 | 129 | 69.0 | 86.6 | 17.6 |
| 30 | 2 < 3 | 2 | 131 | 71.4 | 87.9 | 16.5 |
| 31 | 2 < 4 | 2 | 133 | 73.8 | 89.3 | 15.5 |
| 32 | 3 < 4 | 2 | 135 | 76.2 | 90.6 | 14.4 |
| 33 | 3 < 6 | 2 | 137 | 78.6 | 91.9 | 13.3 |
| 34 | 3 > 7 | 2 | 139 | 81.0 | 93.3 | 12.3 |
| 35 | 5 < 6 | 2 | 141 | 83.3 | 94.6 | 11.3 |
| 36 | 5 < 7 | 2 | 143 | 85.7 | 96.0 | 10.3 |
| 37 | 1 > 4 | 1 | 144 | 88.1 | 96.6 | 8.5 |
| 38 | 2 < 5 | 1 | 145 | 90.5 | 97.3 | 6.8 |
| 39 | 2 < 6 | 1 | 146 | 92.9 | 98.0 | 5.1 |
| 40 | 2 < 7 | 1 | 147 | 95.2 | 98.7 | 3.5 |
| 41 | 3 < 5 | 1 | 148 | 97.6 | 99.3 | 1.7 |
| 42 | 4 < 7 | 1 | 149 | 100.0 | 100.0 | 0.0 |
| | **Total Frequency** | **149** | | | | |

**Source:** Author

For group 3 (students), the cumulative percentage (relation) was one out of a total 42 relationships (2.4%). The cumulative percentage (frequency) for this group was calculated as the number of votes cast per affinity pair as a cumulative percentage of the total number of votes of 149. The power column was calculated on a simular basis as for the other groups. For group 3 (students), power reaches a maximum at 21 relationships. At affinity pair 6<7, power reaches a maximum of 21.1 (highlighted in orange) which implies that 21 relationships account for 71.1% of the variation in this system for group 3 (students). The first 21 relationships in Table 27 were thus included in the IRD of this group in terms of the MinMax criterion (Northcutt & McCoy 2004: 160). Relationships hightlighed in blue represent ambiguous relationships. These ambiguous relationships are further discussed in section 7.3.3.

### 7.3.3 Interrelationship Diagram (IRD): Groups 1 to 3

The creation of the IRD is the first step in rationalising the system. The IRD is considered to be the matrix that comprises all the perceived relationships in the system (Northcutt & McCoy 2004: 170–173). All the affinity pair relationships identified through the Pareto Protocol are used to compile the IRD of each group. Chapter 6, section 6.6.3, provides more detail on the IRD.

#### *7.3.3.1 IRD: Group 1 (learning designers)*

The Pareto Protocol for group 1 (learning designers) indicated that the first 46 relationships in Table 25 should be used to compile an IRD. During the Pareto Protocol, three ambiguous relationships were identified. These are the relationships that have arrows pointing in both directions (having both a cause and effect), as the power is strong in both directions. Both affinity directions were included in the selection of the 46 relationships as part of the Pareto Protocol. Relationships 1>4 and 1<4, for example, were both included in the 46 relationships and are considered an ambiguous relationship. These ambiguous relationships had to be resolved, as only one direction between affinity pairs could be included in the IRD. The ambiguous relationships for group 1 (learning designers) are highlighed in blue in Table 25. Northcutt and McCoy (2004: 162–163) explain that there are two possible topologies consistent with an ambiguity. The first is an undetected common influence as a result of a common affinity. The second is an undetected feedback loop. Ambiguous relationships are ‘put in suspense’ until the SID is created.

Where ambiguous relationships exist, the affinity pair with the highest frequency must be selected for inclusion in the IRD (Du Preez 2015: 125; Northcutt & McCoy 2004: 290). Relationship 1<11 had a frequency of four (highlighted in green in Table 28) which is higher than the frequency of three of relationship 1>11. Relationship 1<11 was thus included in the IRD whilst 1>11 was not. Relationships 1>4 and 1<4 both had a frequency of three. It was thus not possible to determine the affinity pair with the highest frequency. The same can be seen with relationships 1>10 and 1<10, both with a frequency of three. In case of a tie, more observations are possibly needed (Northcutt & McCoy 2004: 290). The affinity pair of first occurrence is included in the IRD (Du Preez 2015: 125). Relationship 1>4 is the relationship of first occurrence (of the affinity pairs 1>4 and 1<4) in Tables 25 and 28 and was therefore included in the

IRD (higlighted in green in Table 28). Relationship 1>10 is also the relationship of first occurrence (of the affinity pairs 1>10 and 1<10) in Table 25 and 28 and was therefore also included in the IRD (higlighted in green in Table 28). Relationships 1<4 and 1>11 could be resolved through the identification of undetected common influences that emerged after the creation of the uncluttered SID for group 1 (learning designers) (Northcutt & McCoy 2004: 163). Refer to Figure 17 (section 7.3.4.1) for the unclutted SID for group 1 (learning designers). Relationship 1<10 could not be resolved through an undetected common influence. The steps recommended by Du Preez (2015: 128–129), and suggested by Northcutt (2015: 19–23) were followed to resolve this conflict.

1. Remove all the redundant links from the cluttered SID. For each ambiguous relationship, insert the second relationship into the uncluttered SID still in the delta circular formation;
2. Examine the system, noting conflicts that create a “double-headed arrow” situation;
3. Starting from bottom right (primary outcome) to top left (primary driver) remove any double-headed arrows (conflicting relationship) if there is another path. Do not remove any of the original relationships that are part of the double-headed arrow pair. If there is no alternative path for the conflicting double-headed arrow, let it remain to be addressed later; and
4. Perform the backward arrow removal process as you would in any uncluttered SID. However, do not remove any of the original relationships.

I thus inserted the 1<10 relationship into the unclutted SID. The steps were followed and Figure 18 (section 7.3.4.1) was created. Relationship 1<10 could thus be resolved through this systematic process.

**Table 28: Ambiguous relationships - Group 1 (learning designers)**

| Affinity pair relationship | Frequency |
|---|---|
| 1 > 4 | 3 |
| 1 < 4 | 3 |
| 1 > 10 | 3 |
| 1 < 10 | 3 |
| 1 > 11 | 3 |
| 1 < 11 | 4 |

**Source:** Author

Subsequent to the identification of the ambiguous relationships, 43 relationships were left for inclusion in the IRD for group 1. The unsorted IRD of this group is set out in Table 29.

**Table 29: Unsorted IRD - Group 1 (learning designers)**

| Unsorted IRD – Group 1 (learning designers) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **OUT** | **IN** | **Δ** |
| **1** | | ← | ↑ | ↑ | ↑ | ← | ↑ | ← | ← | ↑ | ← | 5 | 5 | 0 |
| **2** | ↑ | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | ↑ | 9 | 0 | 9 |
| **3** | ← | ← | | | ↑ | ← | ↑ | ← | | | | 2 | 4 | -2 |
| **4** | ← | ← | | | ↑ | ↑ | ↑ | ← | ↑ | | ↑ | 5 | 3 | 2 |
| **5** | ← | ← | ← | ← | | | ↑ | ← | ↑ | ↑ | ↑ | 4 | 5 | -1 |
| **6** | ↑ | ← | ↑ | ← | | | ↑ | ← | | | | 3 | 3 | 0 |
| **7** | ← | ← | ← | ← | ← | ← | | ← | ↑ | ↑ | ← | 2 | 8 | -6 |
| **8** | ↑ | ← | ↑ | ↑ | ↑ | ↑ | ↑ | | ↑ | | ← | 7 | 2 | 5 |
| **9** | ↑ | ← | | ← | ← | | ← | ← | | ↑ | ↑ | 3 | 5 | -2 |
| **10** | ← | | | | ← | | ← | | ← | | | 0 | 4 | -4 |
| **11** | ↑ | ← | | ← | ← | | ↑ | ↑ | ← | | | 3 | 4 | -1 |

**Source:** Author

The unsorted IRD was sorted in descending order in terms of the Δ column. The ensuing result is presented in Table 30.

**Table 30: Sorted IRD in descending order of Δ - Group 1 (learning designers)**

| Sorted IRD in descending order of Δ - Group 1 (learning designers) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **OUT** | **IN** | **Δ** |
| **2** | ↑ | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | | ↑ | 9 | 0 | 9 |
| **8** | ↑ | ← | ↑ | ↑ | ↑ | ↑ | ↑ | | ↑ | | ← | 7 | 2 | 5 |
| **4** | ← | ← | | | ↑ | ↑ | ↑ | ← | ↑ | | ↑ | 5 | 3 | 2 |
| **1** | | ← | ↑ | ↑ | ↑ | ← | ↑ | ← | ← | ↑ | ← | 5 | 5 | 0 |
| **6** | ↑ | ← | ↑ | ← | | | ↑ | ← | | | | 3 | 3 | 0 |
| **5** | ← | ← | ← | ← | | | ↑ | ← | ↑ | ↑ | ↑ | 4 | 5 | -1 |
| **11** | ↑ | ← | | ← | ← | | ↑ | ↑ | ← | | | 3 | 4 | -1 |
| **3** | ← | ← | | | ↑ | ← | ↑ | ← | | | | 2 | 4 | -2 |
| **9** | ↑ | ← | | ← | ← | | ← | ← | | ↑ | ↑ | 3 | 5 | -2 |
| **10** | ← | | | | ← | | ← | | ← | | | 0 | 4 | -4 |
| **7** | ← | ← | ← | ← | ← | ← | | ← | ↑ | ↑ | ← | 2 | 8 | -6 |

**Source:** Author

In terms of the IQA process, the next step is to determine the drivers and outcomes from the sorted IRD for tentative SID assignments. The value of the Δ is an indication of the relative position of an affinity in a particular system (Northcutt & McCoy 2004:

173–174). Table 31 shows the tentative SID assignments for group 1 (learning designers).

**Table 31: Tentative SID assignments - Group 1 (learning designers)**

| Tentative SID Assignments | | |
|---|---|---|
| **Affinity no** | **Affinity name** | **Classification** |
| **2** | Enabling tools | Primary driver |
| **8** | Change in pedagogy | Secondary driver |
| **4** | Gaming for education -> gamification | Secondary driver |
| **1** | Design process | Circulator or Pivot |
| **6** | Discipline-specific skills | Circulator or Pivot |
| **5** | Soft skills and dispositions | Secondary outcome |
| **11** | Challenging conventions | Secondary outcome |
| **3** | Pure simulation | Secondary outcome |
| **9** | Multi-linguistic environment | Secondary outcome |
| **10** | Cross-functionality | Primary outcome |
| **7** | Learning process | Secondary outcome |

**Source:** Author

Affinities with positive ∆s were classified as drivers whilst those with negative ∆s were classified as outcomes. Affinity number 2 was classified as a primary driver as it affects other affinities but is not affected by others (only outs). Affinities number 8 and 4 were classified as secondary drivers as they influence other affinities (more outs) but are also influenced by other affinities (less ins). Affinities number 1 and 6 were classified as a circulator or pivot as they had equal numbers of ins and outs. Affinities number 5, 11, 3, 9 and 7 were classified as secondary outcomes as they are influenced by other affinities (more ins) but also influence others (less outs). Affinity number 10 was classified as a primary outcome as it is only affected by other affinities and does not affect others in the system (only ins). The sorted IRD in descending order of ∆ (Table

30) together with the tentative SID assignments (Table 31) provided the data for the development of the SID for group 1 (learning designers).

#### *7.3.3.2 IRD: Group 2 (educators)*

The Pareto Protocol for group 2 (educators) indicated that the first 62 relationships in Table 26 should be included in the IRD. Affinity relationships with arrows pointing in both directions that were included in the first 62 relationships were identified as ambiguous. The ambiguous relationships are highlighted in blue in Table 26 and are presented in order of affinity pair in Table 32. The affinity pair with the highest frequency was included in the IRD (highlighted in green in Table 32). The affinity pair with the lowest frequency was not included (highlighted in yellow in Table 32).

Relationships 1>10 and 1<10 both however had a frequency of five. Similarly, relationships 7>10 and 7<10 also both had a frequency of five. It was thus not possible to determine the affinity pair with the highest frequency. The affinity pair of first occurrence was thus included in the IRD (Du Preez 2015: 125). Relationship 1>10 and 7>10 were thus included in the IRD (higlighted in green in Table 32). Relationships 1<5, 1<10, 1>11, 2<5, 3<5, 3>6, 3<7, 6>11, 7<10 and 8>9 were therefore not included in the IRD (highlighted in yellow in Table 32). All these ambiguous relationships could be resolved through the identification of undetected common influences and/or undetected feedback loops that emerged after the creation of the uncluttered SID for group 2 (educators) (Northcutt & McCoy 2004: 163). Refer to Figure 20 (section 7.3.4.2) for the unclutted SID for this group.

**Table 32: Ambiguous relationships - Group 2 (educators)**

| Affinity pair relationship | Frequency |
|---|---|
| 1 > 5 | 6 |
| 1 < 5 | 5 |
| 1 > 10 | 5 |
| 1 < 10 | 5 |
| 1 > 11 | 5 |
| 1 < 11 | 6 |
| 2 > 5 | 7 |
| 2 < 5 | 5 |
| 3 > 5 | 6 |
| 3 < 5 | 5 |
| 3 > 6 | 6 |
| 3 < 6 | 7 |
| 3 > 7 | 7 |
| 3 < 7 | 5 |
| 6 > 11 | 5 |
| 6 < 11 | 6 |
| 7 > 10 | 5 |
| 7 < 10 | 5 |
| 8 > 9 | 5 |
| 8 < 9 | 7 |

**Source:** Author

Subsequent to the identification of the ambiguous relationships, 52 relationships were left for inclusion in the IRD for group 2 (educators). The unsorted IRD of this group is listed in Table 33.

**Table 33: Unsorted IRD - Group 2 (educators)**

| Unsorted IRD – Group 2 (educators) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **OUT** | **IN** | **Δ** |
| **1** | | ↑ | | ← | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ← | ← | 7 | 3 | 4 |
| **2** | ← | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ← | | ← | 7 | 3 | 4 |
| **3** | | ← | | ← | ↑ | ← | ↑ | ↑ | ↑ | | | | 4 | 3 | 1 |
| **4** | ↑ | ← | ↑ | | ↑ | ↑ | ↑ | ↑ | | | | ↑ | 7 | 1 | 6 |
| **5** | ← | ← | ← | ← | | ↑ | ↑ | ↑ | ↑ | | | | 4 | 4 | 0 |
| **6** | ← | ← | ↑ | ← | ← | | ↑ | ↑ | ↑ | ← | ← | ← | 4 | 7 | -3 |
| **7** | ← | ← | ← | ← | ← | ← | | ← | ↑ | ↑ | | | 2 | 7 | -5 |
| **8** | ← | ← | ← | ← | ← | ← | ↑ | | ← | ← | ← | ← | 1 | 10 | -9 |
| **9** | ← | ← | ← | | ← | ← | ← | ↑ | | ← | ← | ← | 1 | 9 | -8 |
| **10** | ← | ↑ | | | | ↑ | ← | ↑ | ↑ | | ← | | 4 | 3 | 1 |
| **11** | ↑ | | | | | ↑ | | ↑ | ↑ | ↑ | | ← | 5 | 1 | 4 |
| **12** | ↑ | ↑ | | ← | | ↑ | | ↑ | ↑ | | ↑ | | 6 | 1 | 5 |

**Source:** Author

The unsorted IRD was sorted in descending order in terms of the Δ column. The sorted IRD is presented in Table 34.

**Table 34: Sorted IRD in descending order of Δ - Group 2 (educators)**

| Sorted IRD in descending order of Δ - Group 2 (educators) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **OUT** | **IN** | **Δ** |
| **4** | ↑ | ← | ↑ | | ↑ | ↑ | ↑ | ↑ | | | | ↑ | 7 | 1 | 6 |
| **12** | ↑ | ↑ | | ← | | ↑ | | ↑ | ↑ | | ↑ | | 6 | 1 | 5 |
| **1** | | ↑ | | ← | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ← | ← | 7 | 3 | 4 |
| **2** | ← | | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ← | | ← | 7 | 3 | 4 |
| **11** | ↑ | | | | | ↑ | | ↑ | ↑ | ↑ | | ← | 5 | 1 | 4 |
| **3** | | ← | | ← | ↑ | ← | ↑ | ↑ | ↑ | | | | 4 | 3 | 1 |
| **10** | ← | ↑ | | | | ↑ | ← | ↑ | ↑ | | ← | | 4 | 3 | 1 |
| **5** | ← | ← | ← | ← | | ↑ | ↑ | ↑ | ↑ | | | | 4 | 4 | 0 |
| **6** | ← | ← | ↑ | ← | ← | | ↑ | ↑ | ↑ | ← | ← | ← | 4 | 7 | -3 |
| **7** | ← | ← | ← | ← | ← | ← | | ← | ↑ | ↑ | | | 2 | 7 | -5 |
| **9** | ← | ← | ← | | ← | ← | ← | ↑ | | ← | ← | ← | 1 | 9 | -8 |
| **8** | ← | ← | ← | ← | ← | ← | ↑ | | ← | ← | ← | ← | 1 | 10 | -9 |

**Source:** Author

The drivers and outcomes from the sorted IRD were then determined for tentative SID assignments. Table 35 provides the tentative SID assignments for group 2 (educators).

**Table 35: Tentative SID assignments - Group 2 (educators)**

| Tentative SID Assignments | | |
|---|---|---|
| **Affinity no** | **Affinity name** | **Classification** |
| **4** | Technological challenges | Secondary driver |
| **12** | Globalisation | Secondary driver |
| **1** | Lecturer competence | Secondary driver |
| **2** | Diverse student profile | Secondary driver |
| **11** | Stakeholder engagement | Secondary driver |
| **3** | Student readiness | Secondary driver |
| **10** | Ethics | Secondary driver |
| **5** | Technology enablers | Circulator or pivot |
| **6** | Intervention methods | Secondary outcome |
| **7** | Interactive engagement | Secondary outcome |
| **9** | Learning outcomes | Secondary outcome |
| **8** | Tool design | Secondary outcome |

**Source:** Author

Affinities number 4, 12, 1, 2, 11, 3 and 10 were classified as secondary drivers as they influence other affinities but are also influenced by other affinities (more outs than ins). Affinity number 5 was classified as a circulator or pivot as it had equal numbers of ins and outs. Affinities number 6, 7, 9 and 8 were classified as secondary outcomes as they are influenced by other affinities but also influence others (more ins than outs). The sorted IRD (Table 34) and tentative SID assignments (Table 35) provided the data for the development of the SID for group 2 (educators).

#### *7.3.3.3 IRD: Group 3 (students)*

The Pareto Protocol for group 3 (students) indicated that the first 21 relationships in Table 27 should be used to compile the IRD. During the Pareto Protocol, three ambiguous relationships were identified. The affinity pair with the highest frequency was included in the IRD (Du Preez 2015: 125; Northcutt & McCoy 2004: 290) (highlighted in green in Table 36). Relationships 6>7 and 6<7 both had a frequency of four. It was thus not possible to determine the affinity pair with the highest frequency. In this case the affinity pair of first occurrence was included in the IRD (Du Preez 2015: 125). Relationship 6>7 is the relationship of first occurrence in Table 27 (of the affinity pairs 6>7 and 6<7) and was therefore included in the IRD (higlighted in green in Table 36). Relationships 1<5, 4<5 and 6<7 were therefore not included in the IRD (highlighted in yellow in Table 36). Relationships 1<5 and 4<5 could be resolved through the identification of undetected common influences that emerged after the creation of the uncluttered SID for this group (Northcutt & McCoy 2004: 163). Refer to Figure 22 (7.3.4.3) for the unclutted SID for group 3 (students). Relationship 6<7 could not be resolved through an undetected common influence. Similar steps were followed as advised by Du Preez (2015: 128–129) and Northcutt (2015: 19–23) to resolve this conflict, however, the conflict could not be resolved. If an ambiguous relationship cannot be resolved through this method, Northcutt and McCoy (2004: 290) advise an alternative resolution. An e-mail was sent to the nine participants of group 3 to "revote" on the direction of the relationship 6>7 or 6<7. Only seven of the nine participants responded with their "revote". Four participants voted in favour of 6>7 while only three voted for 6<7. The relationship 6>7 was thus correctly included in the IRD and SID of this group 3 based on this "revote" (received the largest number of votes) and relationship 6<7 was excluded (received the least number of votes). This ambiguous relationship was thus resolved through the "revote".

**Table 36: Ambiguous relationships - Group 3 (students)**

| Affinity pair relationship | Frequency |
|---|---|
| 1 > 5 | 5 |
| 1 < 5 | 4 |
| 4 > 5 | 5 |
| 4 < 5 | 4 |
| 6 > 7 | 4 |
| 6 < 7 | 4 |

**Source:** Author

Subsequent to the identification of the ambiguous relationships, 18 relationships were left for inclusion in the IRD for this group. The unsorted IRD of group 3 (students) is listed in Table 37.

**Table 37: Unsorted IRD - Group 3 (students)**

| Unsorted IRD – Group 3 (students) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **OUT** | **IN** | **∆** |
| **1** | | ← | ↑ | ← | ↑ | ← | ↑ | 3 | 3 | 0 |
| **2** | ↑ | | ↑ | | ↑ | ↑ | ↑ | 5 | 0 | 5 |
| **3** | ← | ← | | ↑ | ↑ | ↑ | | 3 | 2 | 1 |
| **4** | ↑ | | ← | | ↑ | ↑ | ↑ | 4 | 1 | 3 |
| **5** | ← | ← | ← | ← | | ↑ | | 1 | 4 | -3 |
| **6** | ↑ | ← | ← | ← | ← | | ↑ | 2 | 4 | -2 |
| **7** | ← | ← | | ← | | ← | | 0 | 4 | -4 |

**Source:** Author

The values in the ∆ column of the unsorted IRD were then sorted in terms of descending order. The sorted IRD is set out in Table 38.

**Table 38: Sorted IRD in descending order of ∆ - Group 3 (students)**

| Sorted IRD in descending order of ∆ - Group 3 (students) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **OUT** | **IN** | **∆** |
| **2** | ↑ | | ↑ | | ↑ | ↑ | ↑ | 5 | 0 | 5 |
| **4** | ↑ | | ← | | ↑ | ↑ | ↑ | 4 | 1 | 3 |
| **3** | ← | ← | | ↑ | ↑ | ↑ | | 3 | 2 | 1 |
| **1** | | ← | ↑ | ← | ↑ | ← | ↑ | 3 | 3 | 0 |
| **6** | ↑ | ← | ← | ← | ← | | ↑ | 2 | 4 | -2 |
| **5** | ← | ← | ← | ← | | ↑ | | 1 | 4 | -3 |
| **7** | ← | ← | | ← | | ← | | 0 | 4 | -4 |

**Source:** Author

The drivers and outcomes of the sorted IRD were then determined for tentative SID assignments. Table 39 provides the tentative SID assignments for this group.

**Table 39: Tentative SID assignments - Group 3 (students)**

| Tentative SID Assignments | | |
|---|---|---|
| **Affinity no** | **Affinity name** | **Classification** |
| **2** | Consideration of diversity | Primary driver |
| **4** | Basic fundamentals | Secondary driver |
| **3** | Implementation timing | Secondary driver |
| **1** | Technical knowledge | Circulator or pivot |
| **6** | Interactive teaching simulation application | Secondary outcome |
| **5** | Teaching methodology | Secondary outcome |
| **7** | Development considerations | Primary outcome |

**Source:** Author

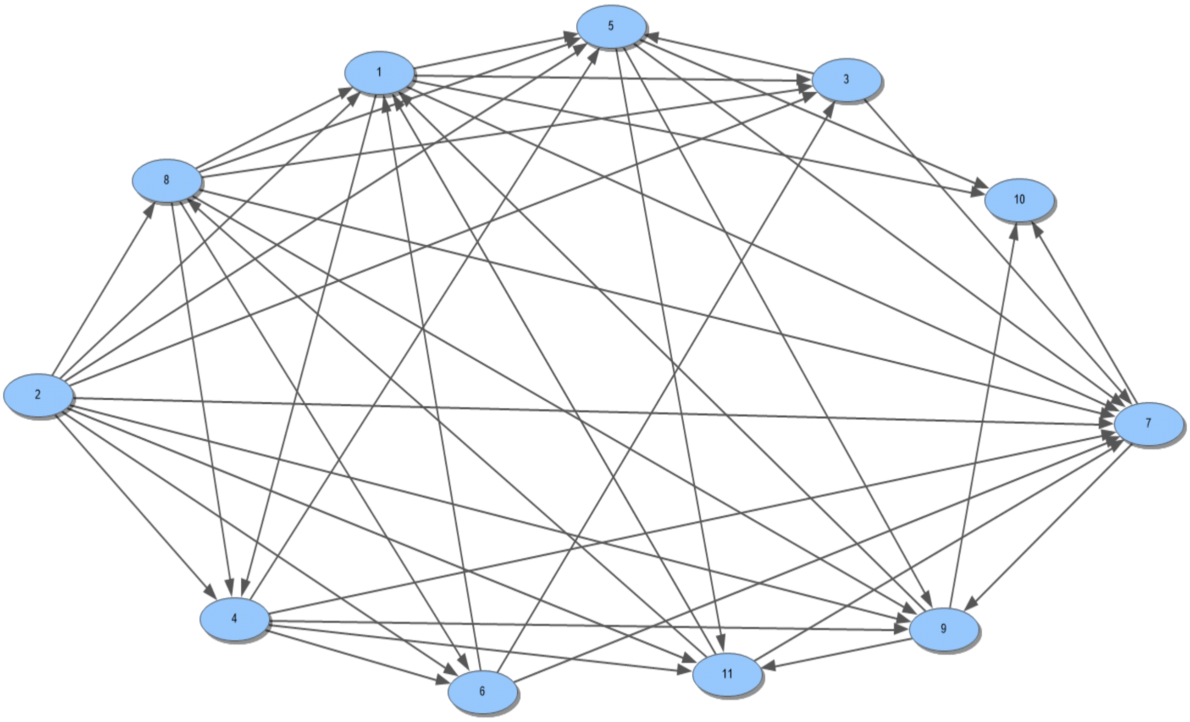
Affinity number 2 was classified as a primary driver as it affects other affinities but is not affected by others (only outs). Affinities number 4 and 3 were classified as secondary drivers as they influence other affinities (more outs) but are also influenced by other affinities (less ins). Affinity number 1 was classified as a circulator or pivot as it had equal numbers of ins and outs. Affinities number 6 and 5 were classified as secondary outcomes as they are influenced by other affinities (more ins) but also influence others (less outs). Affinity number 7 was classified as a primary outcome as it is only affected by other affinities and does not affect others in the system (only ins). The sorted IRD in descending order of Δ (Table 38) together with the tentative SID assignments (Table 39) provided the data for the development of the SID for group 3 (students).

### 7.3.4 System Influence Diagram (SID): Groups 1 to 3

The SID is considered to be a visual representation of the complete system of influences and outcomes. Chapter 6 (section 6.6.4) provides more detail on how the cluttered and unclutterd SIDs are developed. The first version of the SID comprises all the links of the sorted IRD and is referred to as the cluttered SID. The cluttered SID is, however, difficult to interpret and contains too much detail to allow conclusions to be made. For this reason the uncluttered SID is compiled to remove redundant links (Northcutt & McCoy 2004: 176).

### 7.3.4.1 *SID: Group 1 (learning designers)*

The cluttered SID for group 1 (learning designers) is illustrated in Figure 16. Subsequently all reduntant links were removed from the cluttered SID and the uncluttered SID was created (refer to Figure 17). The uncluttered SID with the ambigous relationship resolved is set out in Figure 18.




**Affinities:** 1. Design process. 2. Enabling tools. 3. Pure simulation. 4. Gaming for education -> gamification. 5. Soft skills and dispositions. 6. Discipline-specific skills. 7. Learning process. 8. Change in pedagogy. 9. Multi-linguistic environment. 10. Cross-functionality. 11. Challenging conventions.

**Figure 16: Cluttered SID - Group 1 (learning designers)**
**Source:** Author

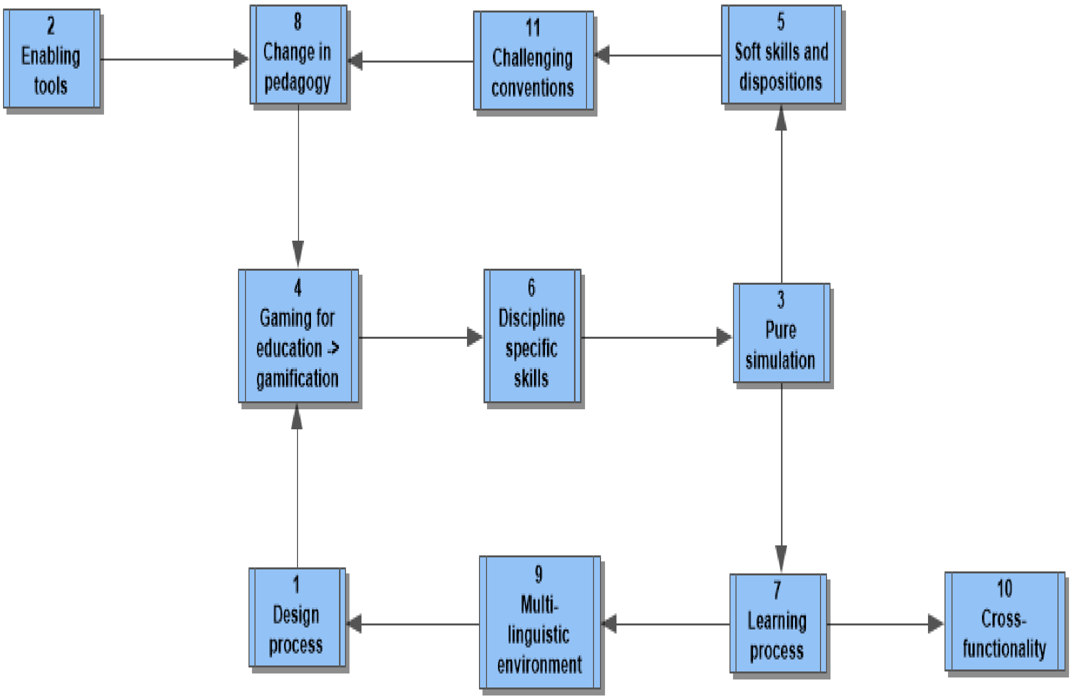



**Figure 17: Uncluttered SID - Group 1 (learning designers)**
**Source:** Author

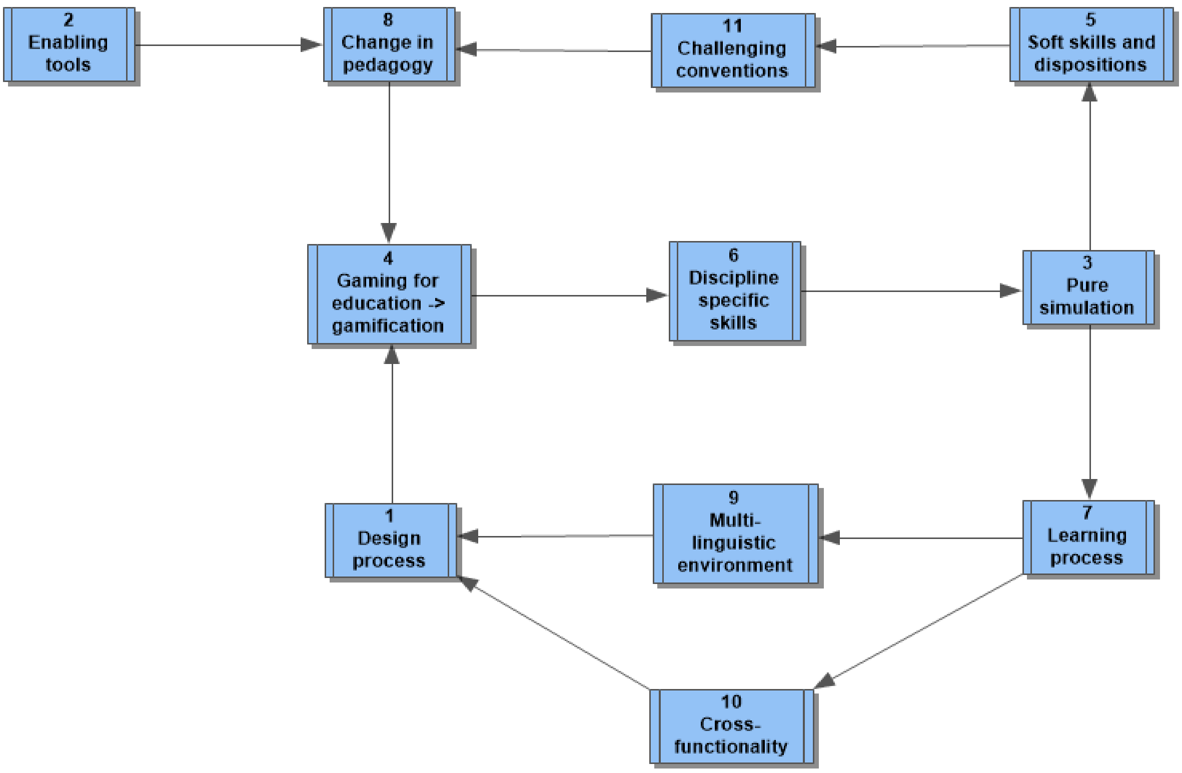
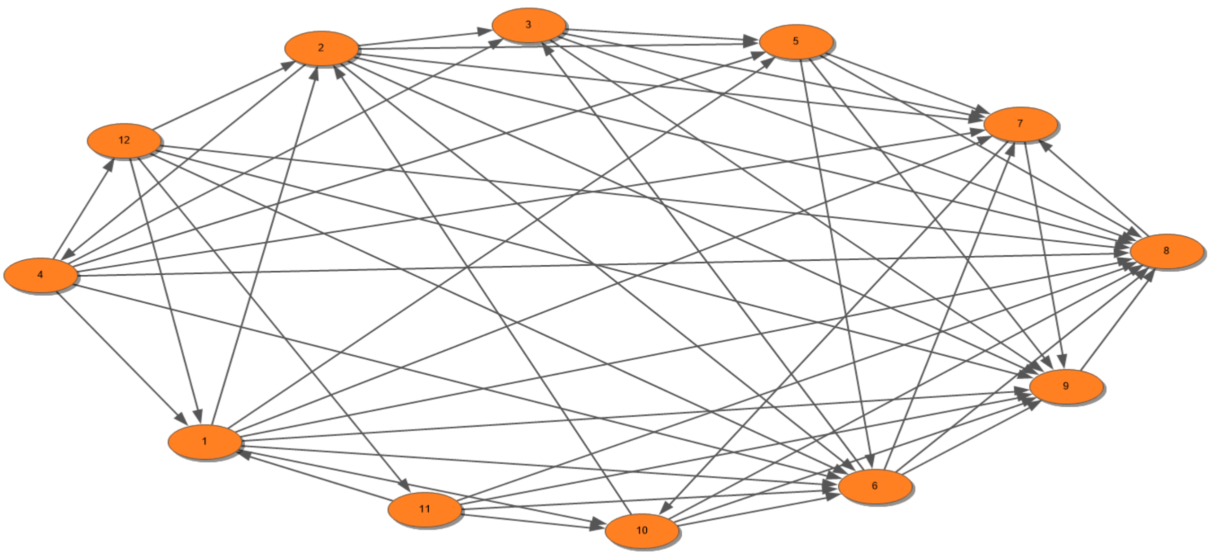



**Figure 18: Uncluttered SID with ambiguous relationship resolved - Group 1 (learning designers)**
**Source:** Author

### 7.3.4.2 SID: Group 2 (educators)

The cluttered SID for group 2 (educators) is illustrated in Figure 19 while the uncluttered SID is presented in Figure 20.




**Affinities:** 1. Lecturer competence. 2. Diverse student profile. 3. Student readiness. 4. Technological challenges. 5. Technology enablers. 6. Intervention methods. 7. Interactive engagement. 8. Tool design. 9. Learning outcomes. 10. Ethics. 11. Stakeholder engagement. 12. Globalisation.

**Figure 19: Cluttered SID - Group 2 (educators)**
**Source:** Author

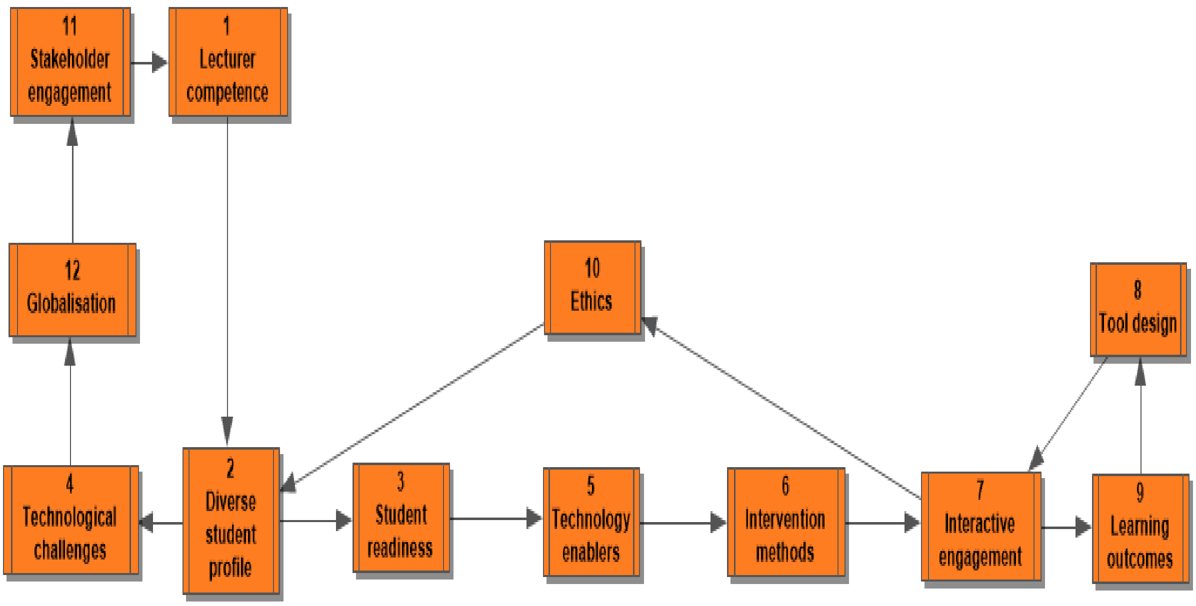
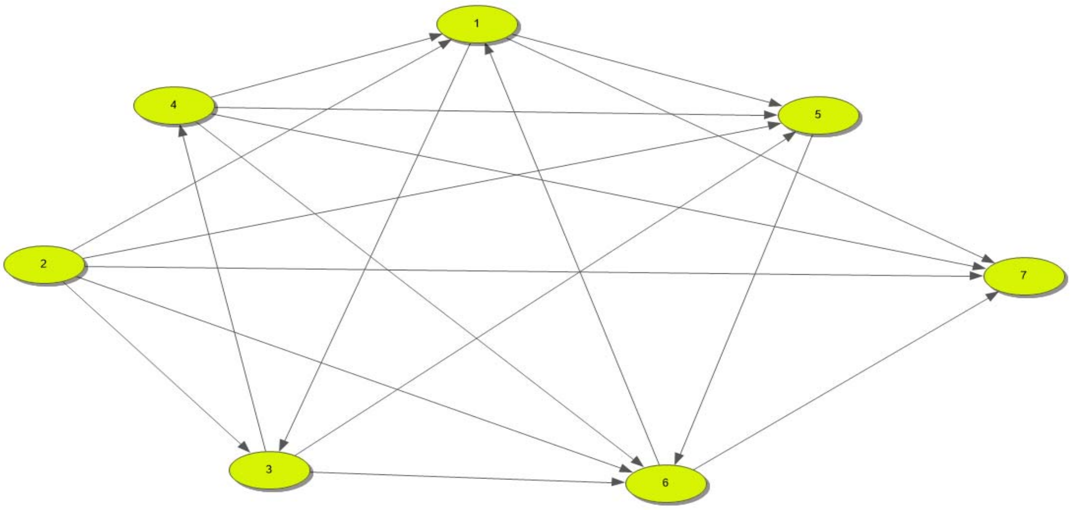



**Figure 20: Uncluttered SID - Group 2 (educators)**
**Source:** Author

### *7.3.4.3 SID: Group 3 (students)*

The cluttered SID for group 3 (students) is provided in Figure 21 while the uncluttered SID is provided in Figure 22.




**Affinities:** 1. Technical knowledge. 2. Consideration of diversity. 3. Implementation timing. 4. Basic fundamentals. 5. Teaching methodology. 6. Interactive teaching simulation application. 7. Development considerations.

**Figure 21: Cluttered SID - Group 3 (students)**
**Source:** Author

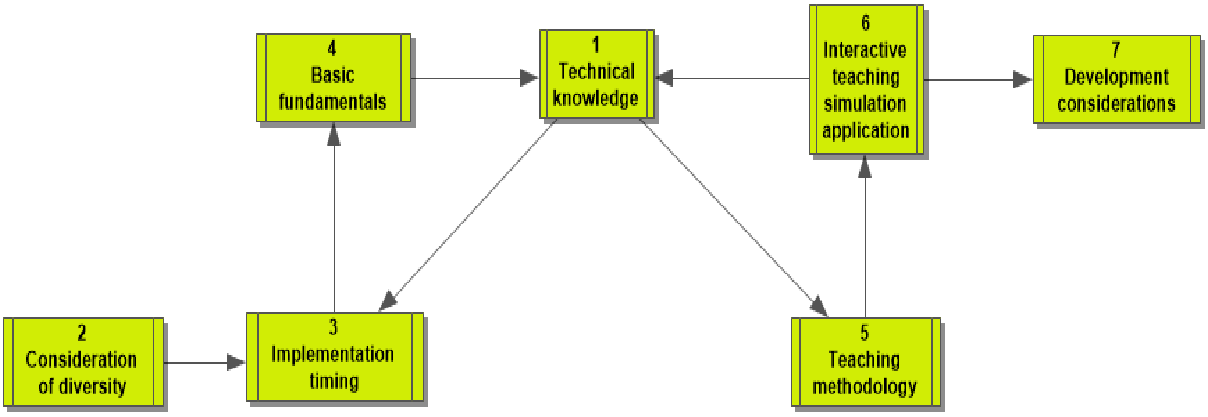



**Figure 22: Uncluttered SID - Group 3 (students)**
**Source:** Author

In sections 7.4 to 7.6 which follow, the results are described in terms of how affinities in each system are related (Northcutt & McCoy 2004: 314–316). Relationships are explained in the words of the participants of the groups, obtained from individual DART documents.

## 7.4 DESCRIPTION OF HOW AFFINITIES ARE RELATED: GROUP 1 (LEARNING DESIGNERS)

The uncluttered SID for group 1 (learning designers) is provided in Figure 17, showing a visual representation of the relationships between the eleven affinities produced by the participants of this group.

### 7.4.1 Primary driver: Group 1 (learning designers)

According to the SID of group 1 (learning designers), **Affinity 2: Enabling tools,** was seen as a primary driver when critical thinking is developed in auditing students through technology-based educational interventions (see Figure 23).


**Figure 23: Primary driver- Group 1 (learning designers)**
**Source:** Author

As part of the affinity description, the group noted the importance of enabling tools such as blogs, forums, wikis, podcasts, jingles, animation and photo captions. It was pointed out by a participant that it is important to consider and select the enabling tools, as they facilitate the lesson (G1-5:12). Enabling tools increase student participation, thus improving teaching and learning as well as students' attitudes (G1-5:13).

Although, the SID of this group indicates that **Affinity 2: Enabling tools,** has an influence on the entire system, it also has a direct influence on **Affinity 8: Change in pedagogy**. With this affinity description, group 1 (learning designers) highlighted that most education fields including pedagogy, andragogy, heutagogy as well as paragogy have changed significantly over the last few years. The role of the educator has also shifted significantly in recent years. A participant in this group indicated that *"(i)f you have enabling tools then you can implement a change in pedagogy"* (G1-4:16). When educators have access to new enabling tools, it could encourage them to make changes in the way they teach (G1-2:16). Task levels differ, based on the students' academic level (first, second, third year or postgraduate). The enabling tools required at each of these levels thus influence the choice of technology based on the changes in pedagogy (G1-5:12).

### 7.4.2 Feedback loop 1: Group 1 (learning designers)

Feedback loop 1 for group 1 (learning designers) is illustrated in Figure 24. I decided to label this feedback loop **'Challenging current ways of teaching'**. The influences of the various affinities on one another are discussed in more detail in this section.

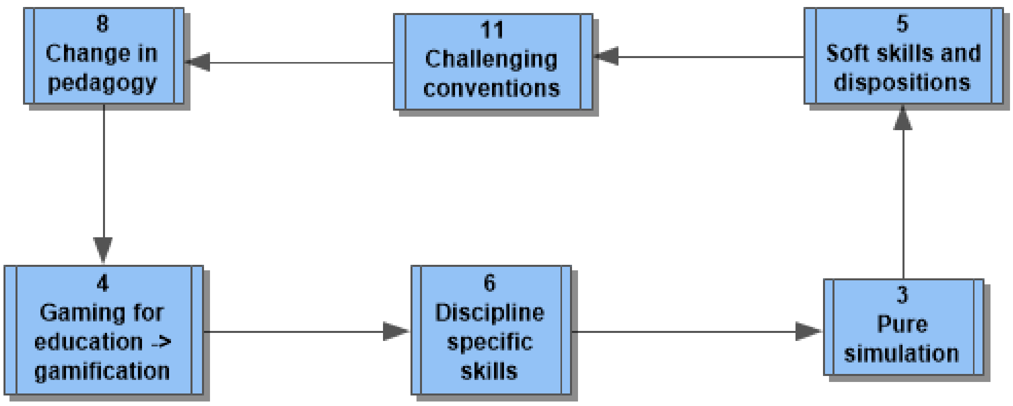



**Figure 24: Feedback loop 1 - Group 1 (learning designers)**
**Source:** Author

Feedback loop 1 commences with **Affinity 8: Change in pedagogy**. According to the SID of this group, **Affinity 8: Change in pedagogy** has a direct influence on **Affinity 4: Gaming for education → gamification**. With this affinity description, group 1 (learning designers) indicated the importance of using gaming principles for educational purposes and for the development of critical thinking in students. According to one participant of the group, *"(i)f you are working to change the way you teach by changing your pedagogy, then gamification can be one of the tools that help you reach your teaching goals. In other words, you can use gamification elements to entice students into a new way of learning - and to get more buy-in from your colleagues, department mangement and college* *approval structures"* (G1-2:31). Another participant also indicated that *"(i)f pedagogy changes, then how you gamify, will change in terms of goals"* (G1-4:31).

Furthermore, in feedback loop 1, **Affinity 4: Gaming for education → gamification** influences **Affinity 6: Discipline-specific skills**. In the affinity description for discipline-specific skills, group 1 (learning designers) indicated that judgement is a core discipline-specific skills which is linked to making informed decisions. In the affinity description, the group also noted the ability to make constant comparisons, to be systematic, organised and to follow certain standards. One participant indicated that gamification can increase discipline-specific skills such as literacy and logical reasoning (G1-2:29). It was also suggested that *"(i)f you have gaming for education then you can create a game that parallels skills"* (G1-4:29). There is also a belief that game rules and standards influence students' behaviour (G1-5:29).

**Affinity 6: Discipline-specific skills** has a direct influence on **Affinity 3: Pure simulation**. In the affinity description, group 1 (learning designers) indicated the significance of pure simulations which include augmented reality, virtual reality and virtual worlds. It was indicated that analysis, critical thinking and informed decision-making ability are important considerations in a pure simulation (G1-5:22).

As feedback loop 1 continues, **Affinity 3: Pure simulation**, has an influence on **Affinity 5: Soft skills and dispositions**. The affinity description identified metacognition, empathy, ethical behaviour, intrinsic motivation, a positive attitute and communication skills among the soft skills and dispositions associated with critical thinking. One participant commented that *"(i)f you have a pure simulation then you have the potential to practice soft skills"* (G1-4:21). Other participants also indicated that if a pure simulation is used it could improve of skills (G1-6:21) and that game rules influence the development of soft skills and dispositions (G1-5:21).

**Affinity 5: Soft skills and dispositions** has an influence on **Affinity 11: Challenging conventions**. With the affinity description of challenging conventions, the group indicated that alternative frameworks should be developed to adapt to the changing landscape in the auditing profession. A participant indicated that *"the decision to challenge the teaching* *conventions around your subject will give you focus as to which soft skills are important for your students. This is part of the authentic assessment component, as you want to prepare your students for their life as a professional in the real-world contexts of your discipline"* (G1-2:40).

Finally, **Affinity 11: Challenging conventions** has a direct influence on **Affinity 8: Change in pedagogy**. One participant remarked that "*any change in conventional way of teaching will by necessity effect the pedagogy about the why and how and the what of the subject matter. For example, if you want to teach by portfolios and give lots of opportunities for the students to choose their own learning tasks, this greatly effects the way you will teach and assess"* (G1-2:52). Other participants in group 1 (learning designers) also believe that when conventions are changed, pedagogy must also change (G1-4:52) as pedagogy is influenced by the conventions (G1-9:52).

### 7.4.3 Feedback loop 2: Group 1 (learning designers)

Feedback loop 2 for group 1 (learning designers) is illustrated in Figure 25. This feedback loop has been labelled as **'Designing learning environments for critical thinking'**. This section provides more detail on the various influences between the affinities in this feedback loop.

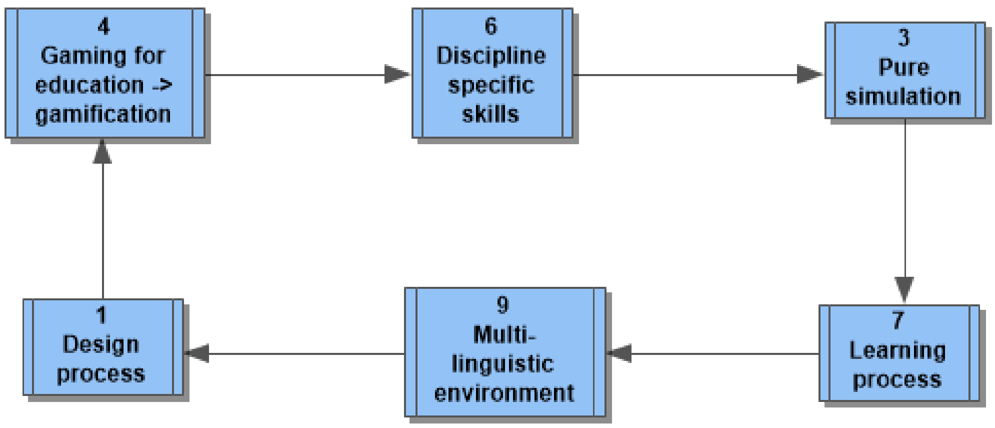



**Figure 25: Feedback loop 2 - Group 1 (learning designers)**
**Source:** Author

Feedback loop 2 commences with **Affinity 4: Gaming for education → gamification**. This affinity has a direct influence on **Affinity 6: Discipline-specific skills**. This relationship also forms part of feedback loop 1. Similarly, **Affinity 6: Discipline-specific skills**, influences **Affinity 3: Pure simulation**, which also forms part of feedback loop 1.

**Affinity 3: Pure simulation,** has a direct influence on **Affinity 7: Learning process**. With the learning process affinity, group 1 (learning designers) highlighted the importance of changing older ways of thinking and changing the current learning processes. Authentic learning should take place where knowledge is applied to real-life contexts. It was indicated that if the simulation shows the correct process, then it will influence the learning process (G1-2:23) and that *"sumulation reinforces learning and improves students' engagement"* (G1-5:23).

In feedback loop 2, **Affinity 7: Learning process**, furthermore influences **Affinity 9: Multi-linguistic environment**. With the affinity description of multi-linguistic environment, group 1 (learning designers) indicated that cognisance should be taken of the language in which critical thinking is developed. They also noted that the power discourse within language should be considered. In the view of one participant, *"the learning process will determine the use and effectiveness of multi-linguistic elements in the course"* (G1-2:47).

**Affinity 9: Multi-linguistic environment** has an influence on **Affinity 1: Design process**. With the description of the design process affinity, group 1 (learning designers) emphasised the importance of principles of quality design. They indicated that industry leaders should be consulted and that the intervention should be user-friendly and based on knowledge creation. It is the view of one participant that *"(i)f the multi-linguistic environment is going to be addressed in this critical thinking module, then the design process should include the relevant technologies to address multi-linguistic issues"* (G1-1:8). It is also the sentiment of another participant that *"(i)f you are planning around multi-lingual activities and resources, your design must then cater for options and choices to be made by students"* (G1-2:8). Furthermore, other participants observed that *"(i)f your environment is multi-lingual, then the design process must be multi-lingual"* (G1-4:8) and *"the teaching and learning will influence the design process based on the students' profile, based on content contextualisation, language e.g. English proficiency"* (G1-5:8).

Finally, **Affinity 1: Design process** has a direct influence on **Affinity 4: Gaming for education → gamification.** One participant noted that *"(i)f quality design principles are followed, then gamification can bring another dimension to the learning experience by addressing critical thinking skill and competencies required in an interactive and competitive or decision-making activity"* (G1-1:3). Another participant also indicated that *"(i)f the design process is good, then good gaming for education tools can be identified"* (G1-6:3).

### 7.4.4 Primary outcome: Group 1 (learning designers)

According to the SID of group 1 (learning designers), **Affinity 10: Cross-functionality** was seen as a primary outcome of this system (see Figure 26). This means that it is affected by other affinities although it does not have an effect on other affinities.

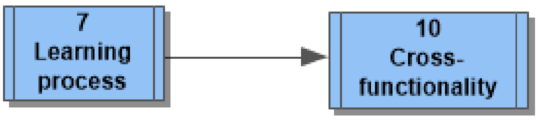



**Figure 26: Primary outcome - Group 1 (learning designers)**
**Source:** Author

Although, **Affinity 10: Cross-functionality** is influenced by other affinities, it is chiefly influenced by **Affinity 7: Learning process**. With the description of the cross-functionality affinity, group 1 (learning designers) highlighted that integration of interdisciplinary skills sets and collaboration among disciplines are important in the design of this educational intervention. Supportive infrastructure should also lay the foundation for the intervention.

### 7.4.5 Reflection and conclusion: Group 1 (learning designers)

After providing and describing the affinities in the SID for each group, Northcutt and McCoy (2004: 333–337) advise a different view of reality. Zooming in and out provided me with the opportunity to obtain a different view of the system. Zooming out provides a *"telephoto lens"* from a distance. When zooming is done, feedback loops are named (as already done) and simpler views are constructed by substituting this name for the names of the individual affinities in the feedback loop.

Figure 27 provides the zoomed out view of the uncluttered SID for group 1 (learning designers).

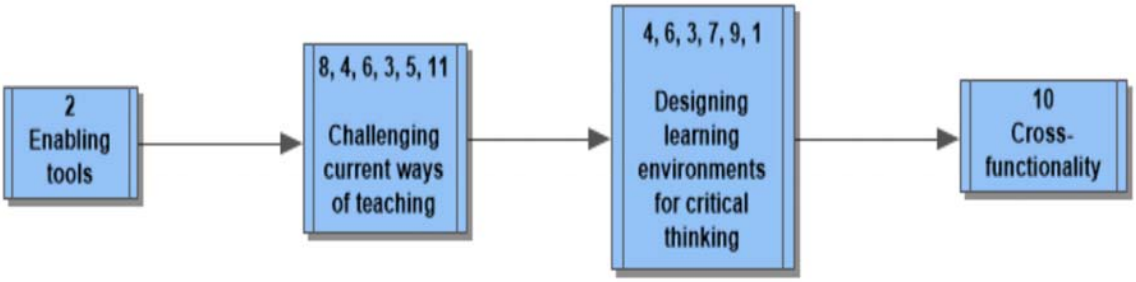



**Figure 27: Zoomed out view - Group 1 (learning designers)**
**Source:** Author

Figure 27, together with the descriptions of relationships between affinities provided in section 7.4, clearly indicate that this group of individuals view **enabling tools** as a significant driver of this system. Access to suitable and effective **enabling tools** provides a platform for **challenging current ways of teaching**. In the view of this group, **enabling tools** are needed to **change pedagogy**. **Changes in pedagogy** drive the incorporation of **gaming for education –> gamification** and **pure simulations** in education to develop **discipline-specific skills**, **soft skills and dispositions** in students and ultimately **challenge conventions**. **Enabling tools** are, however, required to bring these changes about.

**Challenging current ways of teaching** can only take place when **learning environments are designed for critical thinking.** Current ways of teaching auditing can be challenged by introducing **gaming for education –> gamification**, **pure simultions** and a focus on **discipline-specific skills**. Furthermore the **learning process** needs to be adapted, the needs of students in a **multi-linguistic environment** addressed and a specific **design process** followed to develop interventions.

**Designing learning environments for critical thinking** could ultimately lead to **cross-functionality,** where integration of interdisciplinary skills sets and collaboration among disciplines could be achieved.

## 7.5 DESCRIPTION OF HOW AFFINITIES ARE RELATED: GROUP 2 (EDUCATORS)

Figure 20 illustrates the uncluttered SID for group 2 (educators). Twelve affinities were produced by this group. The uncluttered SID is a visual representation of the relationships between these affinities.

### 7.5.1 Feedback loop 1: Group 2 (educators)

Figure 28 visually represents the feedback loop 1 for group 2 (educators). The loop was labelled as **'Responding to lecturer and student needs'**. The influences of the various affinities on one another in feedback loop 1 are discussed in this section.

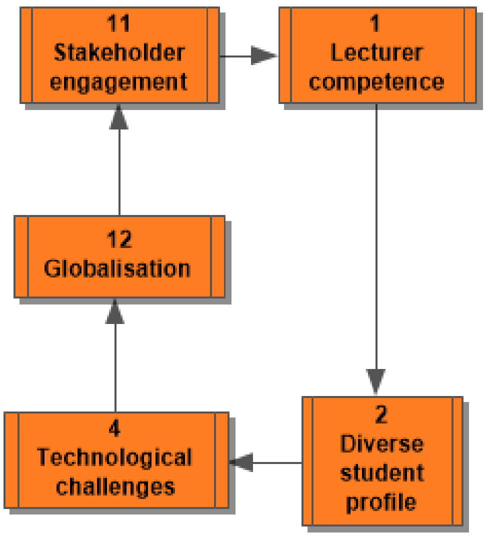



**Figure 28: Feedback loop 1 - Group 2 (educators)**
**Source:** Author

Feedback loop 1 for group 2 (educators) starts with **Affinity 11: Stakeholder engagement**. The SID indicates that this affinity influences **Affinity 1: Lecturer competence**. With the description of the stakeholder engagement affinity, group 2 (educators) noted that there should be collaboration and engagement with academia, professional bodies and practice. With the lecturer competence affinity, this group emphasised the importance of overall lecturer competence in the use of technology. This group also noted that lecturers should receive training and skills development in the use of technology-based educational interventions. According to one participant, there can only be a focus on lecturer competence once professional bodies, academia and practice have *"established the common ground"* (G2-2:10)*. "Stakeholder engagement influences the lecturer competence, as the involvement of the stakeholders will have a direct bearing on the competence of the lecturer"* (G2-4:10). Another participant noted that *(i)f stakeholder engagement is done properly, then this would improve lecturer competence and knowledge of what goes on in the industry"* (G2-5:10). There is also a view that *(i)f the stakeholder groups and their needs have been identfied, then the lecturer can develop competencies to meet these needs"* (G2-6:10). It is, furthermore, the view of one participant that *"(i)f stakeholders demand more of lecturers, then it will influence them to attend training to improve their competence"* (G2-9:10).

**Affinity 1: Lecturer competence** also influences **Affinity 2: Diverse student profile**. With the affinity description of diverse student profile, group 2 (educators) noted the importance of understanding the nature and diversity of the student body before educational interventions are developed. One participant observed that *"(i)f lecturers are competent (and understand learning and development) then they will be able to cope with a diverse student profile"* (G2-1:1). Another participant noted that *"(i)f the lecturer is competent and well trained then he or she will be able to handle and facilitate a diverse student profile on the technology-based educational tool"* (G2-5:1). Competent lecturers will be better equipped to take the diversity of students into account (G2:7:1) and will be able to better understand it (G2-11:1; G2-12:1). It is evident from another participant in this group that *"(i)f lecturers are competent mentors, then they will adapt their interventions based on each student's needs"* (G2-9:1). A clear sentiment of one of the participants is that *"(i)f lecturers are equipped with the necessary skills in the use of technology, then they can respond to the diverse student profile better"* (G2-10:1).

As feedback loop 1 for group 2 (educators) continues, **Affinity 2: Diverse student profile** influences **Affinity 4: Technological challenges**. With the affinity description of technological challenges, group 2 (educators) identified challenges that could be occur when a technology-based educational intervention is introduced. A participant pointed out that *"(i)f the profiles of students are diverse, then it is apparent that a one-size fits all approach will not be suitable"* (G2-7:13). Another participant noted that *"the more diverse the student profile having been exposed to the use of technology at varied levels, the more varied the readiness of students are"* (G2-8:13). Another participant futhermore maintained that *"(i)f the student profile is diverse, then it is likely that not all students will have access to the resources necessary to operate the intervention"* (G2-11:13). *"(I)f the needs of the diverse student profile are not properly considered and interpreted, then technological challenges may remain a challenge for certain students"* (G2-10:13). If, however, the diverse student profile is considered and understood, the technological challenges can be identified and addressed (G2-6:13; G2-12:13).

**Affinity 4: Technological challenges** furthermore has a direct influence on **Affinity 12: Globalisation**. When the affinities were produced, group 2 (educators) pointed out the importance of a continuous comparison with global or international approaches and best practices. A participant noted that if technological challenges are experienced, it becomes difficult to benchmark against international trends and to incorporate those trends (G2-5:38). Another participant stated that *"(i)f there are technological challenges, such as no access to technology, then it will not be possible to measure the practices and outcomes against international criteria"* (G2-11:38). *"If challenges exist, engagement with a global world would be limited"* (G2-12:38). It is, furthermore, the view of one of the participants that *"(i)f the international view on interventions and the practicality thereof is not adjusted for South Africa, then the unique South African student, with some form of technology challenges, will not be successful at any intervention"* (G2-2:38). On the other hand, *"(i)f the technological challenges are understood, then the globalisation needs can be met within the context of the challenges"* (G2-6:38).

Lastly, the feedback loop 1 of group 2 (educators) indicates that **Affinity 12: Globalisation**, influences on **Affinity 11: Stakeholder engagement**. One of the participants explained that *"(i)f the globalisation concept is understood, then the relevant stakeholders within those parameters can be identified and engaged"* (G2-6:66). Other participants claimed that *"(i)f global benchmarking is conducted, then it will also stimulate inevitable stakeholder engagement" (G2-5:66)* and *"globalisation may improve engagement with stakeholders"* (G2-8:66). Another participant in the group pointed out that *"(i)f there is more comparison with international approaches, then it would be possible to also engage more with international stakeholders and not only local stakeholders"* (G2-11:66). It was, furthermore, noted that *"(i)f the world is regarded as a global one, then our definition of stakeholders and the way we engage with them will change"* (G2-12:66).

### 7.5.2 Feedback loop 2: Group 2 (educators)

Feedback loop 2 for group 2 (educators) is provided in Figure 29. I labelled this feedback loop **'Interventions that address interactivity, ethics and diversity'.** This section describes the influences of the various affinities on one another for this particular feedback loop.

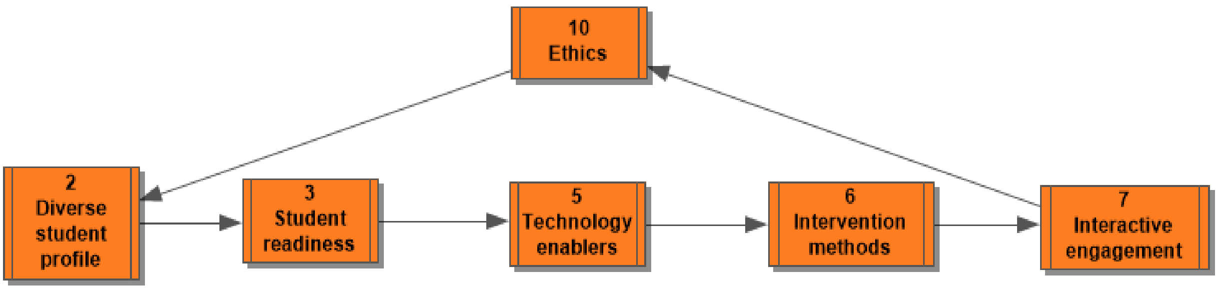



**Figure 29: Feedback loop 2 - Group 2 (educators)**
**Source:** Author

Figure 29 illustrates that feedback loop 2 commences with **Affinity 2: Diverse student profile**. This affinity influences **Affinity 3: Student readiness**. With the affinity description of student readiness, the group identified several challenges that might influence students' readiness when a technology-based educational intervention is introduced. These include a lack of required reading skills and IT skills, amongst others. One participant specified that *"a diverse student profile implies that they will be at different levels of readiness in respect of IT"* (G2-1:12). It was noted that *"(i)f the student profile is diverse, then it is likely that not all students will possess the necessary competence such as reading or IT skills"* (G2-11:12). Also, *"(i)f a student has a specific background and education, then it will have a direct influence on his IT readiness"* (G2-9:12). *"The more diverse the student profile,* *having received secondary education at varied levels, the more varied the readiness of students are"* (G2-8:12). One participant indicated that a diverse student profile influences student readiness as the students' profile (background, education and academic maturity) will have an influence (G2-4:12). It was, furthermore, indicated that *"(i)f the student profile is so diverse and different, then it will influence their levels of readiness to engage with the tool"* (G2-5:12). It was specified that *"(i)f the background of the student and the exposure to technology is not taken into consideration, then the student will less likely be ready to use the technology"* (G2-2:12). *"If the profiles of students are diverse then it is apparent that a one-size-fits-all approach will not be suitable"* (G2-7:12). Another participant indicated that *"(i)f there is a diverse student body, then the student readiness will also be influenced when a technology-based educational intervention is introduced"* (G2-13:12). Some participants, however, felt that *"(i)f the diverse student profile is understood, then the student readiness can be assessed and the needs met"* (G2-6:12) and *"(i)f the profile is considered, student readiness can be improved"* (G2-12:12).

As feedback loop 2 for group 2 (educators) continues, **Affinity 3: Student readiness** influences **Affinity 5: Technology enablers**. With the affinity description of technology enablers, this group identified hardware and software tools or resources that could facilitate the critical thinking development process in students. These include the internet, Google, social media, ipads, laptops and others. It was the feeling of one of the participants that *"(i)f students are not appropriately skilled in IT, they may not be able to use the technology enablers effectively until appropriate training has been provided"* (G2-1:23). It was also mentioned that *"(i)f the students are not ready, then this might change the type of tech(nology) enablers that will be applied during the tool design or teach (sic) process"* (G2-5:23). It was furthermore noted that *"student readiness will influence the technology enablers because this is whether or not the student is appropriately conditioned for technology. If this is not the case, the technology enablers will have to be affected and modified to cater for the needs of the lack of student readiness"* (G2-4:23). It was also the perspective of one of the participants that *"(i)f the hard reality of lack of access to internet for a large part of SA students is not addressed when developing material, then the challenge of technology enablers might cause the programme to fail (G2-2:23).* One participant, however, claimed that *"(i)f the level of student readiness is* *understood, then the appropriate technology enablers can be developed and implemented"* (G2-6:23).

**Affinity 5: Technology enablers** furthermore has a direct influence on **Affinity 6: Intervention methods**. The group, with the affinity description of intervention methods, considered simulations, gamification and case studies as effective intervention methods for critical thinking development in students. They highlighted that experiential learning principles and guidelines should also be considered. One of the participants noted that *"(i)f a student doesn't have the tools or technology that would enable him to get access to interventions, then the intervention would lose its value"* (G2-2:39). *"If technology enablers are in place, then effective and applicable intervention methods could be used"* (G2-13:39) and similarly *"(i)f the technology enablers are understood, then the appropriate intervention methods can be designed and implemented"* (G2-6:39). Also, *"(i)f there is access and good understanding of the technology enablers, then more intervention methods could be used"* (G2-11:39). Moreover, *"(i)f the hardware and software resources are well supported and developed, then the various learning methods could be experimented with and used"* (G2-7:39). One participant felt that *"(i)f easily accessible platforms such as you tube (sic) can be used, interventions will be more effective"* (G2-12:39). *"If social media is used, then lecturers can effectively develop case studies on a platform that is well-known by students"* (G2-9:39). It was the perspective of one of the participants that technology enablers will influence the intervention methods as the enablers *"will be used to develop the intervention method such as assignments etc., so that the critical learning process can be facilitated"* (G2-4:39). Technology enablers could thus *"improve the intervention methods"* (G2-8:39).

As feedback loop 2 for group 2 (educators) continues, **Affinity 6: Intervention methods** influences **Affinity 7: Interactive engagement**. With the interactive engagement affinity, the group noted that communication, dialogue and discussion should form the foundation of an interactive learning environment where critical thinking is developed. It was the view of one of the participants that *"(i)f lecturers effectively use intervention methods that assist in critical thinking, then students will be more likely to participate in interactive engagement"* (G2-7:46). Another participant noted that *"(i)f lecturers use case studies* *effectively, then students would be motivated to discuss these case studies among themselves"* (G2-9:46). *"If the intervention methods are interesting and the students enjoy it, then it should stimulate more interactive engagement"* (G2-11:46). On the contrary, *(i)f the method used for the intervention (like case studies or real-life cases) does not create the platform for discussion, then the students won't be able to have interactive engagements regarding the intervention"* (G2-2:46). It was, furthermore, indicated that *"(i)f the intervention methods are properly designed, then it should include interactive engagement"* (G2-10:46). It was also emphasised that *"(i)f good interventions exist, interactive engagement with students could increase"* (G2-12:46) and that *"(i)f intervention methods are used, then this will help facilitate interactive engagement between parties"* (G2-5:46). Furthermore, intervention methods create *"a platform for interactive engagement"* (G2-13:46).

**Affinity 7: Interactive engagement** furthermore influences **Affinity 10: Ethics**. With the ethics affinity description, the group indicated that ethical considerations should form an overarching theme in all aspects of critical thinking development, the design of educational interventions and in the use of technologies. One participants argued that *"interactive engagement should enable a better understanding and application of ethics"* (G2-1:54). *"Interactive engagement may ensure that ethics is observed in learning"* (G2-8:54). It was also noted that *"(i)f the level or type of interactive engagement is determined, then the appropriate ethical framework can be applied around the engagement"* (G2-6:54). If an interactive environment is created by the lecturer, students can be made constantly aware of ethical considerations (G2-7:54). *"If lecturers engage with students, then they should make reference to ethical considerations throughout"* (G2-9:54).

Lastly, **Affinity 10: Ethics** has a direct influence on **Affinity 2: Diverse student profile**. One participant specified that *"ethics will influence students of various profiles at a more or lesser scale due to the difference in ethics encountered during forming years"* (G2-8:19). Another participant indicated that *"(i)f ethics is core in the teaching and tool design, then this will be communicated to the diverse student profile through teaching methods and tool usage"* (G2-5:19). One participant of group 2 (educators) felt that *"(i)f ethics is taught, student profiles could be changed in an impoverished SA"* (G2-12:19). "*If the* *relevant ethical principles are understood, then these can be appropriately applied to the diverse student profile"* (G2-6:19).

### 7.5.3 Feedback loop 3: Group 2 (educators)

Feedback loop 3 for group 2 (educators) is provided in Figure 30. This feedback loop has been labelled as **'Designing tools to meet outcomes'**. The influences of the affinities in this feedback loop, are discussed in this section.

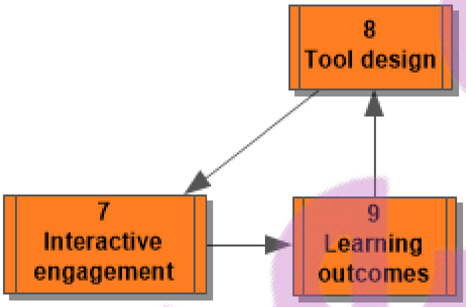



**Figure 30: Feedback loop 3 - Group 2 (educators)**
**Source:** Author

Figure 30 indicates that feedback loop 3 for group 2 (educators) starts off with **Affinity 7: Interactive engagement**. This affinity influences **Affinity 9: Learning outcomes**. This group indicated with the affinity, learning outcomes, that once a student has developed their critical thinking abilities through the intervention, they should be able to think out of the box and adapt their thinking to different situations. It was noted that *"(i)f interactive engagement is used to convene applicable discussions among students and lecturers, then it could have a positive impact on the learning outcomes"* (G2-13:53) because *"(i)f there is interactive engagement between parties, then this will help ident(ify) areas of need and establish the development of learning outcomes"* (G2-5:53). It was also specified that *"(i)nteractive engagement will provide information on the requirements for mastering learning outcomes"* (G2-8:53) and *"(i)f there is more interactive engagement then it should be possible to achieve more learning outcomes"* (G2-11:53). One participant indicated that *"(i)f the level or type of interactive engagement is determined, then the learning outcomes can be appropriately stated"* (G2-6:53). It was, furthermore, indicated that *"(i)f lecturers engage with students, then they should continuously remind students of the learning* *outcomes"* (G2-9:53) and *"(i)f lecturers create an interactive environment, then students will continually bear the learning outcomes in mind* (G2-7:53). *"If students are invited to participate as stakeholders, their opinions could influence (l/o's) learning outcomes"* (G2-12:53). Lastly, it was specified that *"(i)f the interactive discussions are not adjusted to enhance critical thinking, then the learning outcomes will not be met"* (G2-2:53).

**Affinity 9: Learning outcomes** furthermore influences **Affinity 8: Tool design**. With the affinity description of tool design, group 2 (educators) indicated that the intervention design should, amongst other things, be user-friendly with clear instructions and outcomes built into the software. It was stated that *"(t)he learning outcomes will determine the way in which the tools need to be designed to address the learning outcomes"* (G2-5:57). It was furthermore noted that *"(l)earning outcomes will determine the design of the tools"* (G2-8:57) and *"(l)earning outcomes will have an effect on tool design"* (G2-12:57). It was also specified that *"(l)earning outcomes will influence the tool design as the expected outcomes (such as critical thinking) will trigger the development of the tools that will be required to achieve the learning outcome"* (G2-4:57). Moreover, *"(i)f the appropriate learning outcomes are determined, then a suitable tool can be designed"* (G2-6:57). *"If lecturers develop clear, well designed outcomes, then it will improve the lecturer's instructions built into the software"* (G2-9:57).

Finally, **Affinity 8: Tool design** has a direct influence on **Affinity 7: Interactive engagement**. It was noted by one of the participants that *"(i)f the tool or programme do not allow for effective discussions or platforms, then the interactive engagement cannot be effective or successful"* (G2-2:52). It was also specified that *"(i)f the tool design responds to the requirements of students, then interactive engagement will be a principle of the tool"* (G2-10:52) and *"(i)f the tool design is effective then it should stimulate more interactive engagement"* (G2-11:52). Similarly it was stated that *"(i)f tools are designed effectively, interactive engagement could be improved"* (G2-12:52). Moreover, *"(i)f there (are) clear instructions to the students and by making it more user-friendly, then it would also increase the interactive engagement among students and thereby having a positive impact on critical thinking"* (G2-13:52). *"Tool design will influence the interactive engagement due to the never ending changing of the technology landscape both locally* *and internationally. Technology changes rapidly. For this reason, the intervention methods will never be cast in stone so to speak but evolve"* (G2-4:52).

### 7.5.4 Reflection and conclusion: Group 2 (educators)

Figure 31 provides the zoomed out view of the uncluttered SID for group 2 (educators). The zooming out process was followed, described by Northcutt and McCoy (2004: 333–337), where feedback loops were named (as already done) and simpler views constructed by substituting this name for the names of the individual affinities in the feedback loop.


**Figure 31: Zoomed out view - Group 2 (educators)**
**Source:** Author

To **respond to the needs of lecturers and students** it is necessary for **stakeholder engagement** where these needs can be identified and communicated. Through proper **stakeholder engagement**, **lecturers** can identify the skills and **competencies** they require to effectively develop and use technology-based educational interventions. This will increase **lecturers' competence in** meeting the needs of a **diverse student profile**, where many **technological challenges** are often faced**.** These **challenges and needs** have to be addressed if an intervention, aimed at critical thinking development, is to match **global** standards, allowing auditing students to be critical thinkers in a **globalised** world. It is thus crucial for **stakeholders to engage** and compare the intervention with international approaches, taking into account the unique South African context.

To **respond to the needs of lecturers and students**, **interventions that address interactivity, ethics and diversity** could provide an effective platform. **The diversity of students** should be considered, as this might influence whether students can effectively engage with the intervention. **Students might not be ready** to use **technology enablers** that could serve as the platform for effective and suitable **intervention methods**. Effective **intervention methods** can lay the foundation for **interactive engagement** where **ethical considerations** should be incorporated**. Ethics** should guide learning in a **diverse student profile**.

**Interventions that address interactivity, ethics and diversity** should be **designed to meet specific outcomes**. **Interactive engagement** between the relevant parties will assist in identifying, establishing and communicating the specific **learning outcomes**. The **learning outcomes** will determine how the **tools need to be designed** to meet the specific needs. If the tools encourage **interactive engagement** and meet the specific **learning outcomes**, it could have a positive impact on students' critical thinking.

## 7.6 DESCRIPTION OF HOW AFFINITIES ARE RELATED: GROUP 3 (STUDENTS)

The uncluttered SID for group 3 (students) is provided in Figure 22. This group produced seven affinities which are presented in the uncluttered SID.

### 7.6.1 Primary driver: Group 3 (students)

The uncluttered SID for group 3 (students) indicates that, **Affinity 2: Consideration of diversity,** was seen as a primary driver in this system (see Figure 32). With the affinity description of consideration of diversity, this group noted that the diversity of students should be considered.

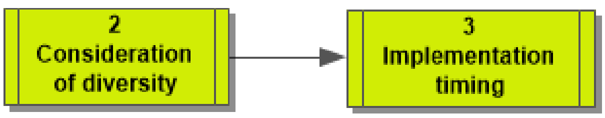



**Figure 32: Primary diver - Group 3 (students)**
**Source:** Author

**Affinity 2: Consideration of diversity** as a primary driver has an influence on the entire system. However, it has a direct influence on **Affinity 3: Implementation timing**. The group, with the affinity description of implementation timing, emphasised that the development of critical thinking in students is a process that should start as early as possible, preferably at undergraduate level. It was the view of one of the participants in the group that *"(i)f there is a variety of cultures and backgrounds among students then earlier implementation will be required to bring all students to the same level by the end of the undergraduate program(me)"* (G3-5:7). It was also noted that *"(i)f a student doesn't have prior exposure to technology, then the implementation timing will be affected as a student without this exposure will struggle"* (G3-8:7). Furthermore, it was noted that *"(i)f (a) student differs in background to the average group, then (it) would take a little longer to understand but that doesn't mean it(')s potential application handicap. It(')s just a new mental environment." (G3-7:7)*. In summary, *"(i)f the consideration of diversity of the students is to be considered, one would then understand that the earlier it is implemented, the more likely students would more or less (be at) the same level by their post graduate studies"* (G3-3:7).

### 7.6.2 Feedback loop 1: Group 3 (students)

Feedback loop 1 for group 3 (students) is illustrated in Figure 33. I labelled this feedback loop **'Teaching basics and technical knowledge at the right time'**. The influences of the affinities in feedback loop 1 on one another are discussed in this section.

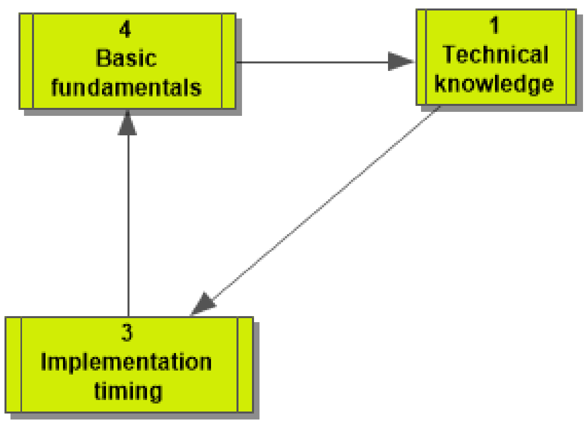



**Figure 33: Feedback loop 1 - Group 3 (students)**
**Source:** Author

Feedback loop 1 of group 3 (students), starts off with **Affinity 3: Implementation timing** and its influence on **Affinity 4: Basic fundamentals**. With the affinity description of basic fundamentals, the group emphasised that the technology-based educational intervention should focus on the basic audit fundamentals and principles of a business environment. It was emphasised that *“(b)asic fundamentals should start as early as possible, so that students can learn as early as possible”* (G3-6:12). It was furthermore noted that *“(i)f this process is implemented when students start with these basics, then it will help cement their knowledge in this regard”* (G3-8:12). It was also indicated that *“the quicker the fundamental principles are included in the development phase, then implementation will be quicker”* (G3-9:12).

As feedback loop 1 for group 3 (students) continues, **Affinity 4: Basic fundamentals** has a direct influence on **Affinity 1: Technical knowledge**. With the affinity description of technical knowledge, the group emphasised the importance of technical knowledge specifically relating to controls as well as assertions, amongst others. It was noted that *“(i)f one understands the basic fundamentals, then, and only then, can one start building on your technical knowledge”* (G3-3:3). It was also specified that *“(t)echnical knowledge and the basic fundamentals go hand in hand”* (G3-4:3) and that *“(i)f a student has the basic fundamentals, then it will be easy for them to apply technical knowledge”* (G3-6:3). On the other hand, *“(i)f students don’t have a(n) understanding of the basic fundamentals, they (are) not going to have the required technical knowledge”* (G3-8:3). A student will not be able to understand the technical auditing details if the basic concepts are not fully grasped (G3-1:3). It was, furthermore, indicated that *“(i)f the basic fundamentals of audit procedures are included in applications, then it will be easier to use”* (G3-9:3).

The last link in feedback loop 1 of group 3 (students), is the influence of **Affinity 1: Technical knowledge** on **Affinity 3: Implementation timing**. One participant indicated that an *“IT foundation could be provided to student(s) at an early stage”* (G3-2:2). It was also noted that *“(if) (there is) no prior technical knowledge, then early implementation would be of no value”* (G3-3:2). Lastly, *“(i)mplementation can only happen once students start with the specific course work where they start to acquire the specific technical knowledge. (e)g. 2nd year of undergraduate study”* (G3-8:2)

### 7.6.3 Feedback loop 2: Group 3 (students)

Feedback loop 2 for group 3 (students) is set out in Figure 34. This feedback loop was labelled as **'Teaching methodologies in a simulation application'**. The links between these affinities are further discussed in this section.

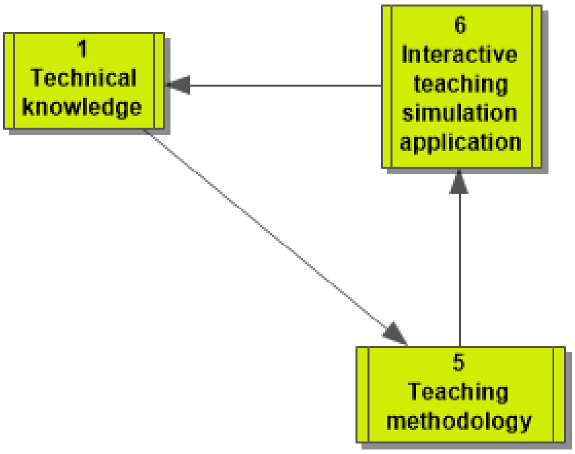



**Figure 34: Feedback loop 2 - Group 3 (students)**
**Source:** Author

Figure 34 indicates that feedback loop 2 for group commences **with Affinity 1: Technical knowledge**. This affinity has a direct influence on **Affinity 5: Teaching methodology**. With this affinity, the group emphasised specific teaching methodologies as the platform through which the educational intervention can be delivered to the students. It was indicated that *"(t)he (t)echnical knowledge will be used on the teaching methods"* (G3-6:4). One participant felt that *"with the technical knowledge, you can move on to the method of teaching"* (G3-1:4). Futhermore, *"audit business language could be implemented at early times of the studies"* (G3-2:4). It was also specified that *"(i)f technical knowledge is lacking, then the lecturer will need to focus on the basic technical skills needed to work properly"* (G3-5:4).

**Affinity 5: Teaching methodology** has an influence on **Affinity 6: Interactive teaching simulation application**. The group, with the interactive teaching simulation application affinity, indicated that the software for this audit application could be made available on smartphones, tablets and computers. One participant noted that *"(i)f the method of teaching used in simulations is wrong, then interactive learning will not be an effective* *teaching material"* (G3-5:19). It was also specified that *"(t)hese different teaching methods should be incorporated into this application"* (G3-8:19). Lastly, it was observed that *"(g)reat teaching methodology would assist student to interact effectively if followed appropriately"* (G3-2:19).

Finally, feedback loop 2 for group 3 (students) ends with the influence of **Affinity 6: Interactive teaching simulation application** on **Affinity 1: Technical knowledge**. One participant signalled that *"(i)f the interactive teaching simulation app is used effectively it would then help to build one(')s technical knowledge"* (G3-3:5). Furthermore, it was indicated that *"(i)f the application functions correctly, then the technical knowledge would be easier (to teach)"* (G3-4:4). It was also pointed out that *"(i)f teaching simulations are not comprehensive in knowledge transfer(red) to student, then technical knowledge will be lacking and leave the student unable to perform certain tasks"* (G3-5:4). *"If the method of teaching used by the lecturer can change, the technical knowledge of students will improve"* (G3-9:4). In conclusion, *"(u)sing such simulation can develop and ground students in their understanding of this technical knowledge"* (G3-8:4).

### 7.6.4 Primary outcome: Group 3 (students)

The uncluttered SID for group 3 (students) indicates that **Affinity 7: Development considerations** was seen as a primary outcome of this system (see Figure 35). It is thus affected by other affinities, but does not have any effect on the others.

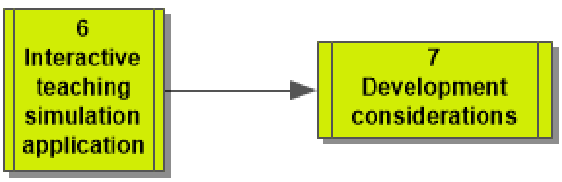



**Figure 35: Primary outcome - Group 3 (students)**
**Source:** Author

**Affinity 7: Development considerations** is primarily influenced by **Affinity 6: Interactive teaching simulation application**. With the affinity, development considerations, the group emphasised that the intervention should be adaptable, cost-effective, appealing, interesting and attractive to students, with built-in security measures, access settings and continuity controls. It was indicated that *"(i)f the simulations are not properly designed, then the development of the students will be hindered"* (G3-5:21). It was, furthermore, noted that *(i)f developments were to be considered as basics, then interactive teaching would be broad and advanced"* (G3-2:21).

### 7.6.5 Reflection and conclusion: Group 3 (students)

Figure 36 provides the zoomed out view of the uncluttered SID for group 3 (students). The zooming out process, described by Northcutt and McCoy (2004: 333–337), was also followed.

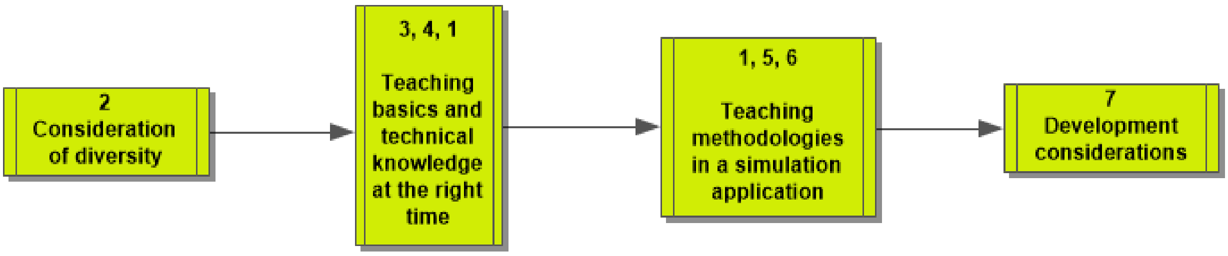



**Figure 36: Zoomed out view - Group 3 (students)**
**Source:** Author

**Consideration of diversity** was a key driver in the system in the view of group 3 (students). The diversity may include students' prior knowledge, personal backgrounds and prior exposure to technology. **Diversity of students** should be considered when **interventions are introduced to teach basics and technical knowledge**. The **diversity of students** should be taken into account when the **implementation timing** of interventions is considered. Interventions should preferably be introduced as early as possible so that **basic audit fundamentals** can be introduced to students as early as possible. Only when a proper understanding of **basic fundamentals** exists, can the focus shift to **technical knowledge** aspects.

In the view of group 3 (students), the **teaching of basics and technical knowledge** should be incorporated into **teaching methodologies presented in a simulation application**. **Technical knowledge** drives the **teaching methodologies**. Different

**teaching methodologies** should also be incorporated into an **interactive teaching simulation application** that should in turn develop students' **technical knowledge**.

**Development considerations** was seen as the primary outcome of this system by group 3 (students). The **interactive teaching simulation** application should be adaptable, cost-effective, appealing, interesting and attractive to students, with built-in security measures, access settings and continuity controls. The design principles of virtual reality and virtual machines should be considered.

A typical IQA report lastly requires comparisons to be made. This can include comparisons among individuals within the groups and across groups. It can also include comparisons among the groups' systems. For purposes of this study, a comparison among the three groups' systems was made (Northcutt & McCoy 2004: 50–51), as described in section 7.7.

## 7.7 COMPARISON OF THE SYSTEMS OF THE THREE GROUPS

In sections 7.2 to 7.6, the affinities produced by the three groups, as well as the overall placement of the affinities in the SIDs, was described. Relationships between affinities were explained in the words of the participants, as obtained from individual DART documents. The aim of this section is to compare the systems of the three groups.

To contrast and compare results at a system level, Northcutt and McCoy (2004: 343) suggest that interpretation can be conducted in a structural way. This allows for the SIDs of the groups to be compared in terms of their systemic properties. The affinities comprising the SIDs can be compared and the SIDs (composite systems) themselves can be compared (Northcutt & McCoy 2004: 346–366). In the following section, the affinities of the three groups are compared.

### 7.7.1 Comparing the affinities among the three groups

To compare and contrast affinities, Northcutt and McCoy (2004: 346) advise an interpretive interrogation of affinities where it is important to understand how the affinities compare across the groups. Section 7.2 provided the names and descriptions of the affinities produced by each of the three focus groups. Group 1 (learning designers) produced eleven affinities, group 2 (educators) produced twelve affinities and group 3 (students) produced seven affinities. In total, 30 affinities were produced across the three groups. These affinities represent concepts that the groups believe should be taken into account when critical thinking is developed in auditing students through technology-based educational interventions.

The three groups consisted of individuals from different occupations with diverse expertise, varied opinions and experiences. Participants in group 1 (learning designers) were selected because of their expertise and knowledge of 21st century ICTs. These experts have insight into e-learning environments, education in 21st century teaching and learning practices, simulations and instructional design. With expertise in advanced ICTs and e-learning environments, I expected that the affinities generated by group 1 (learning designers) would have a strong focus on technologies that could be used to develop critical thinking. I also expected that this group would focus more on the design of these ICTs and how these technologies could be used in learning environments to develop critical thinking. This was indeed the case. The affinities of this group were focused on technology-based educational interventions (pure simulations, gaming for education and other enabling tools), the design of the intervention and the changing learning environment.

Group 2 (educators) consisted of auditing lecturers at SAICA programme providers and SAICA representatives. These participants do not necessarily have the expertise in advanced technologies and interventions that the participants in group 1 (learning designers) have, but I expected that they would have a general understanding of some technologies that could be used to develop critical thinking in students. I also expected that the participants in this group would focus more on auditing curriculum aspects, teaching strategies, matters relating to students and matters affecting them as educators. This was also the case with group 2 (educators). This group did indeed mention several technology-based educational interventions (simulations, gamification, case studies) and also focused on the design of the interventions. They placed more emphasis on the readiness of the educator and the student to engage with the intervention. They also focused on the outcomes of the intervention.

Group 3 (students) comprised postgraduate auditing students. Most of these students are part of the millennial generation that grew up with rich and interactive learning environments (Bell et al. 2008: 4). I thus expected that these participants would be fairly well-informed regarding advanced technologies. I also expected that these participants would focus on auditing content matters and other matters that affect them directly as students. The students placed less emphasis on detailed design considerations of the intervention, although certain developmental aspects were mentioned. Many of their affinities were, however, focused on technical auditing content knowledge and business knowledge.

Given the differences among the groups, I expected that some affinities would be unique. The three groups were, however, all presented with the same issue statement, namely: *'Thinking about a technology-based educational intervention to develop critical thinking in auditing students, what comes to mind?'* This issue statement set the scene for affinity production and analysis. Given that all three groups explored the same phenomenon, it was also not unreasonable to expect that some affinities may share similar meanings.

Affinities of different systems can either have the same meaning or different meanings when they are compared. In many instances, groups provide a different name to, essentially, the same affinity. As such, there is always a common core of affinities across constituencies (Northcutt & McCoy 2004: 212–213). To identify the common core of affinities, Northcutt and McCoy (2004: 212–215) advise a process of affinity reconciliation to identify commonalities. Affinities with the same meaning should be reconciled. While maintaining the integrity of the affinities initially produced, the researcher should compile a new list of reconcilied affinities (Northcutt & McCoy 2004: 212–215). This process of reconciling affinities is generally performed in IQA to arrive at a single reconciled interview protocol to be used for interviewing participants subsequent to the focus groups (Northcutt & McCoy 2004: 212–215). This process of affinity reconciliation was also followed by

Ungurait (2007: 60–65), Plant (2015: 208–213) and Robertson (2015: 125–129) as these scholars conducted interviews subsequent to the focus groups.

Although individual interviews were not conducted with participants in this particular study, the affinity reconciliation was performed with a slightly different purpose in mind. By comparing the affinities across the three groups and identifying those affinities with similar meanings, the list of 30 affinities across the three groups could be reconciled to a core list of affinities. This list of common core affinities represents the key concepts that these participants perceive as important when technology-based educational interventions are used to develop critical thinking in auditing students. The list of common core affinities could be further examined in Chapter 8 to determine if these affinities provide validation for the preliminary framework or insight into additional concepts and relationships that needed to be added to the framework (as presented in Chapter 8).

For these reasons, I followed this process of affinity reconciliation to identify the common core affinities across the three groups. The names of the initial 30 affinities produced across the three focus groups, are summarised in Table 40 and the reconciled list of common core affinities is set out in Table 41.

**Table 40: Names of initial 30 affinities produced across three groups**

| Number | Group 1 (learning designers) | Group 2 (educators) | Group 3 (students) |
|---|---|---|---|
| | Affinity name | | |
| 1 | Design process | Lecturer competence | Technical knowledge |
| 2 | Enabling tools | Diverse student profile | Consideration of diversity |
| 3 | Pure simulation | Student readiness | Implementation timing |
| 4 | Gaming for education → gamification | Technological challenges | Basic fundamentals |
| 5 | Soft skills and dispositions | Technology enablers | Teaching methodology |
| 6 | Discipline-specific skills | Intervention methods | Interactive teaching simulation application |
| 7 | Learning process | Interactive engagement | Development considerations |
| 8 | Change in pedagogy | Tool design | |
| 9 | Multi-linguistic environment | Learning outcomes | |
| 10 | Cross-functionality | Ethics | |
| 11 | Challenging conventions | Stakeholder engagement | |
| 12 | | Globalisation | |

**Source:** Author

**Table 41: Reconciled list of twenty common core affinities**

| Affinity number | Names of common core affinities |
|---|---|
| 1 | Design and development considerations *(reconciled)* |
| 2 | Technology-based enabling tools *(reconciled)* |
| 3 | Consideration of student diversity *(reconciled)* |
| 4 | Collaboration among stakeholders and disciplines *(reconciled)* |
| 5 | Educational interventions and teaching methods ideal for critical thinking development *(reconciled)* |
| 6 | Soft skills and dispositions |
| 7 | Discipline-specific skills |
| 8 | Learning process |
| 9 | Change in pedagogy |
| 10 | Challenging conventions |
| 11 | Lecturer competence |
| 12 | Student readiness |
| 13 | Technological challenges |
| 14 | Interactive engagement |
| 15 | Learning outcomes |
| 16 | Ethics |
| 17 | Globalisation |
| 18 | Technical knowledge |
| 19 | Implementation timing |
| 20 | Basic fundamentals |

**Source:** Author

The following affinities were reconciled as they essentially had similar meanings:

- Group 1 (learning designers) specifically mentioned the importance of the **design process** with principles of quality design that should be evaluated and followed. As part of the description of this affinity, this group indicated that the intervention should be user-friendly and based on knowledge creation. Group 2 (educators) similarly produced an affinity named **tool design**. As part of the description of this affinity, group 2 (educators) noted that the intervention design should be user-friendly with clear instructions and outcomes built into the software. Group 3 (students) produced the affinity, **development considerations**. This group indicated that the intervention should be adaptable, cost-effective, appealing, interesting and attractive to students. They also noted that the interventions should have built-in security measures, access settings and continuity controls with certain design principles. As these affinities all related to the design and development of the intervention, they shared a similar meaning and were thus reconciled. A collective name, **design and development considerations,** was given to these reconciled affinities (shown in green in Tables 40 and 41)**.**

- Group 1 (learning designers) identified **enabling tools** such as blogs, forums, wikis, podcasts, jingles and animation among others. Group 1 (learning designers) stressed that these tools enable teaching. Group 2 (educators) produced the affinity **technology enablers**, specifying that these enablers include hardware and software tools or resources that can facilitate the critical thinking development process in students. They identified the internet, Google, social media, advanced Excel, other software applications (including various student-related applications), ipads, laptops and others. The examples of enabling tools that group 1 (learning designers) provided included various software applications (blogs, forums, wikis and podcasts). All these tools (hardware and software) enable teaching and thus, critical thinking development in students. For this reason, I viewed these enabling tools and technology enablers as affinities with similar meanings. These affinities were thus reconciled and collectively named **technology-based enabling tools** (shown in orange in Tables 40 and 41).
- Group 2 (educators) produced the affinity, **diverse student profile**. The participants of this group noted the importance of understanding the nature and diversity of the student body before developing educational interventions. This group highlighted that it should be considered whether students have a residential (face-to-face) or distance learning background. They also noted that it should not be assumed that students from a younger generation are technologically empowered. Group 3 (students) produced **consideration of diversity** as an affinity, indicating that the diversity of students should be considered. This group noted the importance of considering students' prior knowledge, personal backgrounds (for example culture and ethnicity) and prior exposure to technology. One first glance it would seem that only these two affinities bear resemblance, but on closer inspection the affinity **multi-linguistic environment,** produced by group

1 (learning designers) also shares similarities. Under this affinity, the participants of group 1 (learning designers) indicated that the multi-linguistic environment within South Africa should be considered and that cognisance should be taken of language (first, second or third language) in which critical thinking is developed. The power discourse within language should be considered. This is also in essence a consideration of student diversity. As these affinities all deal with the diversity of the study body, how student diversities should be considered in the development of critical thinking and in the design of interventions, these affinities were considered similar in meaning. A reconciled name for these affinities was provided as **consideration of student diversity** (shown in light blue in Tables 40 and 41).

- Group 1 (learning designers) produced the affinity **cross-functionality**. With the description of this affinity, the participants of this group noted that integration of interdisciplinary skills sets and collaboration among disciplines are important in the design of this educational intervention. They also indicated that collaboration among IT experts, educational technologists and academics is required when an interdisciplinary educational intervention is designed. Group 2 (educators) produced the affinity **stakeholder engagement**. Group 2 (educators) noted that there should be collaboration and engagement among academia, professional bodies and practice to identify demands in the workplace, to remain relevant and to identify the best possible ways of addressing current challenges in the profession. These groups both identified the importance of collaboration and engagement. Whether it is between stakeholders or between disciplines, collaboration is vital in the addressing the current critical thinking skills gap and developing interventions to address this skills gap. Given the similarities between these two affinities, they were reconciled and provided the name **collaboration among stakeholders and disciplines** (shown in yellow in Tables 40 and 41).
- Group 1 (learning designers) produced the affinities **pure simulation** and **gaming for education → gamification**. The participants of this group noted the significance of pure simulations as well as gaming principles for educational purposes and in developing students' critical thinking. Augmented reality, virtual

reality and virtual worlds such as Second Life were all mentioned as part of pure simulations. Group 1 (learning designers) also noted the importance of user-friendly, interactive games for the development of critical thinking in students. Within auditing, games of deception and role play were also mentioned. Group 2 (educators) produced the affinity, **intervention methods**. This group specifically mentioned simulations, gamification and case studies as effective intervention methods. All these could be provided through computer-based platforms. Group 2 (educators) noted that these methods should contain real-life scenarios, case studies and examples to contextualise learning. Experiential learning principles and guidelines should also be considered. Group 3 (students) produced the affinities **teaching methodology** and **interactive teaching simulation application**. With the affinity, teaching methodology, the participants emphasised specific teaching methodologies as the platform through which the ecucational intervention could be delivered to students. These include lecture videos, computer-based auditing scenarios, technology-based audit tests, videos with audit simulations and workshops. Group 3 (students) also noted that an interactive teaching simuation application should be available to students which could feature story boards of audit case studies or scenarios. This simulation application could also include audit cartoons, training software and/or activity-based simulations. In my view, these four affinities had similar meanings as they all relate to educational interventions and active learning methods that are considered ideal for developing students' critical thinking. They range from simulations, gamification, case studies, lecture videos, simulation applications, experiential learning methods, contextualised learning and others. These affinities were thus reconciled and named **educational interventions and teaching methods ideal for critical thinking development** (shown in purple in Tables 40 and 41).

Through this affinity reconciliation protocol, the initial list of 30 affinities across the three groups could be reduced to a list of twenty common core affinities. From these twenty core affinities, it would seem that the three groups identified a fairly diverse range of concepts that should be considered when technology-based educational interventions are used to develop critical thinking in auditing students. Similarities among the affinities could, however, be identified not only by looking at affinity names, but also at the descriptions of the affinities. It could be that one group described certain aspects of another group's affinity as part of an affinity description under an unrelated affinity name. These affinities would thus not have been reconciled in the affinity reconciliation protocol as they would have had unrelated affinity names. An example of this is **implementation timing** of the intervention. Group 2 (educators) mentioned that students should be exposed to technology-based educational interventions as early as possible. This was discussed as part of their **tool design** affinity. Group 3 (students) also discussed the timing of implementation, mentioning that students should be exposed to technology-based educational interventions as early as possible. This was discussed as part of their **implementation timing** affinity. As these affinities were unrelated, they were not reconcilied as part of the affinity reconciliation protocol. Certain aspects discussed as part of the affinity descriptions, however, shared similarities.

The comparison of affinities provides useful insight into the concepts that should be considered when technology-based educational interventions are used to develop critical thinking in auditing students. By comparing the SIDs of the three groups, an even deeper understanding of the phenomenon can be obtained. To further compare findings at a system level, the SIDs themselves were compared (Northcutt & McCoy 2004: 346–366). This comparison is provided in section 7.7.2.

### 7.7.2 Comparing the SIDs of the three groups

In section 7.3 the unclutted SIDs for groups 1 to 3 were presented. In section 7.3 the zoomed out views of the systems were also presented as they provide a different view of reality according to Northcutt and McCoy (2004: 333–337). For the purposes of this study, the uncluttered SIDs and zoomed out views of the systems for the three groups, were compared in terms of their systemic properties from a structural perspective (Northcutt & McCoy 2004: 358). The uncluttered SID and zoomed out view of each group are repeated in Figures 37 to 42 for ease of reference.

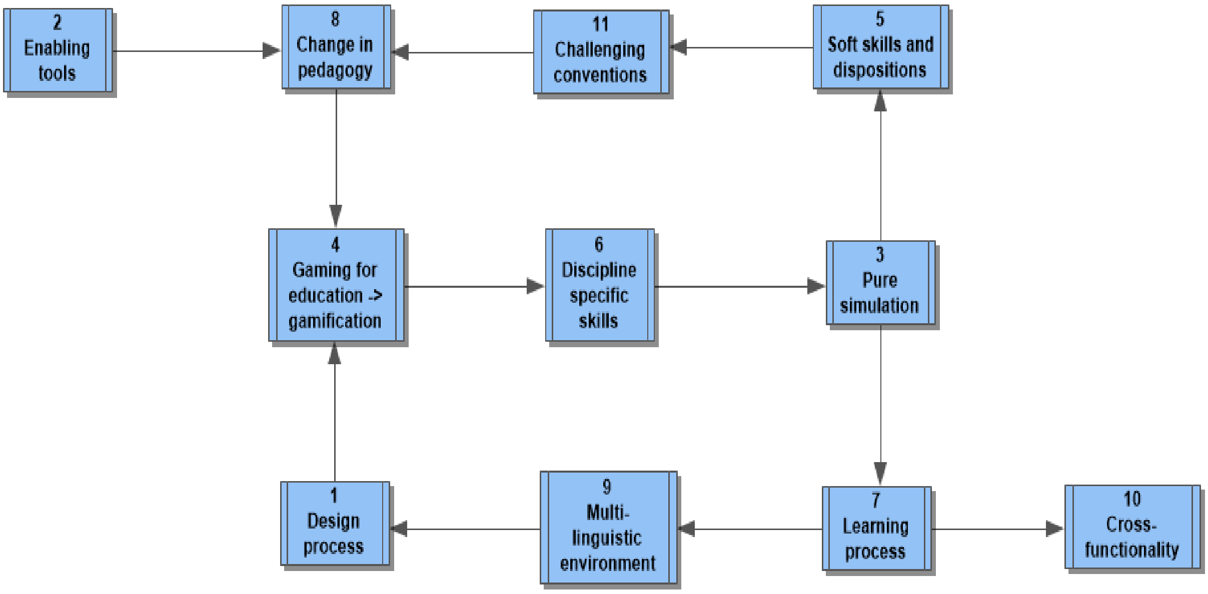



**Figure 37: Uncluttered SID - Group 1 (learning designers)**
**Source:** Author

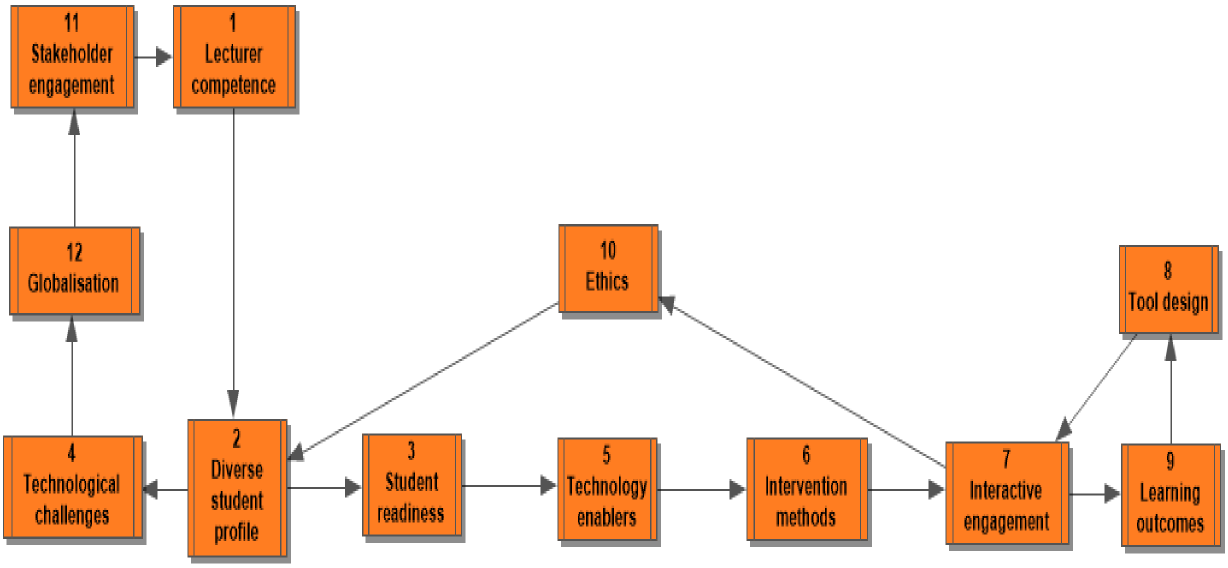



**Figure 38: Uncluttered SID - Group 2 (educators)**
**Source:** Author

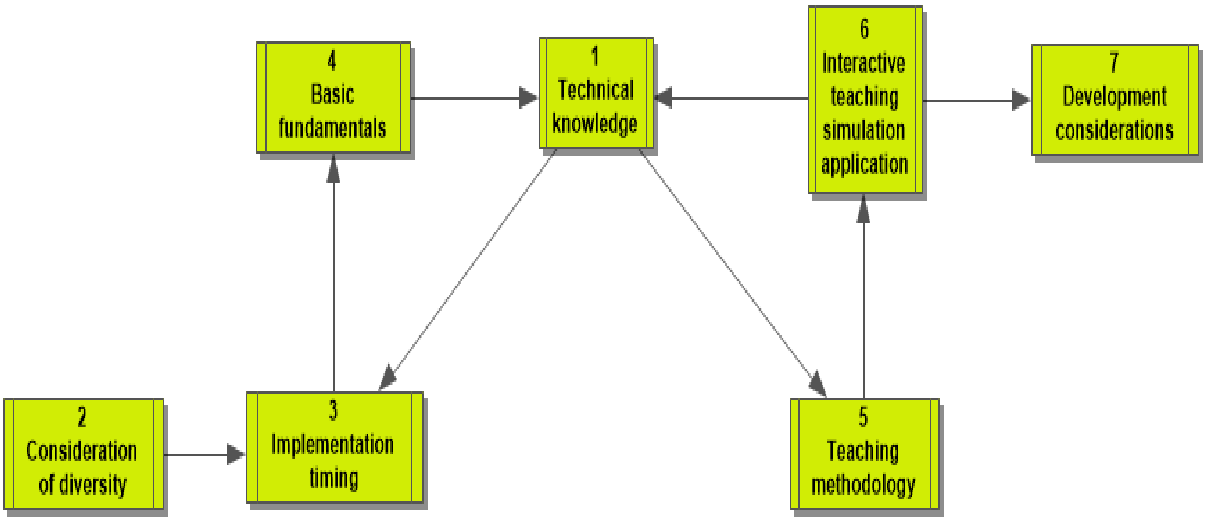



**Figure 39: Uncluttered SID - Group 3 (students)**
**Source:** Author

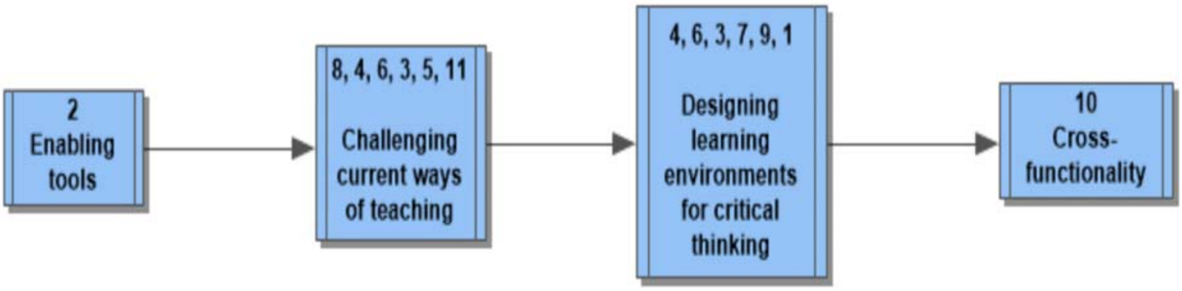



**Figure 40: Zoomed out view - Group 1 (learning designers)**
**Source:** Author


**Figure 41: Zoomed out view - Group 2 (educators)**
**Source:** Author

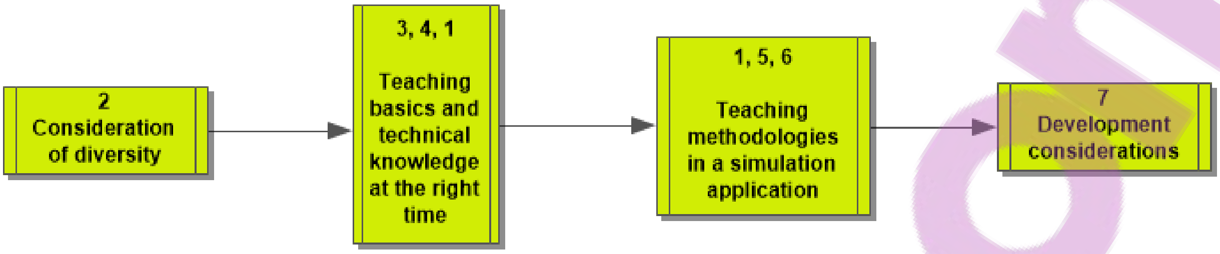



**Figure 42: Zoomed out view - Group 3 (students)**
**Source:** Author

From Figures 37 to 42 and the detail contained in sections 7.3 to 7.6, it is evident that all three groups produced fairly complex SIDs with various feedback loops. Upon closer inspection of these uncluttered SIDs and zoomed out views of the three groups, it is also evident that no similarities could be found in the placement of the affinities among the three groups. Although group 1 (learning designers) and group 3 (students) both had a single affinity as a primary driver in their systems, these primary drivers differed. Group 1 (learning designers) viewed **enabling tools** as the primary driver while group 3 (students) viewed **consideration of diversity** as the primary driver. Similarly, group 1 (learning designers) and group 3 (students) both had a single affinity as a primary outcome of their systems. Again, these primary outcomes differed between the two groups. Group 1 (learning designers) identified **cross functionality** as the primary outcome of their system while group 3 (students) identified **development considerations** as the primary outcome. Group 2 (educators), had no primary drivers or primary outcomes of their system.

## 7.8 CONCLUSION

Chapter 7 presented the IQA data obtained. Section 7.2 described the elements or affinities of the systems for groups 1 to 3. Sections 7.3 to 7.6 explained the relationships between these affinities in the systems. These sections provided the results of the theoretical coding performed in terms of the IQA process and a description of the overall placement of affinities in the SID for each group. Section 7.7 compared the systems of the three groups. An understanding was obtained of how the concepts and the systems of the three groups compared to one another.

A common core list of twenty affinities was arrived at through an affinity reconciliation protocol (section 7.7). This common core list of affinities represents the concepts, from the perspective of the three groups, that should be considered when critical thinking is developed in auditing students through technology-based educational interventions. These common core affinities are further examined in Chapter 8 to determine whether they validate the concepts and relationships proposed in the preliminary framework or whether they provide insights into concepts and relationships that should be added to the final conceptual framework. Based on this analysis and interpretation, the final conceptual framework is then presented in Chapter 8.

# CHAPTER 8
# FINAL CONCEPTUAL FRAMEWORK

## 8.1 INTRODUCTION

Chapter 1 of this study highlighted the need for an integrated and robust framework aimed at the development of critical thinking in auditing students. It was also noted in Chapter 3 that technological tools could be used to allow students to become active learners. The primary research objective (A) of this study was thus aimed at proposing a holistic conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions. To provide insight into the key constructs, concepts, assumptions, beliefs and theories related to critical thinking, the primary research question (B) was directed at exploring the concepts, and relationships between these concepts, that should be considered when critical thinking is developed in auditing students through technology-based educational interventions.

| | |
|---|---|
| **Primary research objective (A)** | To propose a conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions |
| **Primary research question (B)** | Which concepts, and relationships between these concepts, should be considered when critical thinking is developed in auditing students through technology-based educational interventions? |

These concepts and the relationships between them, were derived inductively and deductively from the literature presented in Chapters 2 to 4 as well as from the perspectives of three groups of participants who were knowledgeable about the phenomenon. Chapters 2, 3 and 4 provided more insight into the conceptualisation of critical thinking, its measurement and the factors that may influence critical thinking. These chapters also explored how critical thinking can be developed through teaching strategies and technology-based educational interventions. Chapters 2 to 4 furthermore highlighted the main gaps that research, such as this study, are to address. The insights gained from these chapters, derived inductively and deductively from the body of knowledge, provided the foundation for the key concepts and relationships as set out in the preliminary, literature-based, conceptual framework, presented in Figure 13 of Chapter 5 and repeated here as Figure 43 for ease of reference. Annexure N summarises the key concepts and relationships from the preliminary framework together with literature references. The relationships in the preliminary framework are all indicated alphabetically.

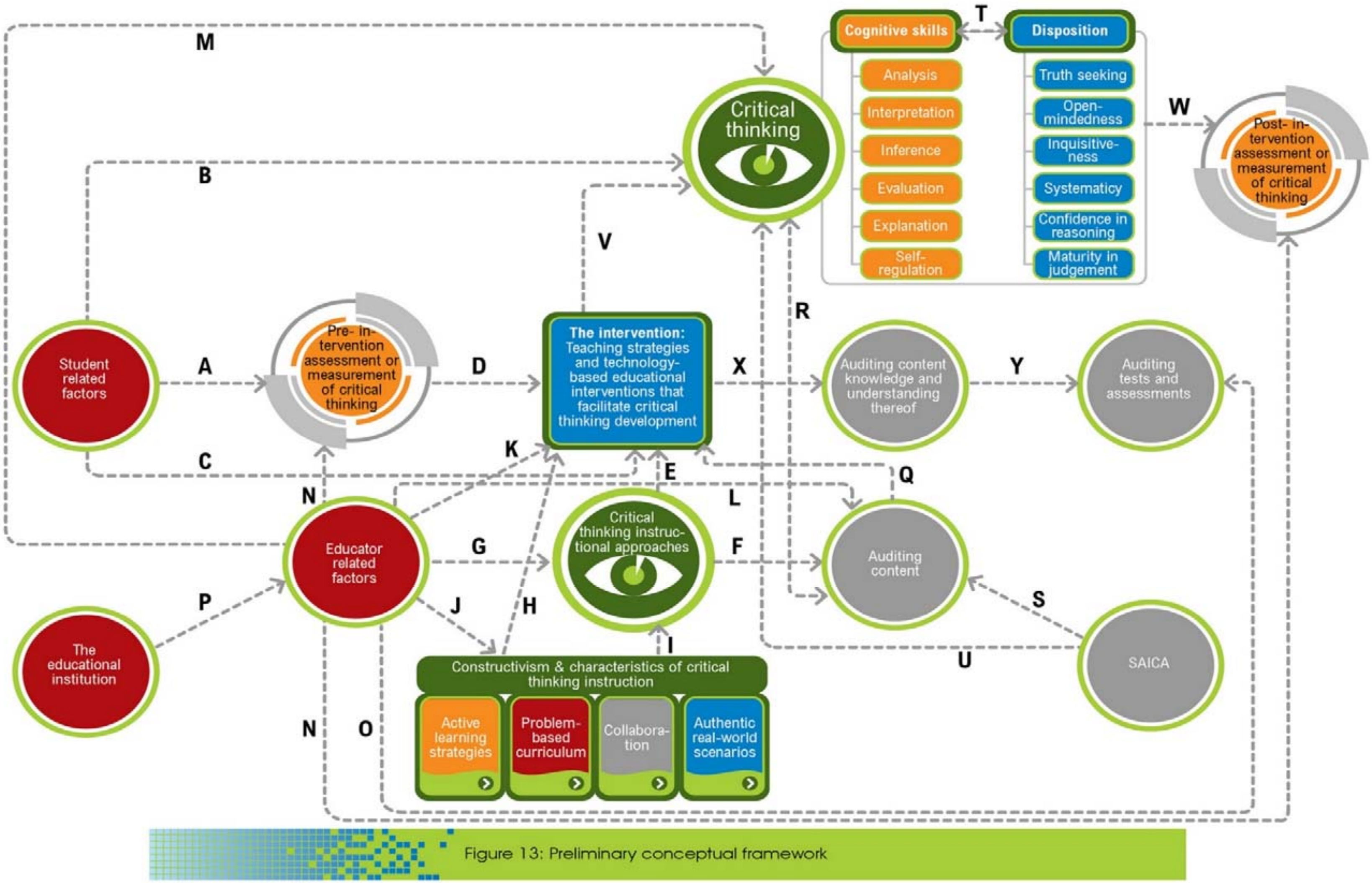



**Figure 43: Preliminary conceptual framework**
**Source:** Author

## 8.2 FINAL CONCEPTUAL FRAMEWORK

According to Maxwell (2013: 41), a conceptual framework is constructed and is not something that already exists. The final conceptual framework for this study was therefore constructed as follows:

- The concepts and relationships that were established in the preliminary, literature-based, conceptual framework, provided the foundation for the final conceptual framework. I paid attention to existing theories and research on the phenomena to inform the preliminary framework (Maxwell 2013: 41) (refer to Figure 13 in Chapter 5 and Annexure N).
- According to Maxwell (2013: 41) initial theories and results can often be incomplete or misleading. It is thus necessary for subsequent research to establish a more complete and well-supported theory or framework. Each idea or finding should therefore be critically examined to see whether it is valid in constructing the theory or framework (Maxwell 2013: 41). To validate the concepts and relationships proposed in the preliminary conceptual framework or to provide new insights into additional concepts and relationships that should be added to the final framework, the perspectives of three groups of participants were obtained. In total, 30 affinities were produced across the three IQA focus groups. These affinities represent concepts that these three groups believe should be taken into account when critical thinking is developed in auditing students through technology-based educational interventions (refer to section 7.2 in Chapter 7). In section 7.7, an affinity reconciliation protocol was performed to arrive at a single reconciled list of twenty common core affinities (Table 41 in section 7.7). These twenty core affinities are further examined in sections 8.2.1 to 8.2.20 to establish whether they validate the concepts and relationships proposed in the preliminary conceptual framework, or whether they provide new insights into concepts and relationships that should be added to the final conceptual framework.
  - Those concepts and relationships, which form part of the preliminary, framework and which have been **validated** through the analysis and interpretation of the twenty common core affinities, are presented in yellow

in Annexure O. Seven concepts and eight relationships were **validated** after this further examination; and

- o The new concepts and relationships that were **added** to the final framework are presented in green in Annexure O. Seven new concepts and seventeen new relationships were **added** after this further examination.

This conceptual framework thus represents the theoretical contribution of this study (Northcutt & McCoy 2004: 302). Northcutt and McCoy (2004: 302) advise that the researcher should *“think beyond the narrow conceptual scope of the data to examine wider possibilities”.* In this chapter, I thus reviewed existing literature from Chapters 2 to 4 (refer to Figure 13 in Chapter 5, Annexures N and O) and also examined a wider body of knowledge that informs the findings of the IQA (refer to sections 8.2.1 to 8.2.20) where concepts and relationships were **added**. The end product is a novel, integrated and robust framework aimed at the development of critical thinking in auditing students, as presented in Figure 44. This figure highlights the seven new concepts that were **added** to the preliminary framework, namely:

- Design and development considerations (section 8.2.1);
- Technology-based enabling tools (section 8.2.2);
- Collaboration among stakeholders and disciplines (section 8.2.4);
- Learning process (section 8.2.8);
- Technological challenges (section 8.2.13);
- Ethics (section 8.2.16); and
- Globalisation (section 8.2.17).

Figure 44 also highlights the seventeen new relationships that were **added** to the preliminary framework. Relationships one to seventeen are illustrated in Figure 44. Critical thinking and other associated learning outcomes are also highlighted in Figure 44, although these were not **added** as a separate concept. This concept was **expanded** by other associated learning outcomes as explained in section 8.2.15. All other concepts and relationships from the preliminary framework have been greyed out in Figure 44.

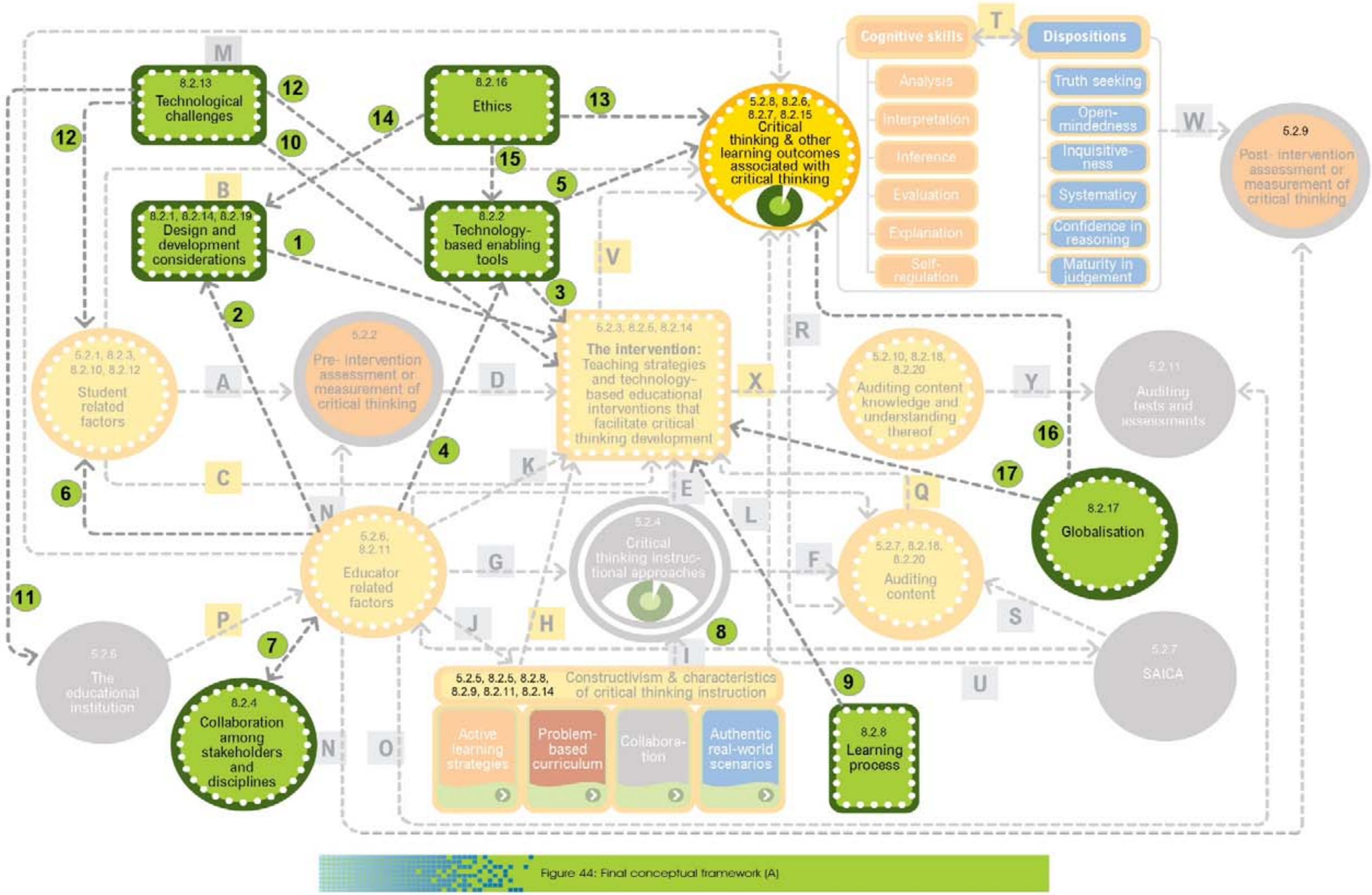



**Figure 44: Final conceptual framework (A)**
**Source:** Author

In sections 8.2.1 to 8.2.20, the twenty common core affinities are further analysed and interpreted to establish whether they **validate** the concepts and relationships proposed in the preliminary framework or whether they provide new insights into concepts and relationships that should be **added** to the final framework. The section numbers in which these common core affinites are discussed are also indicated in Figure 44 for ease of reference.

### 8.2.1 Design and development considerations

Through the reconciliation process, three affinities were reconciled as they shared certain similarities. These affinities included design process (group 1 – learning designers), tool design (group 2 – educators) and development considerations (group 3 – students). Various important aspects were also mentioned as part of these detailed affinity descriptions. Based on the affinity descriptions of the three groups, the design and development considerations include various aspects:

- Principles of quality design must be evaluated and followed. Group 1 (learning designers) noted this aspect. In Chapter 4 (section 4.3) the importance of the correct design of the structure and format of case studies was also mentioned (Kim et al. 2006: 867–876).
- The intervention should be user-friendly. Group 1 (learning designers) and group 2 (educators) mentioned that the intervention design should be user-friendly. In Chapter 4 (section 4.3) it was also mentioned that general usability criteria should be followed in the design of the application or intervention. These include certain functionalities, user guidance, consistency and error prevention among others (Van Wyk 2015: 200–208). De Villiers (2005: 351) asserts that it is essential for instructional systems to be easy to learn and use.
- The intervention should have clear instructions and outcomes built into the software. Group 2 (educators) mentioned this aspect. In Chapter 4 (section 4.3) it was also stated that clear goals, objectives and outcomes should form part of the instructional design of the application or intervention (Van Wyk 2015: 200–208).

Felker (2014: 19–23) also states that to design an effective educational game, the objectives of the game have to be defined with clear learning goals.

- The intervention should provide triggers to allow students to progress through various levels of learning and incorporate decision trees. These aspects were mentioned by group 2 (educators). In Chapter 4 (section 4.3) it was specifically noted that case studies should be engaging and challenging and should allow numerous levels of analysis and interpretation by the student. Difficulty of the content can be increased progressively (Kim et al. 2006: 867–876).
- The intervention should enable students to reflect on their learning. The importance of this aspect was noted by group 2 (educators). In Chapter 2 (section 2.2) it was mentioned that the philosopher, Ennis, believes that critical thinking is reflective and reasonable thinking (Ennis 1985: 45). It is thus no surprise that another synonym for critical thinking is critical reflection (Hepner 2015: 73–74). Facione (1990a: 2–16) mentions self-regulation, which includes self-examination and reflection, as part of the core critical thinking skills. Scheffer and Rubenfeld (2000: 358) also note that reflection forms part of the habits of the mind of a critical thinker. A critical thinker should thus be able to reflect on his or her own thinking. In Chapter 4 (section 4.2) it was noted that constructivism, which is ideal for critical thinking development, supports student reflection (Alessi & Trollip 2001: 32). It was also noted that students should be given adequate time and opportunity to reflect on content (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21).
- The intervention should provide feedback to students. This aspect was mentioned by group 2 (educators). In Chapter 4 (section 4.3) the importance of feedback to students was also noted. Immediate feedback from fellow students and educators assists students in understanding problems from others' perspectives (Goldenberg et al. 2005: 310–314). Rush *et al.* (2008: 501–508) found that immediate feedback should be incorporated into simulations to increase students' sense of active participation and interaction. A simulation game provides an ideal opportunity for immediate feedback to students (Peddle 2011: 648–649). Van Wyk (2015: 200–

208) furthermore notes that feedback to user responses should form part of the instructional design considerations.

- The intervention should be introduced to students as early as possible, preferably for first year of studies. Group 2 (educators) noted that students should be exposed to technology-based educational interventions as early as possible, preferably from their first year. Group 3 (students) also indicated that the development of critical thinking in students is a process that should start as early as possible, preferably at undergraduate level. Group 3 (students), however, felt so strongly about this concept that they produced it as a separate affinity – implementation timing – which is described in more detail in section 8.2.19.
- Applications, databases, software and new technologies should be repurposed regularly and customised for specific needs. The intervention should be adaptable. Group 1 (learning designers) noted that all applications, databases, software and new technologies should be repurposed and customised for specific needs. Group 3 (students) also mentioned that the intervention should be adaptable. Felker (2014: 19–23) asserts that well-designed interventions, such as games, can provide wonderful educational experiences to students but that they are challenging to design. An iterative design process is required with prototypes, tests, deployments and assessments.
- The intervention should be cost-effective. This aspect was mentioned by group 3 (students). In Chapter 4 (section 4.3) it was mentioned that fixed costs involved in developing simulations are fairly high (Bell et al. 2008: 1430). It was also noted that simulation games can be very costly to develop and implement (Peddle 2011: 648–649). The design of web-based simulations is especially complex, time-consuming and expensive (Salleh et al. 2012: 377). Costs and resources relating to these types of interventions thus have to be well budgeted for (Peddle 2011: 648–649).
- The intervention should be appealing, interesting and attractive to students. These aspects were mentioned by group 3 (students). In Chapter 4 (section 4.3) it was also mentioned that general usability criteria should be followed in the design of

the application or intervention. This included various aesthetics criteria, one being that the screen should be interesting to look at (Van Wyk 2015: 200–208).

- The intervention should have built-in security measures, access settings and continuity controls. These aspects were mentioned by group 3 (students).

Chapter 4 (section 4.3) provided certain design features of teaching strategies and technology-based educational interventions that are considered ideal for critical thinking development such as case studies, PBL and simulations. Design features or design and development considerations were, however, not included as a separate concept in the preliminary framework as I considered these aspects inherent to the intervention concept in the preliminary framework. The three IQA focus groups, however, emphasised the importance of the design process, principles of quality design and other important development considerations. The concept design and development considerations is thus **added** as a separate concept to the final conceptual framework (Figure 44).

Based on the affinity descriptions, the following new relationships have also been identified that relate to the design and development considerations and have thus been **added** to the final framework:

- ***Relationship 1:*** Principles of quality design and other design features should guide the design and development of the intervention. The relationship between the intervention and the design and development considerations is illustrated as relationship 1 in Figure 44. According to Herrington and Reeves (2011: 594), design principles which are based on comprehensive practical and theoretical principles, should guide the design and development of learning environments in higher education. This new relationship is thus supported by literature.
- ***Relationship 2:*** Relationship K in the preliminary framework indicated that the educator generally has an influence on the selection and/or design of the teaching strategies and educational interventions. To effectively design and develop technology-based educational interventions, the educator would need a proper understanding of design and development considerations related to the intervention. Yang (2014: 748) concurs, noting that educators should adequately

equip themselves to select appropriate learning instruction and to use technology-based tools effectively. To obtain a thorough understanding of the design and development considerations, group 1 (learning designers) specifically mentioned that industry leaders in software design should be consulted. The relationship between the educator and the design and development considerations, with possible consultation with industry leaders in software design, is indicated as relationship 2 in Figure 44. Felker (2014: 19–23) notes that game design should be a team effort as it involves a diverse range of skills. He advises that the educators should partner with a diverse team in the design process so that the educator has access to skills and perspectives he or she does not have.

All three IQA focus groups produced affinities relating to the design and development of the intervention with various important aspects mentioned in this regard. From the discussion in this section, together with the body of knowledge that support these considerations, it is evident that the design and development consideration concept deserves substantial consideration when critical thinking is developed in auditing students through technology-based educational interventions.

### 8.2.2 Technology-based enabling tools

In section 7.7 the affinity, enabling tools produced by group 1 (learning designers) and the affinity, technology enablers produced by group 2 (educators), were reconciled. These tools (hardware and software resources) include blogs, forums, wikis, podcasts, jingles, animation, photo captions, the internet, Google, social media, data sources, CaseWare, ULink, computer assisted audit techniques (CAATs), ipads, laptops and other student-related applications.

In Chapter 4 (section 4.2) it was mentioned that constructivist principles are ideal for critical thinking development. Constructivist teaching strategies are interactive and student-centred (McHaney 2011: 183). Various teaching strategies and technology-based educational interventions based on constructivist principles, were mentioned in Chapter 4 (section 4.2). These include discussion forums, podcasts, wikis, blogs, games, simulations, virtual worlds and VLEs (McHaney 2011: 182–184). Technology-based enabling tools were, however, not addressed as a separate concept in the preliminary framework as these were considered to be included in the intervention concept. The two groups, however, highlighted the importance of these hardware and software resources that enable teaching. I thus **added** technology-based enabling tools as a separate concept to the final conceptual framework to include other hardware and software resources that enable teaching as well. The literature also supports the importance of such tools. Majumdar (2015: 1) states that technology-based tools can aid educators to teach more efficiently and in communicate with students more effectively. These tools can be used to engage students and to extend the learning process. Majumdar (2015: 1) provides seven examples of technology-enabled tools for teaching and learning. These include social networking sites, blogs and wikis, photo-sharing, video-sharing, podcasts, audio/video/web conferencing and flipped classrooms.

The following new relationships have also been identified from the affinity descriptions and have thus been **added** to the final conceptual framework:

- ***Relationship 3:*** Tools enable teaching, according to group 1 (learning designers). In Chapter 4 (section 4.3) it was, for example, mentioned that the internet can support case studies, PBL and web-based simulations. It was also mentioned that Computer-Supported Collaborative Learning focuses on collaborative learning that is delivered via computers and the internet. AODs are an example of a Computer-Supported Collaborative Learning tool. These tools can thus support the delivery of, or serve as a platform for, teaching strategies and technology-based educational interventions. This is illustrated as relationship 3 in Figure 44. De Villiers (2005: 354) asserts that technologies used in teaching and learning can be categorised as full or empty instructional technologies. A full instructional technology holds information or content that is transferred to the student in an interactive way. An empty instructional technology is, in essence, only a shell that supports communication or exploration. This includes the internet, for example.
- ***Relationship 4:*** Group 1 (learning designers) noted that it is important for educators to consider and select the enabling tools, as they facilitate the lesson. It was mentioned as part of relationship K (refer to Annexures N and O) that the

educator generally has an influence on the selection and/or design of the teaching strategies and educational interventions. This is also true in the selection of the technology-based enabling tools. This is illustrated as relationship 4 in Figure 44. Yang (2014: 748) notes that educators should be able to select appropriate learning instruction and be able to use technology-based tools effectively.

- ***Relationship 5:*** Technology enablers could facilitate the critical thinking development process in students according to group 2 (educators). The relationship between technology-based enabling tools and critical thinking is illustrated as relationship 5 in Figure 44. Mansbach (2015: 1) is in agreement, noting that educators should use technology-based tools such as discussion forums to develop students' critical thinking.

Two of the three groups mentioned technology-based enabling tools with various examples of such tools. These tools were also a primary driver in the system for group 1 (learning designers). Technology-based enabling tools are evidently, based on the discussion in this section and supporting literature, an important concept to consider when critical thinking is developed in auditing students through technology-based educational interventions.

### 8.2.3 Consideration of student diversity

In section 7.7 the affinity multi-linguistic environment produced by group 1 (learning designers), diverse student profile by group 2 (educators) and consideration of diversity by group 3 (students) were all reconciled as they shared certain similarities.

Student-related factors were addressed in Chapter 3 (section 3.3) as well as in the preliminary framework. Various student-related factors were identified throughout the literature that may have an influence on students' critical thinking. These included factors such as age, gender, academic performance, prior knowledge or experience, type of academic programme or field of study, academic grade or level, student learning styles and various others. Refer to Table 10 in section 3.3 for a summary of these student-related factors. It was concluded that consideration has to be given to the potential impact these factors may have on critical thinking. As all three groups produced affinities relating to student diversity, the concept of student-related factors in the preliminary framework is thus **validated**. It is evident that a proper understanding of the nature and diversity of the student body is needed before educational interventions can be designed or critical thinking effectively developed. Elder (2004: 1) also asserts that students differ in terms of preferred learning styles, race, gender, ethnicity, intellectual skill level, culture, personality and various other diversities. All students are unique. Although there are increased calls for equality in the classroom, Elder (2004: 1) argues that teaching students to become critical thinkers is the best way to make an integrated approach to instruction possible: *"(i)n short, through critical thinking we place all instruction, including its diversity components, on firm foundation so that improving students' reasoning abilities, as well as their abilities to evaluate the reasoning of others, becomes the primary focus"* (Elder 2004: 1).

Relationship B in the preliminary framework noted that students' critical thinking in general as well as its development may be influenced by certain student-related factors. As part of the affinity descriptions, group 1 (learning designers) mentioned that the language (first, second or third language) in which critical thinking is developed, should be considered. They noted that advanced machine translation software could be used to facilitate translation between languages. Relationship B in the preliminary framework is thus **validated**. Relationship C in the preliminary framework indicated that the effectiveness of interventions may also be influenced by student-related factors. Group 2 (educators) stated that a sound understanding of the nature and diversity of the student body was necessary prior to interventions being developed. This included consideration of whether students are from residential or distance learning backgrounds or whether students are technologically empowered. Group 3 (students) noted that students' prior knowledge, personal backgrounds (for example culture and ethnicity) and prior exposure to technology should be considered. From these affinity descriptions, it is evident that relationships B and C are **validated** by the consideration of the student diversity concept.

Based on the affinity descriptions, the following new relationship was **added** to the final framework:

- ***Relationship 6:*** Group 2 (educators) specifically mentioned that a proper understanding of the nature and diversity of the student body is necessary prior to interventions being developed. In relationship K it was mentioned that the educator generally has a influence on the selection or design of these interventions. With this in mind, the educator should have an understanding of the diversity of the student body and should consider this diversity when the intervention is selected or designed. This is illustrated as relationship 6 in Figure 44. Felder and Brent (2005: 57) concur, asserting that educators should have a proper understanding of student differences to meet the diverse learning needs of their students: *"(t)he more successful they are in doing so, the more effectively they can design instruction that benefits all of their students"* (Felder & Brent 2005: 72).

All three IQA focus groups mentioned aspects regarding student diversity in one form or another. Consideration of diversity was also seen as a primary driver in the system of group 3 (students). Based on the discussion in this section, student diversity is a significant concept to consider when critical thinking is developed in auditing students through technology-based educational interventions.

### 8.2.4 Collaboration among stakeholders and disciplines

The affinity, cross-functionality, produced by group 1 (learning designers) and the affinity, stakeholder engagement, produced by group 2 (educators), were reconciled in section 7.7. Group 1 (learning designers) specifically noted the importance of collaboration between disciplines in the design of educational interventions with integration of interdisciplinary skills sets. Collaboration between IT experts, educational technologists and academics is, according to group 1 (learning designers), required for successful interdisciplinary educational interventions. This group also noted the importance of supportive infrastructure as the foundation for the intervention. Group 2 (educators) emphasised the importance of collaboration between academia, professional bodies and practice to identify demands in the workplace, remain relevant and identify ways of addressing current challenges in the profession. Although the preliminary framework makes reference to some of these bodies, for example, the educator (academic) and

SAICA (professional body), collaboration among these stakeholders and other disciplines is not specifically addressed in the preliminary framework. Collaboration among stakeholders and disciplines, as a seperate concept, is thus **added** to the final conceptual framework.

Adams *et al.* (2017: 2) assert that collaboration is crucial for obtaining effective results. They describe collaboration as a key trend in educational technology in the *New Media Consortium (NMC) Horizon Report: 2017 Higher Education*. They also note that multi-disciplinary leadership groups, communities of practice, institutions and educators should all learn from one another to support educational change. SAICA and academics in South Africa have also undertaken a collaborative research project to address current issues that the accounting profession is faced with. More than 40 academics, involved in the training of chartered accountants across South Africa, are involved in this project, aimed at addressing the needs of the profession through relevant research (South African Institute of Chartered Accountants 2018: 18–19). Although collaboration across professional and organisational boundaries can have various rewards, it can also pose difficulties. Individuals may be pushed out of their comfort zones while others may feel frustrated by constant discussion without real action (National Estuarine Research Reserve Assosiation 2018: 1). These challenges should be kept in mind and addressed throughout.

Based on the affinity descriptions of the two groups, the following new relationships were **added** to the final framework:

- ***Relationship 7:*** Both groups mentioned that academics must collaborate or engage with other stakeholders and disciplines in the design of the intervention. The educator, who is considered an academic, is thus part of this collaboration. This collaboration or engagement between the educator and the other stakeholders is illustrated as relationship 7 in Figure 44. McKee *et al.* (2017: 1–13) also note that an innovative intervention can be implemented with the support of peer collaboration among academics. In their study, this included leaders of the hospital, research personnel in the academic institute, nurse researchers and experts in experiential learning. These researchers noted the benefits of merging expertise and the opportunity of collaborating in new ways.

- ***Relationship 8:*** Both the educator and SAICA were concepts illustrated in the preliminary framework. The collaboration among academics and professional bodies, mentioned by group 2 (educators), would thus include the educator (academic) and SAICA (professional body). This collaboration is mainly to identify demands in the workplace, remain relevant and identify ways of addressing current challenges in the profession. This is illustrated as relationship 8 in Figure 44. The collaborative research project between SAICA and academics supports this relationship in the final conceptual framework (South African Institute of Chartered Accountants 2018: 18–19). Evans, Burritt and Guthrie (2011: 1–34) also note that collaboration between academics at the university, industry and professional bodies is critical for technology transfer and reaching productive and valuable outcomes.

Two of the three groups mentioned several aspects with regards to collaboration among disciplines and stakeholders. From the discussion in this section and the literature in support of this concept, it is evident that collaboration among stakeholders and disciplines is an important concept to consider when critical thinking is developed in auditing students through technology-based educational interventions.

### 8.2.5 Educational interventions and teaching methods ideal for critical thinking development

The objective of this study is to propose a conceptual framework for developing critical thinking in auditing students through technology-based educational interventions. In the rationale of this study (Chapter 1), it was noted that educators should make use of the advances in educational technologies to facilitate critical thinking development as these technologies provide effective platforms for critical thinking. Chapter 4 thus provided a detailed overview of teaching strategies and technology-based educational interventions that facilitate critical thinking development. This overview mainly focused on case studies, PBL and simulations. The importance of concept maps, Socratic questioning, AODs, debates, conference learning, role plays, modelling and video vignettes was, however, also noted for the development of critical thinking. Based on this overview, section 5.2.3 in Chapter 5 introduced the intervention concept in the preliminary framework. The intervention concept includes teaching strategies and technology-based educational interventions that facilitate critical thinking development. The preliminary framework also included various influences and relationships that have to be considered with regards to the intervention. Section 5.2.3 in Chapter 5 mentioned these influences and relationships. Also refer to Figure 13 and Annexure N for detail on these relationships.

Given this context, the following affinities were subsequently reconciled in section 7.7:

- Pure simulation and gaming for education → gamification produced by group 1 (learning designers);
- Intervention methods produced by group 2 (educators); and
- Teaching methodology and interactive teaching simulation application produced by group 3 (students).

As part of the affinity descriptions, group 1 (learning designers) noted the importance of pure simulations in the development of critical thinking. These pure simulations include augmented reality, virtual reality and virtual worlds. Group 1 (learning designers), furthermore noted the importance of gaming for educational purposes as well as user-friendly, interactive games for the development of critical thinking in students. Within the field of auditing, this group proposed games of deception and role play. Group 2 (educators) also noted that simulations, gamification and case studies provide effective intervention methods for critical thinking development. They also noted that these interventions can be provided through a computer-based platform. Group 3 (students), likewise provided teaching methodologies which included lecture videos, computer-based auditing scenarios, technology-based auditing tests, videos with audit simulations and workshops. Group 3 (students), noted that an interactive teaching simulation application could be made available to students and that this application could feature story boards of audit case studies or scenarios, questions and solutions. This application could also include audit cartoons, training software and activity-based simulations. From this discussion, it is clear that the intervention concept, teaching strategies and technology-based educational interventions that facilitate critical thinking development, as presented in the preliminary framework, is **validated**.

The groups also noted the importance of these educational interventions and teaching methods in the development of students' critical thinking. Relationship V in the preliminary framework indicated that various types of teaching strategies and technology-based educational interventions facilitate critical thinking development (for example PBL, case studies and simulations). Relationship V is thus also **validated** by these affinity descriptions.

As part of the affinity description of gaming for education → gamification, group 1 (learning designers) also noted that gaming principles provide opportunity for peer versus peer interaction or competition. Group 3 (students) also noted that students should be encouraged to work individually or in teams through the interactive teaching simulation application. These principles relate to collaboration (part of constructivism and characteristics of critical thinking instruction) as indicated in the preliminary framework. As part of the affinity description of intervention methods, group 2 (educators) mentioned that the intervention should contain real-life scenarios, case studies and examples to contextualise learning. They also noted that experiential learning principles and guidelines should be considered as part of the intervention. This relates to authentic, real-world scenarios and active learning strategies respectively, as specified in the preliminary framework. These affinity descriptions thus **validate** the constructivism and characteristics of critical thinking instruction concept. Relationship H in the preliminary framework also noted that principles of constructivism that align with the characteristics of critical thinking instruction, inform the teaching strategies and technology-based educational interventions that facilitate critical thinking development. Based on the affinity descriptions and the discussion in this section, relationship H is thus also **validated**.

All three groups produced affinities related to educational interventions and teaching methods aimed at critical thinking development. It is evident that this is a significant concept to consider when critical thinking is developed in auditing students through technology-based educational interventions and also provides validation for the rationale for this study.

### 8.2.6 Soft skills and dispositions

In Chapter 5 (section 5.2.8), critical thinking cognitive skills and dispositions were discussed as part of the preliminary framework. It was noted that the consensus statement on critical thinking, as well as the cognitive skills and dispositions, as arrived at by the APA, would serve as a foundation for this study's preliminary framework. It was also noted in Chapter 5 that improved critical thinking skills and dispositions is one of the main outcomes of the intervention (teaching strategies and technology-based educational interventions) for this particular study.

Group 1 (learning designers) identified several soft skills and dispositions that they, as a group, associate with critical thinking. They identified metacognition, empathy, ethical behaviour, intrinsic motivation, a positive attitude, good communication skills as well as the ability to assess a situation and ask the right questions. From this affinity description, it is evident that the critical thinking skills and dispositions concept, as presented in the preliminary framework, is **validated** as group 1 (learning designers) associates these soft skills and dispositions with critical thinking. The examples mentioned by group 1 (learning designers) cannot, however, be directly linked to the examples of cognitive skills and dispositions provided in the preliminary framework. Refer to section 8.2.15 for a further discussion on this matter.

Relationship T in the preliminary framework indicated that a good critical thinker has to possess both cognitive skills and dispositions as one cannot function without the other. As group 1 (learning designers) identified both cognitive skills and dispositions associated with critical thinking, this provides **validation** for relationship T.

### 8.2.7 Discipline-specific skills

Group 1 (learning designers) identified certain discipline-specific skills. This group identified judgement, which they related to making informed decisions. Maturity in judgement was listed as one of the critical thinking dispositions in the preliminary framework. This disposition is thus specifically **validated**. Group 1 (learning designers) also noted that the ability to be systematic is an auditing specific skill. Being systematic was also listed as one of the critical thinking dispositions in the preliminary framework and is thus **validated**. The ability to make constant critical comparisons, to be organised and to follow certain standards were also mentioned by group 1 (learning designers). These examples do not directly relate to those provided in the preliminary framework but do provide other examples of critical thinking cognitive skills and dispositions. Refer to section 8.2.15 for a further discussion on this matter. Although the group mentioned these skills under discipline-specific skills, the examples **validate** the critical thinking cognitive skills and dispositions concept in the preliminary framework. These skills and dispositions, although generic, can be applied to the auditing profession as well. From this affinity description, it is apparent that the critical thinking skills and dispositions concept, as presented in the preliminary framework, is **validated**.

### 8.2.8 Learning process

Chapter 4 highlighted concerns raised in accounting education regarding the lack of active learning strategies, cooperative learning environments and real-world examples. Given that these strategies and environments are ideal for critical thinking development, principles of constructivism and characteristics of critical thinking instruction were included in the preliminary framework (refer to section 5.2.5 in Chapter 5).

With the learning process affinity, group 1 (learning designers) touched on some of the principles of constructivism and characteristics of instruction that promote critical thinking. This group indicated that authentic learning takes place where knowledge is applied to real-life contexts and situations. They noted that this is vital for critical thinking development. This relates to authentic real-world scenarios as specified in the preliminary framework and **validates** the constructivism and characteristics of critical thinking instruction concept. Group 1 (learning designers) also indicated the importance of collaborative learning, information sharing and student engagement. These relate to a collaborative learning environment as indicated in the preliminary framework and again **validates** the constructivism and characteristics of critical thinking instruction concept.

These principles also **validate** relationship H in the preliminary framework where the principles of constructivism, that align with the characteristics of critical thinking instruction, inform the teaching strategies and technology-based educational interventions that facilitate critical thinking development.

Group 1 (learning designers), however, also highlighted other important principles of learning that form part of the learning process. The concept learning process was thus **added** to the final conceptual framework to also include other principles of learning. Examples provided by group 1 (learning designers) relate to:

- The transferability and application of knowledge in different settings. The ability to adapt thinking in different situations to come up with solutions to problems, was also addressed in section 8.2.15 as part of learning outcomes associated with critical thinking. Baril *et al.* (1998: 392–396) stress the importance of the ability to transfer knowledge from one situation to another and Halpern (1998: 451) similarly asserts that the objective of education is to assist students in transferring their thinking skills and becoming better critical thinkers in real-world situations. Section 3.5.1 of Chapter 3 provided an overview of the transferability of critical thinking to other contexts and settings. Jones (2015: 169) notes that although there are commonalities in critical thinking across disciplines, the analytical tools, principles and thinking patterns used across disciplines might differ. *"Critical thinking is a disciplined act (or set of facts), first, because it requires an orderliness of thinking, and, second, because this order is contextual. There are some aspects of each of the disciplinary descriptions of critical thinking that are relevant across disciplinary contexts, such as use of logic and evidence, evaluation of claims and explanations, analysing arguments for clarity and precision, and making reasoned judgements. However, the ways in which they operate in each discipline and the knowledge required in order to think critically mean that a course of general critical thinking skills may not equip students to think critically in a disciplinary context"* (Jones 2015: 178).
- Creative thinking. It was indicated in Chapter 2 (section 2.2) that surrogate terms for critical thinking include creative thinking (Mojica 2010: 16; Facione 1990a: 5).

Bozik (1987: 1–13) found that there is a symbiotic relationship between critical and creative thinking. To master content knowledge, students require both.

- Interactivity. Also refer to section 8.2.14 where interactive engagement is addressed as a learning outcome associated with critical thinking. Section 4.2 of Chapter 4 indicated that teaching strategies for constructivism are interactive and student-centred (McHaney 2011: 183). Section 4.2 also stressed that constructivist learning environments should comprise interactive learning activities to promote higher order thinking (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21). Interactive learning, with or without technology, develops students' problem-solving and critical thinking skills (Study.com 2018a: 1)
- Progressive enquiry. *"In progressive inquiry, students' own, genuine questions, and their previous knowledge of the phenomena in question are a starting point for the working process, and attention is drawn to the main concepts and deep principles of the domain"* (Lakkala 2008: 1). This pedagogical model is a question-driven process. It can be used in educational settings, but it is mostly designed for use in computer-supported collaborative learning (Lakkala 2008: 1–3).
- Autodidactic learning. Klauer (1988: 360–361) describes autodidactic learning as the ability of a student to take over responsibility for his or her own independent learning by taking on teaching functions. The student should be able to plan his or her learning, regulate learning and manage the learning process.
- Rhizomatic learning. Cormier (2017: 1) summarises rhizomatic learning as a complex process of sense-making where each student brings their own context and own needs. This type of learning is disorganised and does not fit into the traditional structures of education. It encourages unrestricted and creative inquiry with little structure to guide learning as students themselves negotiate the curriculum.
- Deep learning approaches (avoiding didactic or rote learning). Group 1 (learning designers) indicated that old ways of thinking and current learning processes should be changed to address the growing gap between basic and higher education. They indicated that the intervention should avoid didactic or rote learning. This is in line with the SAICA competency framework which indicates that

although understanding content is extremely important, the aim is to move away from rote learning and memorisation of pure facts (South African Institute of Chartered Accountants 2014a: 16–23). Harrington (2018: 1) similarly describes the ability to think critically as optimal and notes that rote style didactive learning is not ideal. She argues that the public educational school system is following a standards-based system which is not conducive to critical thinking development.

- Locus of control. An individual who believes that he or she controls their own life and bases their success or failure on their own work, has internal locus of control. On the other hand, external locus of control refers to when an individual believes that their success is the result of other influences (Study.com 2018b: 1).

Based on the affinity description of this group, the following new relationship was **added** to the final conceptual framework:

- ***Relationship 9:*** Group 1 (learning designers) indicated that the intervention should avoid didactic or rote learning and that deep learning approaches should be emphasised. Locus of control should also be considered in the intervention. These principles that form part of the learning process (as noted in this section), should thus preferably form part of the intervention. The teaching strategies and technology-based educational interventions should thus include some, or all of these principles. This is illustrated as relationship 9 in Figure 44.

### 8.2.9 Change in pedagogy

With the change in pedagogy affinity, group 1 (learning designers), noted that most education fields have changed significantly over the last couple of years. These fields include pedagogy, andragogy, heutagogy and paragogy. With these changes they indicated that in recent years the focus has moved to students obtaining knowledge from peer students. Chapter 4 (section 4.3) also indicated that collaboration among students improves the development of metacognition, the formulation of ideas and the ability to engage in high level discussions (Scott 2015: 6–7). This relates to collaboration as specified in the preliminary framework and **validates** the constructivism and characteristics of critical thinking instruction concept.

Group 1 (learning designers), furthermore raised the question of who teaches who as the role of the educator has shifted significantly in recent years. In Chapter 4 (section 4.2) it was highlighted that in a constructivist learning environment, the instructor merely provides guidance (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21) and takes on the role of facilitator. This aspect thus also **validates** the principles of constructivism and characteristics of critical thinking instruction in the preliminary framework. As the aspects discussed under the change in pedagogy affinity mainly **validate** other concepts in the preliminary framework, this was not added as a separate affinity in the final framework.

### 8.2.10 Challenging conventions

Group 1 (learning designers) addressed several aspects under the challenging conventions affinity. This group stressed the importance of using dialectic methods to challenge conventional ways of teaching auditing students and advised that alternative frameworks should be developed to adapt to the changing landscape in the auditing profession. Chapter 1 of this study highlighted the need to challenge conventional ways of teaching auditing students and the need for alternative frameworks. By proposing a new conceptual framework, this study is doing precisely that. This affinity description thus **validates** the rationale for this study.

Group 1 (learning designers) furthermore mentioned that auditors might not be naturally inclined to think critically as a result of current didactical educational practices. This is in line with Chapter 3 (section 3.4) where it was noted that most educators were not taught to be critical thinkers, as they themselves were taught through passive teaching strategies such as lectures (Paul & Elder 2007: 7). Chapter 3 (section 3.5.2) highlighted that critical thinking is an active process and that active learning strategies are required to develop critical thinking (Mortellaro 2015: 122–123). Chapter 4 (section 4.1), however, described how concerns have been raised regarding the lack of active learning strategies in accounting education (Massey et al. 2002: 1). The aim is thus to move away from rote learning and memorisation of pure facts (South African Institute of Chartered Accountants 2014a: 16–23).

Group 1 (learning designers) also stressed that if the auditing profession is to address the current skills gap, the focus of teaching should not only be on teaching explicit content knowledge but should move to the development of skills such as critical thinking. This is in line with Chapter 1 (section 1.1) where it was indicated that with an increased emphasis on critical thinking, traditional teaching strategies are no longer adequate (EON Reality 2018: 1). It was also highlighted in Chapter 1 (section 1.1) that the focus of higher education has shifted from teaching *what to think* to *how to think* (Purvis 2009: 1). These aspects of the affinity description again **validate** the rationale for this study.

Group 1 (learning designers) also note that attention should be paid to nuances such as gender, racial differences, language barriers and others as the educational intervention should empower all students. Based on these aspects, the concept of student-related factors in the preliminary framework is **validated.**

Although the affinity, challenging conventions, does not validate many concepts or relationships in the preliminary framework, it in essence provides **validation** for the rationale of this study. Changes in the auditing profession, such as artificial intelligence and automation of routine manual tasks, are reshaping the profession. These changes are creating a need for a different set of competencies and skills required from auditors. For auditors to truly add value and stay relevant, they need to be able to think critically and solve unstructured problems. The auditor of the future can thus no longer only rely on content knowledge and foundational literacies such as numeracy and literacy. It is in many instances assumed that an auditor is automatically a good critical thinker after obtaining a higher education degree, but is this really the case? Educators in accounting education are in many instances chartered accountants themselves, with no or limited training in critical thinking development. These educators also teach how they themselves have been taught. Educators in accounting education are now, however, faced with modifying their old ways of teaching to foster critical thinking in auditors of the future, who will be able to meet the needs of a changing profession. This requires conventions to be challenged.

### 8.2.11 Lecturer competence

With the lecturer competence affinity, group 2 (educators) emphasised the importance of overall lecturer competence in the use of technology and staying up to date with technological advancements, thus being tech-savvy. In Chapter 1 (section 1.1) it was highlighted that technology-based educational interventions can provide effective platforms for developing the essential 21st century skills, including critical thinking (World Economic Forum 2015: 1–8). The educator would, however, need a thorough understanding of relevant technologies and educational interventions to effectively develop critical thinking in students. Bharti (2014: 1) asserts that educators should make a concerted effort to understand technologies and learn how to use them in their teaching practices.

The aspects discussed in the lecturer competence affinity description relate to the educator-related factors concept and thus **validate** this concept in the preliminary framework. In section 8.2.1, relationship 2 was **added** to the final conceptual framework. Relationship 2 maintains that the educator would need a sound understanding of design and development considerations to effectively design and/or develop technology-based educational interventions. The aspects mentioned under the lecturer competence affinity description **validate** this added relationship.

Group 2 (educators) furthermore noted that lecturers should receive training and skills development that would enable them to use technology-based interventions effectively. It was also noted in Chapter 3 (section 3.4) that educators require specific training to successfully develop critical thinking (Reed 1998: 166) and should be empowered through critical thinking workshops and courses (Gharib et al. 2016: 274). An educational institution has an obligation to support its educators in understanding how to teach for critical thinking (Van Erp 2008: 114–116) and management should create a support system for educators where they feel empowered to develop critical thinking (Gharib et al. 2016: 274). Relationship P in the preliminary framework indicated that the educational institution must support educators in this regard. As training and skills development should preferably be provided by the educational institution, relationship P in the preliminary conceptual framework is **validated**.

Group 2 (educators) also noted that lecturers should act as facilitators and mentors of students in the interventions as these interventions are completely different forms of teaching that students might not be familiar with. In section 8.2.9 it was mentioned that educators in a constructivist learning environment act as facilitators and mentors, merely providing guidance to students (Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21). This aspect thus **validates** the principles of constructivism and characteristics of critical thinking instruction in the preliminary framework.

### 8.2.12 Student readiness

As part of this affinity, group 2 (educators) identified several challenges that may influence students' readiness to use technology-based educational interventions. This group noted that students might not 'buy-in' or see the benefits of such an intervention and may even show resistance to it. This group indicated that students may not have the required reading or IT skills to benefit from such an intervention. These issues are also supported by the literature. Bharuthram (2012: 208) observes that many students who enter South African higher education institutions have inadequate reading and writing skills. Many students also have also had little or no exposure to computer technologies (Arif 2001: 32). The group highlighted that training should be provided to students to equip them with IT skills. This need is also supported in the literature. Franklin and van Harmelen (2007: 1–27) argue that students should be provided with support and training in the use of educational technologies. Group 2 (educators) also identified possible risks related to online exposure. The aspects discussed under the affinity, student readiness, relate to the concept, student-related factors, and thus **validate** this concept in the preliminary framework.

Relationship C in the preliminary framework also indicated that the effectiveness of critical thinking educational interventions may be influenced by student-related factors. Student readiness and the aspects mentioned under this affinity description may have an influence on the effectiveness of critical thinking educational interventions. Relationship C is thus **validated**.

### 8.2.13 Technological challenges

Group 2 (educators) identified several technological challenges that could occur when a technology-based educational intervention is introduced. Technological challenges were not addressed as part of the preliminary framework. This concept was thus **added** to the final framework. The challenges mentioned by the group include 'teething' problems during the implementation phase of the intervention. The challenges also include the university and its IT department as there may be a lack of sufficient resources or structures to successfully support the intervention. Peddle (2011: 648–649) also notes that simulations, particularly virtual games, can be very expensive and time-consuming to develop. Budgets for staff training, simulation platforms and IT support are needed. The group further indicated that the effectiveness of the intervention could be affected by students' lack of resources to use the intervention. This could include slow internet connections, internet downtime, a lack of personal computers and/or other hardware. Inadequate technological infrastructure such as poor networks, limited or no internet access and unreliable power supply create major impediments. Poor maintenance and a lack of maintenance strategies further hinder progress. Universities need effective ICT technical support to assist students (South African Institute for Distance Education 2013: 18–36).

From this affinity description, the following new relationships were added to the final framework:

- ***Relationship 10:*** Group 2 (educators) indicated that some of these technological challenges could be experienced during the implementation phase of the intervention. These challenges thus relate to the intervention itself. This is indicated as relationship 10 in Figure 44.
- ***Relationship 11:*** Group 2 (educators) mentioned that these challenges could also include the university (referred to as the educational institution in the preliminary framework) and its IT department as there may be a lack of resources or structures

to support the intervention. These challenges thus relate to the educational institution itself. This is indicated as relationship 11 in Figure 44.

- ***Relationship 12:*** Group 2 (educators) highlighted that the effectiveness of the intervention could be affected by students' lack of resources to use the intervention. This could include slow internet connections, internet downtime, a lack of personal computers and/or other hardware. These challenges relate to the student (student-related factors) as well as the technology-based enabling tools (section 8.2.2). Relationship 12 in Figure 44 thus includes both these concepts.

### 8.2.14 Interactive engagement

With this affinity, group 2 (educators) noted that communication, dialogue and discussions should form the foundation of an interactive learning environment where critical thinking is developed. They indicated that this engagement should not only take place between the lecturer and the student but also between the students themselves. In Chapter 4 (section 4.2.3) it was determined that one of the characteristics of instruction that develops critical thinking, is the stimulation of interaction among students (Ten Dam & Volman 2004: 370). It was also highlighted that constructivist learning environments are considered ideal for critical thinking (Van Erp 2008: 22) as such environments promote collaborative learning activities (Alessi & Trollip 2001: 32). Collaboration focuses on the idea that a person constructs knowledge by negotiating meanings with others (Harasim 2012: 72). The WEF also identifies the ability to collaborate as an essential 21$^{st}$ century competency (World Economic Forum 2015: 1–3).

Interactive engagement thus relates to collaboration as specified in the preliminary framework and **validates** the constructivism and characteristics of critical thinking instruction concept. Relationship H indicates that principles of constructivism, that align with the characteristics of critical thinking instruction, inform the teaching strategies and technology-based educational interventions that facilitate critical thinking. This relationship is also **validated** by this affinity description.

Group 2 (educators) indicated that online interactive discussion forums, discussion groups, interactive communities and chat rooms provide effective platforms for interactive engagement between these parties. These examples of interactive engagement are supported by the examples provided in Chapter 4 (section 4.3.4) where various examples of computer-supported collaborative learning tools (Xia et al. 2013: 87) were provided. This relates to the intervention concept in the preliminary framework as these examples relate to teaching strategies and technology-based educational interventions that facilitate critical thinking development. The intervention concept is thus **validated**.

Group 2 (educators) furthermore indicated that students should be encouraged to share their thoughts and ask questions on these interactive platforms which should provide them with real-time feedback. Connectivity between students can also be promoted by providing them with assignments or podcasts that require online feedback and discussions. In Chapter 4 (section 4.3) the importance of feedback to students was also noted. Immediate feedback from fellow students and educators assists students in understanding problems from others' perspectives (Goldenberg et al. 2005: 310–314). Van Wyk (2015: 200–208) also noted that feedback to user responses should form part of the instructional design considerations. As part of the design and development considerations concept **added** to the final conceptual framework, it was indicated that the intervention should provide feedback to students. Feedback thus relates mainly to design and development considerations and therefore **validates** this concept that was **added** to the framework.

### 8.2.15 Learning outcomes

Group 2 (educators) indicated that once a student has developed their critical thinking abilities through the intervention, they should be able to think out of the box and adapt their thinking to different situations to come up with solutions to problems. Relationship V in the preliminary framework presents the relationship between the intervention and critical thinking development. Group 2 (educators) therefore indicated that once a student has developed their critical thinking through the intervention, certain learning outcomes should be achieved. This **validates** the relationship between the intervention and critical thinking development. Relationship V is thus **validated**.

With the learning outcomes affinity, group 2 (educators) also highlighted other learning outcomes associated with critical thinking development. These include pervasive skills, problem-solving abilities, discretionary thinking, reflecting on one's own thinking, identifying and dealing with ethical issues and interrogating information. The ability to know how to use and apply new technologies should also be included as an ultimate learning outcome.

Section 8.2.6 (soft skills and dispositions), 8.2.7 (discipline-specific skills) and 8.2.15 (learning outcomes) show many similarities, although these are less obvious. These sections were not reconciled as part of the reconciliation process as I only identified these smaller nuances after gaining a deeper understanding of these affinity descriptions. Section 8.2.6 described the soft skills and dispositions that group 1 (learning designers) associated with critical thinking. Section 8.2.7 provided the discipline-specific skills that group 1 (learning designers) identified. Many of the skills and dispositions mentioned in these two sections relate, according to this group, to critical thinking. Some of the skills and dispositions mentioned by group 1 (learning designers) as part of their soft skills and dispositions affinity, overlap with the learning outcomes provided by group 2 (educators). Group 1 (learning designers) mentioned, for example, that metacognition is associated with critical thinking. Group 2 (educators) noted that reflecting on one's own thinking should be a learning outcome associated with critical thinking. Both these groups thus identified metacognition and associated it with critical thinking. By the same token, group 1 (learning designers) identified various discipline-specific skills. Most of these skills could, however, be directly linked to critical thinking skills and dispositions in the preliminary framework. In essence, sections 8.2.6, 8.2.7 and 8.2.15 all relate to critical thinking skills, dispositions and learning outcomes associated with critical thinking. These skills, dispositions and learning outcomes are mostly generic, but can also be applied to a specific discipline such as auditing.

Based on this discussion, the critical thinking concept in the preliminary framework is thus **validated** by the learning outcomes affinity. This critical thinking concept in the final conceptual framework is, however, also **expanded** to include other learning outcomes associated with critical thinking. These learning outcomes are thus associated with critical thinking and are the learning outcomes that group 2 (educators) believes should be achieved once a student has developed their critical thinking through the intervention. According to the three groups, critical thinking cognitive skills, dispositions and other learning outcomes associated with critical thinking, hence include the following:

- Metacognition (thinking about one's thinking or reflecting on one's own thinking) – sections 8.2.6 and 8.2.15). It was noted in Chapter 2 (section 2.2) that surrogate terms for critical thinking include metacognition (Hepner 2015: 73–74). The APA Delphi study also lists self-regulation as a critical thinking cognitive skill. This involves the ability to monitor one's own cognitive activities (Facione 1990a: 2–11, 2011: 5–9). The literature is in support of the importance of metacognition in support of active learning and self-monitoring one's own cognitive functions. Planning, monitoring and revising are all metacognitive activities. These activities assist students in becoming active as opposed to passive learners (Bell & Kozlowski 2008: 302). Draeger (2015: 1) asserts that *"both critical thinking and metacognition help ensure that students can reliably achieve desired learning outcomes. Both require practice and both require the explicit awareness of the relevant processes";*
- Empathy (section 8.2.6). Paul (1992: 12–13) listed intellectual empathy as one of the traits of the mind of a critical thinker (section 2.2 of Chapter 2). A good critical thinker is able to sympathetically see others' points of view, even though it might differ from their own views, and then discuss it in insightful ways (Paul & Elder 2005: 34). Vilen (2015: 1) notes that *"the connection between critical thinking and empathy might not be obvious; it might even seem contradictory. However, if critical thinking involves seeking, analyzing and evaluating multiple perspectives on a complex question or issue, then being able to 'see' through someone else's eyes is essential".*
- Ethical behaviour (section 8.2.6) and the ability to deal with ethical issues (section 8.2.15). Group 1 (learning designers) noted that ethical behaviour forms part of the soft skills and dispositions associated with critical thinking. Group 2 (educators) stressed that the ability to deal with ethical issues should be a learning outcome

associated with critical thinking. Group 2 (educators), however, felt so strongly about ethics that they described it as the pillar of the chartered accountancy profession. They produced ethics as a separate affinity, which is described in more detail in section 8.2.16.

- Intrinsic motivation (section 8.2.6). Baril *et al.* (1998: 398) assert that good critical thinkers exhibit initiative and motivation. A good critical thinker can take action without explicit directions and has the motivation to complete the task. 'Motivational dispositions' are also considered vital for critical thinking. These dispositions include, among others, a concern for being well-informed, inquisitiveness, open-mindedness and fair-mindedness (Weiler 2005: 48).
- A positive attitude (section 8.2.6). Chapter 2 (section 2.2) indicated that a good critical thinker possesses critical thinking skills and the positive attitude to use the skills (Halpern 1998: 452). Good critical thinkers, furthermore, have a 'critical spirit' with an eagerness to search for trustworthy evidence, devotion to reason as well as a keen and inquisitive mind (Facione 1990a: 11, 2011: 10).
- Good communication skills (section 8.2.6). Communication is one of the essential 21st century competencies identified by the WEF, as discussed in Chapter 1 (section 1.1) (World Economic Forum 2015: 1–3). Yusuf and Adeoye (2012: 311–314) also assert that critical thinking and communication skills are vital competencies. They note that good communication skills will improve critical thinking in students as it involves an interactive process of sharing facts, feelings and ideas. Good communication skills are also required of the chartered accountant of 2025 (Chartered Accountants Worldwide 2017: 12).
- The ability to assess a situation and ask the right questions (section 8.2.6). According to the APA Delphi study, evaluation is the ability to assess the credibility of statements or other representations and inference is the ability to draw reasonable conclusions (Facione 1990a: 2–11, 2011: 5–9). Both these cognitive skills will allow a critical thinker to assess or evaluate a situation, make reasonable conclusions (inferences) and then to ask relevant questions based on these conclusions. Evaluation is also in the upper three levels of Bloom's taxonomy (Yusuf & Adeoye 2012: 314). Paul and Elder (2005: 43) are also of the opinion that

*“the quality of thinking is given in the quality of the questioning of the thinker. It is not possible to be a good thinker and a poor questioner”*.

- Judgement (this an example of a critical thinking disposition) (section 8.2.7). Chapter 2 (section 2.2) indicated that surrogate terms for critical thinking include judgement (Hepner 2015: 73–74). Section 2.2 furthermore specified that the APA Delphi study defines critical thinking as purposeful, self-regulatory judgement (Facione 1990a: 2). It is also expected of a chartered accountant to exercise professional judgement in choosing between alternative approaches to a problem in order to find solutions (South African Institute of Chartered Accountants 2014a: 18).
- Making constant critical comparisons (section 8.2.7). Baril *et al.* (1998: 393) indicate that a good critical thinker has the ability to create an expectation of what the evidence should be and to compare the actual evidence to that expectation.
- To be systematic (section 8.2.7). It was noted in section 2.2 of Chapter 2 that accomplished thinkers (stage six of the stages of critical thinking development) are able to systematically take charge of their thinking (Elder & Paul 2010: 1). This is also an example of a critical thinking disposition (refer to Annexure O).
- To be organised (section 8.2.7). Orderliness in working with complexity is one of the dispositions of critical thinking mentioned in the APA Delphi study (Facione 1990a: 13) in section 2.2 of Chapter 2.
- To follow certain standards (section 8.2.6). In Chapter 2 (section 2.2), it was indicated that critical thinkers should be able to apply standards (Scheffer & Rubenfeld 2000: 357–358). This entails judgement according to established personal, professional or social rules or criteria. Section 2.3 thus concluded that from the literature, critical thinking is a process of self-disciplined, self-directed, focused thinking based on certain standards.
- Ability to think out of the box (section 8.2.15). To think outside the box is a term often linked to critical thinking where good critical thinkers have the ability to explore their own experience ‘bank’ and use relevant information to solve problems (Baril et al. 1998: 396). Samarji (2014: 1) asserts that educators, trainers and employers generally associate critical thinking with the ability to think outside the

box. This is essentially the ability to have a 'helicopter view' of something. It is, however, also important for a critical thinker to be able to think inside, outside and across the box in a 'contextual manner', according to Samarji (2014: 1).

- Ability to adapt thinking in different situations to come up with solutions to problems (section 8.2.15). The ability to transfer knowledge from one situation to another, is considered to be part of the cognitive attributes and characteristics of critical thinking (Baril et al. 1998: 392–396).
- Pervasive skills (section 8.2.15). Barac and Du Plessis (2014: 53–57) describe the importance of developing pervasive skills in chartered accountancy students. They also note that various surrogate terms are used for pervasive skills throughout the literature. These include professional skills, non-technical skills, transferable skills, soft skills, core skills or employability skills. The SAICA competency framework provides detailed guidance on the pervasive qualities and skills that should be demonstrated by entry-level chartered accountants (South African Institute of Chartered Accountants 2014a: 45). These pervasive qualities and skills include ethical behaviour and professionalism, personal attributes and professional skills (South African Institute of Chartered Accountants 2014a: 17).
- Problem-solving abilities (section 8.2.15). In Chapter 2 (section 2.2) it was indicated that problem-solving and decision-making are some of the surrogate terms most often used for critical thinking (Turner 2005: 275). Psychologists also regularly link critical thinking to problem-solving (Hepner 2015: 77; Reed 1998: 22).
- Discretionary thinking (section 8.2.15). In Chapter 2 (section 2.2) it was described that critical thinking involves self-disciplined, self-directed, reasoned and focused thinking (Brunt 2005: 60–61; Halpern 1998: 449–451; Kataoka-Yahiro & Saylor 1994: 351–353; Paul 1992: 9–10; Facione 1990a: 1–18; Ennis 1985: 45). Critical thinking is also reflective and reasonable thinking aimed at making decisions about what to believe or do (Ennis 1985: 45). This is, in essence, thinking that requires discretion.
- The ability to interrogate information (section 8.2.15). The WEF indicates that it is becoming progressively more important for individuals to be able to solve unstructured problems and analyse information (World Economic Forum 2015: 2).

Automation of routine tasks has also necessitated improved skills and competencies such as analysis, interpretation and critical thinking (Guthrie 2017: 1–2).

- The ability to know how to use and apply new technologies (section 8.2.15). To stay relevant, an auditor has to be tech-savvy with good thinking skills (Guthrie 2017: 1–2). The SAICA competency framework indicates that the integration of IT is an essential part of almost all the tasks undertaken by chartered accountants (South African Institute of Chartered Accountants 2014a: 24). ICT literacy is also a foundational literacy required in the 21st century, according to the WEF (World Economic Forum 2015: 1–3). Professional bodies and employers are also progressively placing more emphasis on IT skills required from accounting students (Papageorgiou 2014: 71–74).

The importance of these critical thinking cognitive skills, dispositions and other learning outcomes associated with critical thinking is thus supported by the literature.

### 8.2.16 Ethics

The ethics affinity was produced by group 2 (educators). Apart from the professional values, ethics and attitudes that IES 3 prescribes (section 2.2 of Chapter 2), ethics was not dealt with in detail in this particular study or in the preliminary framework. The auditing profession in general and large auditing firms in South Africa have, however, gone through a very unsettling few months where unethical practices, scandals and cover-ups have been exposed (Andersen 2018: 1). With recent reports of unethical behaviour of some chartered accountants and widespread negative publicity around the accounting profession, many people are asking whether chartered accountants are still behaving ethically (Dorfan 2018: 14–15). Given the importance of ethics in the auditing profession, this was **added** as a separate concept in the final framework.

The importance of ethics and critical thinking is also supported in the literature. Fasko (1994: 3–12) emphasises that various researchers point to the need for individuals to be taught to think critically about values, as aspects of ethical behaviour are generally aspects of cognition. There thus appears to be a relationship between critical thinking and moral or ethical reasoning. Melillo (2010: 1) also states that critical thinking plays a vital role in ethics. He notes that critical thinking allows a person to analyse information and/or situations to determine whether something is right or wrong. Critical thinking is thus a mental process of evaluation to determine ethical standards, where decisions are made on truths and verified information. The importance of ethics can thus not be ignored in the development of critical thinking.

Based on the ethics affinity description, the following new relationships were also **added** to the final framework:

- ***Relationship 13:*** Group 2 (educators) indicated that ethical considerations should form an overarching theme in all aspects of critical thinking development. Ethics are considered to be a pillar of the chartered accountancy profession and should drive the habits of the mind as well as the critical thinking skills of students. The relationship between ethics and critical thinking is illustrated as relationship 13 in Figure 44. This is supported by literature. Fasko (1994: 3–12) indicates that there appears to be a relationship between critical thinking and moral or ethical reasoning. The vital relationship between critical thinking and ethics is also noted by Zivera (2011: 32) who asserts that this relationship should be kept in balance if either of these are to be beneficial.
- ***Relationship 14:*** Group 2 (educators) also stressed that ethical considerations should form an overarching theme in all aspects of the design of educational interventions. The relationship between ethics and the design and development considerations is illustrated as relationship 14 in Figure 44. This relationship is supported by the literature. Research and design has to be supported by ethical and legal norms although ethics is often seen as a weakness to innovation (Institute of Electrical and Electronics Engineers n.d.: 55). Privacy is, for example, a key ethical concern in ICT, partially because of the increased volume of data that systems such as virtual or augmented reality are capable of collecting. An understanding of possible ethical issues of ICTs is thus necessary so that these ethical issues can be understood and dealt with appropriately (Stahl, Timmermans & Flick 2017: 369–377).

- ***Relationship 15:*** It was also pointed out by group 2 (educators) that ethical considerations should form an overarching theme in all aspects relating to the use of technologies. The relationship between ethics and the technology-based enabling tools is illustrated as relationship 15 in Figure 44. This relationship is supported by the literature. Stahl, Timmermans and Flick (2017: 369–377) note that although research and innovation in emerging technologies are beneficial, they can also have ethical implications. These ethical implications include concerns over human rights and their overall well-being. By understanding the ethical issues that technologies present, research and innovation can be responsibly undertaken.

### 8.2.17 Globalisation

Group 2 (educators) produced the globalisation affinity. This concept did not form part of the preliminary framework and was thus **added** to the final conceptual framework. The importance of aligning courses with best practices, principles and standards is, however, supported by the literature. Paul and Elder (2005: 1–66), as part of the Foundation for Critical Thinking, developed a guide with critical thinking competency standards, principles, indicators and outcomes. Various institutions make use of the guidelines provided by this foundation to re-conceptualise and reconstruct their courses to align them with best practices, describing the positive effects this has had (The Foundation for Critical Thinking 2018: 1).

Based on the affinity description of globalisation, the following new relationships were also **added** to the final conceptual framework:

- ***Relationship 16:*** Group 2 (educators) noted the importance of a continuous comparison with global or international approaches and best practices to enhance the development of students' critical thinking. This relationship is illustrated by relationship 16 in Figure 44. This is supported by the literature. Heft and Scharff (2017: 48–49) believe that educators are generally misinformed about effective techniques for critical thinking development, leading to ineffective course design. They incorporated best practices for critical thinking skills development, obtained from prior scholarship of teaching and learning research, into their course design. They reported that the experimental group significantly outperformed the comparison group in terms of critical thinking sub-skills.

- ***Relationship 17:*** Group 2 (educators), furthermore highlighted that a process of benchmarking interventions with international standards should be in place. This relationship is illustrated by relationship 17 in Figure 44. Felker (2014: 19–23) notes the importance of benchmarking and assessment for games. He states, however, that there are limited established best practices or models to follow which makes benchmarking difficult to do.

#### 8.2.18 Technical knowledge

With this affinity, group 3 (students) prioritised technical knowledge specifically relating to controls as well as assertions. They noted that segregation of duties within an IT division and controls over the storing of client data is important. These aspects fall under the auditing related specific competencies as prescribed by the SAICA competency framework (South African Institute of Chartered Accountants 2014a: 74–92). The aspects that group 3 (students) noted under the technical knowledge assertion thus relate to auditing content and its understanding in the preliminary framework. These aspects **validate** both these concepts. Baril *et al.* (1998: 395), however, note that a good critical thinker should have the ability to understand how auditing procedures fit into the overall objectives of the financial audit, unlike poor critical thinkers who can perform these procedures but fail to grasp their logic.

Group 3 (students) furthermore indicated that technical knowledge of the payroll and personnel cycle, revenue and receipt cycle, as well as the acquisition and payments cycle should be illustrated through videos. Relationship X in the preliminary framework notes that the teaching strategies and technology-based educational interventions should focus on students' understanding of auditing content. These strategies and interventions could include videos that convey the technical knowledge on these various cycles. Relationship X is thus **validated**.

Relationship Q in the preliminary framework indicates that to foster a proper understanding of auditing content and effectively develop critical thinking, the content should be delivered through active learning strategies. It was noted in Chapter 4 (section 4.3) that De Villiers (2015: 199) used various active learning strategies, including videos created in Go Animate, in an auditing course. In Chapter 3 (section 3.5) it was indicated that active learning strategies foster the development of critical thinking in students (Jordan D'Ambrisi 2011: 36). Videos can thus be used as an active learning strategy to foster a proper understanding of auditing content and to effectively develop critical thinking in students. Relationship Q is thus also **validated**.

### 8.2.19 Implementation timing

Group 2 (educators) noted that students should be exposed to technology-based educational interventions as early as possible, preferably from their first year. Group 3 (students) also emphasised that the development of critical thinking in students is a process that should start as early as possible, preferably at undergraduate level. This group produced the affinity, implementation timing, as a separate affinity. These two groups thus indicated that auditing students should be exposed to interventions aimed at critical thinking development, as early as possible. Implementation timing was also included as part of the design and development considerations concept that was **added** to the final conceptual framework (refer to section 8.2.1). Implementation timing thus **validates** the design and development consideration concept. This also provides **validation** for relationship 1 that was **added** to the final framework (refer to section 8.2.1).

### 8.2.20 Basic fundamentals

Through this affinity, group 3 (students) emphasised that the technology-based educational intervention should focus on basic audit fundamentals and principles of a business environment and expose students to these concepts. Students are generally exposed to these fundamentals and principles as the SAICA competency framework is mainly focused on developing competencies within the context of a business environment. SAICA's vision is to produce chartered accountants who possess business and entrepreneurial skills to foster effective leadership in a business context (South

African Institute of Chartered Accountants 2014a: 7). Baril *et al.* (1998: 395) also assert that good critical thinkers have the ability to understand various aspects of the business and how these aspects relate to one another. Basic audit fundamentals and principles of a business environment should thus be engrained in auditing courses that follow the SAICA competency framework. These aspects thus relate to the auditing content and the auditing content knowledge and its understanding in the preliminary framework. The aspects described under the basic fundamentals affinity description thus **validate** for both these concepts.

Relationship X in the preliminary framework notes that the teaching strategies and technology-based educational interventions that are aimed at critical thinking development, should focus on students' understanding of auditing content. Group 3 (students) emphasised that the technology-based educational intervention should focus on basic audit fundamentals and principles of a business environment. Relationship X is thus **validated**.

## 8.3 CONCLUSION

The primary research question of this study relates to the concepts, and the relationships between these concepts, that should be considered when critical thinking is developed in auditing students through technology-based educational interventions. In a coherent and structured manner, Chapter 8 summarised these concepts and relationships to provide a comprehensive conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions, thereby addressing the primary objective of this study. The final conceptual framework is illustrated in Figure 44 and summarised in Annexure O. Figure 45 illustrates the final conceptual framework with all concepts and relationships, including those that have been **added** and **validated** (no concepts and relationships are greyed out). The concepts and relationships encircled and highlighted in green, indicate concepts and relationships that have been **added** to the final conceptual framework, subsequent to the analysis and interpretation of the twenty common core affinities. Seven new concepts and seventeen new relationships were **added** after this further examination. The concepts and relationships encircled and highlighted in yellow, indicate concepts and relationships that have been **validated** through the analysis and interpretation of the twenty common core affinities. Seven concepts and eight relationships could be **validated** (of which one was expanded) after this further examination. The concepts and relationships encircled and highlighted in grey, remain unchanged from the preliminary framework and could not be validated through the further analysis performed in Chapter 8.

Chapter 9 which follows summarises the contribution of this study, proposes recommendations for further research and provides my own reflections and final conclusion.

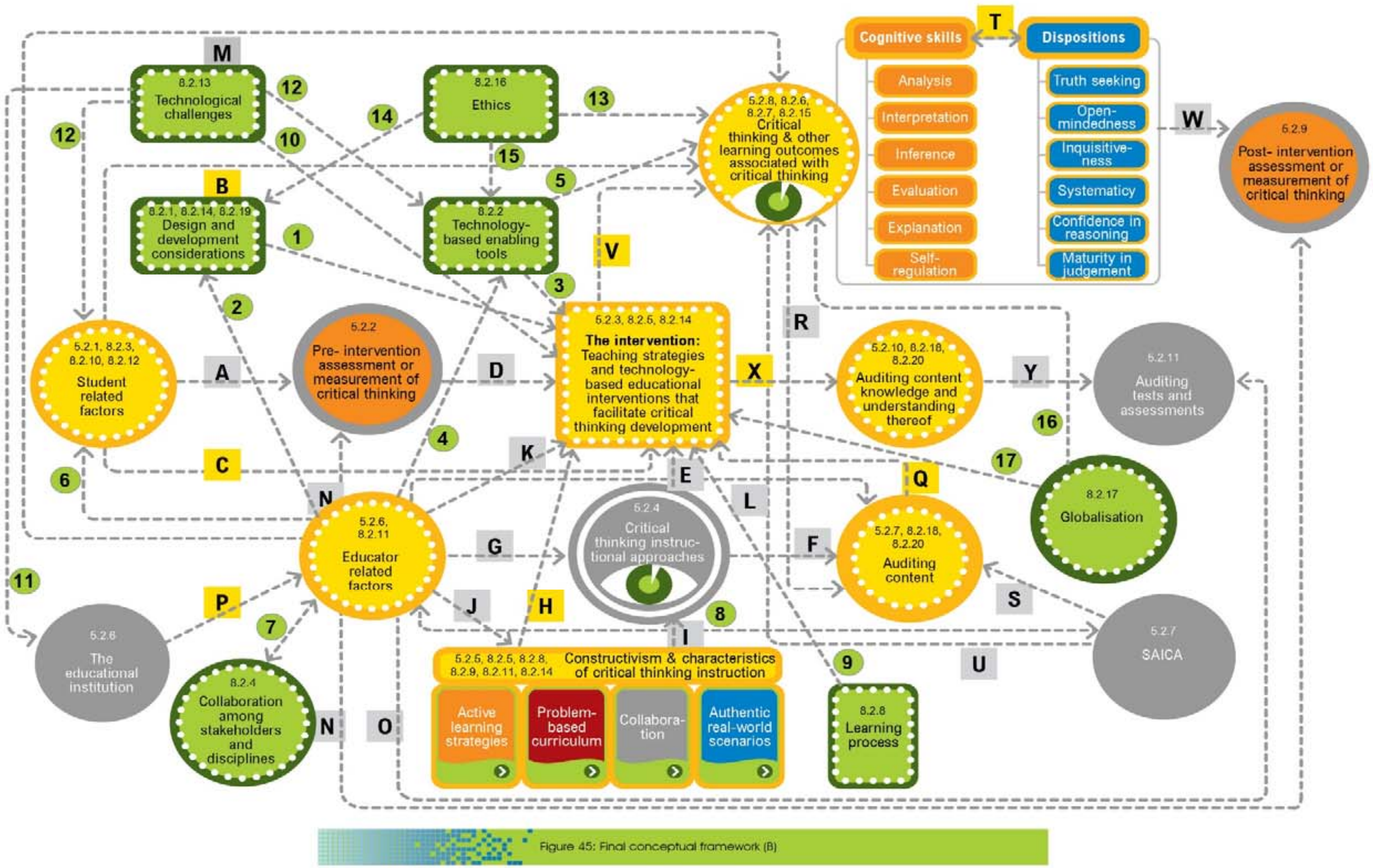



**Figure 45: Final conceptual framework (B)**
**Source:** Author

# CHAPTER 9
# CONCLUSIONS, RECOMMENDATIONS AND REFLECTIONS

## 9.1 INTRODUCTION

Chapter 1 of this study indicated that the auditing profession is facing immense changes and must adapt to stay relevant. Rapid changes in technology are having a major impact on how companies conduct their business, with technology being integrated into almost all aspects of day-to-day business. This, in turn, has an impact on the skills and competencies required of auditors providing services to these companies. Routine audit tasks are being automated and artificial intelligence is altering the way in which audits are being conducted. Block-chain has the potential to completely change the auditing profession, as ledgers may become redundant in future. Data analytics is also altering the way in which audits are conducted, as this allows for artificial intelligence-based systems to audit all of a company's transactions as opposed to only samples. In the near future, Google Finances and Apple Audit might become household names, raising the question of whether the auditing profession as we know it today will still be relevant (Chartered Accountants Worldwide 2017: 1–20).

To remain relevant, the auditor of the future must therefore adapt to this fast-changing, technology-driven world. With regular claims that the profession is not delivering entry-level chartered accountants with the necessary skills and competencies to truly add value to auditing clients, the onus is on all parties involved to address this enormous challenge. Although technical competence still remains relevant, much more emphasis needs to be placed on the skills required to meet the needs of the 21$^{st}$ century workforce, which include critical thinking. Critical thinking capabilities offer an auditor the ability to truly add value by being able to solve unstructured problems, analyse and interpret information, think out of the box, assess a situation, ask the right questions, make informed decisions, make constant critical comparisons and interrogate information.

Accounting education practices are, however, still largely focused on the delivery of technical content knowledge. With a shift in the demand for skills, educators in accounting education are now faced with the task of developing critical thinking in auditing students. Technology-based educational interventions, which include simulations, virtual reality and games, provide effective platforms for developing these essential 21st century skills but educators are often hesitant to use these technologies and are frequently unsure of how critical thinking should be developed in students.

Chapter 1 indicated the need for a robust, holistic framework for critical thinking development through technology-based educational interventions. The primary objective of this study was thus to propose a conceptual framework which could guide educators in developing critical thinking in auditing students through technology-based educational interventions, so that the growing need for critical thinking auditors can be addressed. This study addressed the need for a robust, holistic framework for critical thinking development as set out in sections 9.2 and 9.3. Section 9.2 summarises the main findings together with the conclusions reached in this study. Section 9.3 sets out the main contributions of this study. This study offers new theoretical contributions, contextual and policy contributions as well as methodological contributions that are all discussed in further detail in section 9.3. In section 9.4, I reflect on my role as researcher and the methodology used in this study. Recommendations for further research are highlighted in section 9.5 together with certain limitations of the study.

## 9.2 SUMMARY OF FINDINGS AND CONCLUSIONS

A theoretical contribution was offered through this study which proposes a conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions. A conceptual framework is in the domain of theoretical extension. To propose a conceptual framework for critical thinking development in auditing students, an understanding of key constructs, concepts, assumptions, beliefs and theories, relevant to critical thinking was required. An understanding of the relationships between these concepts was essential. To address the primary objective of this study, the primary research question focused on the concepts, and relationships between these concepts, that should be considered when critical thinking is developed in auditing students through technology-based educational interventions. Several secondary research objectives and secondary research questions also guided this study to achieve the primary objective and provide answers to the primary research question. A summary of the main findings is presented in sections 9.2.1 to 9.2.6 which follow.

### 9.2.1 Critical thinking and its measurement

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|---|---|
| **Secondary research objective A1** | To obtain an understanding of what critical thinking is and how it is measured. |
| **Secondary research question B1** | What is critical thinking and how is it measured? |

A traditional literature review was carried out in Chapter 2 to understanding what critical thinking is and how it can be measured, thereby addressing secondary research objective A1 and secondary research question B1. From the literature it was evident that critical thinking is a process of self-disciplined, self-directed, focused thinking and/or reasoning, aimed at arriving at reasonable inferences, conclusions or judgements based on certain standards. Critical thinking also involves cognitive skills and dispositions, two dimensions considered to be equally important in developing students' critical thinking. After a review of the literature, it was concluded in Chapter 2 that comprehensive conceptualisation of critical thinking provided by the APA Delphi study (Facione 1990a: 1–19) would provide the lens through which critical thinking is defined and conceptualised in this study's conceptual framework (refer to Chapter 5). The expert panel arrived at the following consensus statement (definition) with regards to critical thinking and the ideal critical thinker:

> We understand critical thinking to be purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation and inference, as well as explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgement is based. Critical thinking is essential as a tool of inquiry. As such, critical thinking is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, critical thinking is a pervasive and self-rectifying human phenomenon.

> The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgements, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating good critical thinkers means working toward this ideal. It combines developing critical thinking skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society (Facione 1990a: 2).

This conceptualisation of critical thinking and critical thinking dimensions (cognitive skills and dispositions) was included in the preliminary framework, as discussed in section 5.2.8 of Chapter 5.

Chapter 2, furthermore, provided more detail on the stages of critical thinking development as described by Elder and Paul (2010: 1). The six stages – from unreflective thinker to accomplished thinker – were discussed in this chapter. Chapter 2 also provided an overview of critical thinking measurement or assessment. Standardised and non-standardised measurement instruments were discussed. The assessment or measurement of critical thinking was thus included in the preliminary framework.

Chapter 2 highlighted certain gaps in the existing literature that demonstrated the need for a working theory for critical thinking development. The insights obtained in Chapter 2 also shed light on several key constructs, concepts, assumptions, beliefs and theories related to critical thinking and its measurement. Chapter 2 furthermore provided insights on possible relationships between these. These understandings created a foundation for the preliminary framework presented in Chapter 5.

### 9.2.2 Factors that may influence students' critical thinking

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| **Secondary research objective 2 (A2)** | To obtain an understanding of factors that may influence students' critical thinking. |
| **Secondary research question 2 (B2)** | Which factors may potentially influence students' critical thinking? |

A traditional literature review was carried out in Chapter 3 to understand the factors that may influence students' critical thinking in order to address secondary research objective A2 and secondary research question B2. The purpose of Chapter 3 was not to provide an exhaustive list of factors or an exhaustive analysis of their correlation with critical thinking, but rather to offer insights into key constructs, concepts, assumptions, beliefs and theories related to factors that may influence critical thinking and its development in students. The literature was not always consistent as to exactly which factors influence critical thinking or what their exact influence is. The literature examined in Chapter 3 did, however, show that these factors are mainly student-related, educator-related or instructional. Student-related factors that may influence critical thinking can be summarised as:

- Age;
- Gender;
- Academic performance;
- Prior knowledge or experience;
- Type of academic programme or field of study;
- Academic grade or level;
- Student learning styles; and
- Other student-related factors such as self-concept, feelings, culture, personal characteristics, nationality, ethnicity, type of high school, income level of parents, mother's educational level, native English language and reading ability.

These student-related factors were thus included in the preliminary framework.

Although the literature is limited on educator-related factors, these can be summarised as follows:

- The educator being trained in critical thinking instruction;
- The educator's prior experience in critical thinking instruction;
- The support that the educator is receiving from the educational institution or management related to critical thinking development;

- The educator's attributes, characteristics, teaching philosophy, attitude and values; and
- The educator's ability to model critical thinking.

These educator-related factors were included in the preliminary framework.

The literature also indicated that instructional factors, which include critical thinking instructional approaches as well as specific teaching strategies, may influence critical thinking. Instructional approaches include:

- General or stand-alone approach: Thinking skills are developed separately from subject or discipline content and are taught in a separate class;
- Infusion or embedded approach: Critical thinking is explicitly taught within the context of the subject or discipline;
- Immersion approach: This approach integrates critical thinking into subject content instruction, but the actual development of critical thinking skills is not made explicit;
- Mixed approach: This approach entails a mixture of the general approach together with either the infusion or the immersion approach.

These critical thinking instructional approaches were included in the preliminary framework.

From the literature presented in Chapter 3 it is also evident that active learning strategies are required to develop critical thinking in students (Jordan D'Ambrisi 2011: 36). The main types of tools or vehicles through which active learning is provided include:

- Case studies;
- Simulations;
- Problem-based learning;
- Concept mapping;
- Questioning techniques (including Socratic questioning);
- Collaboration and asynchronous online discussions;

- Written assignments;
- Reflective writing, logs and journals; and
- Modelling.

These teaching strategies and technology-based educational interventions were thus included in the preliminary framework.

Chapter 3 emphasised gaps in the existing literature that justify the need for a theory. The understandings obtained in Chapter 3, provided insights into key constructs, concepts, assumptions, beliefs and theories on factors that may influence critical thinking and its development. It also provided insights into possible relationships and influences that may exist between these concepts. These understandings created the foundation for the preliminary framework presented in Chapter 5.

### 9.2.3 Critical thinking development through teaching strategies and technology-based educational interventions

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| **Secondary research objective A3** | To obtain an understanding of how critical thinking is most effectively developed through teaching strategies and technology-based educational interventions. |
| **Secondary research question B3** | How is critical thinking most effectively developed through teaching strategies and technology-based educational interventions? |

One of the gaps identified in the literature presented in Chapter 2 indicated that although the APA Delphi study's (Facione 1990a: 1–19) definition and conceptualisation of critical thinking provides detail on the skills and dispositions needed for critical thinking, it does not provide adequate guidance on how critical thinking should be developed in students. By the same token, Bloom's taxonomy and its revised version, fail to provide sufficient guidance for the development of critical thinking. Chapter 4 thus aimed to obtain an understanding of how critical thinking is most effectively developed through teaching strategies and technology-based educational interventions, thereby addressing secondary research objective A3 and secondary research question B3.

Chapter 4 provided an overview of learning theories in general, with a specific focus on learning theories that facilitate critical thinking development, as teaching strategies should be constructed to support learning theories. From the literature presented in Chapter 4, it was established that the promotion of active learning, a problem-based curriculum, interaction between students and the use of real-world problems, are among the characteristics of instruction that develop critical thinking (Ten Dam & Volman 2004: 370). From the discussion in Chapter 4, it was also concluded that principles of constructivism aligned with these characteristics, are ideal for critical thinking development as they:

- Promote active learning;
- Use authentic learning through real-world simulated situations and problems;
- Encourage cooperative or collaborative learning;
- Facilitate learning through experience;
- Are characterised by a student-centred approach; and
- Are characterised by students constructing their own ideas of reality or knowledge based on previous experiences.

Constructivism and characteristics of critical thinking instruction were thus included in the preliminary framework.

Against this backdrop, three key teaching strategies and technology-based educational interventions were evaluated in more detail in Chapter 4, namely, case studies, PBL and simulations. A brief overview of other teaching strategies that also facilitate critical thinking was also provided. Teaching strategies and technology-based educational interventions that facilitate critical thinking development were thus included in the preliminary framework.

Chapter 4 highlighted gaps in the existing literature that include a lack of comprehensive conceptual frameworks for the development of critical thinking through technology-based educational interventions. Chapter 4 also provided insights into key constructs, concepts, assumptions, beliefs and theories on teaching strategies and technology-based educational interventions that facilitate critical thinking development. These understandings created a foundation for the preliminary framework presented in Chapter 5.

### 9.2.4 The preliminary conceptual framework

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|---|---|
| **Secondary research objective A4** | To propose a preliminary, literature-based, conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions. |
| **Secondary research question B4** | Which concepts and the relationships between these concepts, should be considered when critical thinking is developed in auditing students through technology-based educational interventions, as evident from the literature? |

The objective of Chapter 5 was to propose a preliminary conceptual framework, based on existing literature, for the development of auditing students' critical thinking through technology-based educational interventions, thereby addressing secondary research objective A4 and secondary research question B4. The foundation for the preliminary framework was derived from established critical thinking concepts, existing theories, conceptualisations of critical thinking and critical thinking development as set out in Chapters 2 to 4. These concepts were inductively and deductively derived from the body of knowledge set out in these chapters and were included in the preliminary framework illustrated in Figure 13 and summarised in Annexure N. The following concepts were identified:

- Critical thinking and its dimensions (cognitive skills and dispositions);
- Assessment or measurement of critical thinking;
- Auditing content, auditing content knowledge and its understanding;
- Auditing tests and assessments;
- Student-related factors that may influence critical thinking;
- Educator-related factors that may influence critical thinking;
- Critical thinking instructional approaches;
- The intervention: Teaching strategies and technology-based educational interventions that facilitate critical thinking development; and
- Constructivism and characteristics of critical thinking instructions.

Figure 13 and Annexure N thus illustrate and summarise the concepts that should be considered when critical thinking is developed in auditing students through technology-based educational interventions, as evident from the literature. The relationships between these concepts are also illustrated in Figure 13 and summarised in Annexure N.

### 9.2.5 IQA results – concepts that should be considered when critical thinking is developed in auditing students through technology-based educational interventions

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| **Secondary research objective A5** | To obtain an understanding of the concepts that should be considered when critical thinking is developed in auditing students through technology-based educational interventions. |
| **Secondary research question B5** | Which concepts should be considered when critical thinking is developed in auditing students through technology-based educational interventions, from the perspective of:<br>• Instructional designers, online learning designers, educational technologists, teaching and learning consultants as well as experts in e-learning environments;<br>• Auditing lecturers at SAICA-accredited programme providers and SAICA representation; and<br>• Postgraduate auditing students at Unisa? |
| **Secondary research objective A6** | To obtain an understanding of how these concepts relate to one another. |
| **Secondary research question B6** | How are these concepts related to one another? |
| **Secondary research objective A7** | To obtain an understanding of how the concepts and the systems of the three groups compare to one another. |
| **Secondary research question B7** | How do the concepts as identified by the three groups, and the systems of the three groups, compare to one another? |

To validate concepts and relationships proposed in the preliminary framework or to provide insights into additional concepts and relationships that should be added to the final conceptual framework, the perspectives of three groups of participants were obtained. Three IQA focus groups' perspectives were obtained relating to the concepts, also referred to as affinities, that should be considered when critical thinking is developed in auditing students through technology-based educational interventions, to address secondary research objective A5 and secondary research question B5. The three focus groups produced 30 concepts (affinities).

Once these concepts (affinities) were established, it was important to understand how these affinities relate to one another in order to address secondary research objective A6 and secondary research question B6. In sections 7.3 to 7.6, the overall placement of the affinities in the SIDs was described. Relationships between affinities were explained in the words of the participants, as obtained from individual DART documents. A Pareto Protocol was performed and IRDs were compiled for each group. From these IRDs, SIDs were then constructed. Interestingly, enabling tools were seen as the primary driver in the SID of group 1 (learning designers) whereas consideration of diversity was seen as the primary driver in the SID for group 3 (students). The SID of group 1 (learning designers) indicated that cross-functionality was the primary outcome whereas development considerations was the primary outcome in the SID of group 3 (students). There were no primary drivers or primary outcomes in the SID for group 2 (educators).

It was then necessary to understand how the concepts and systems of the three groups compare to one another to address secondary research objective A7 and secondary research question B7. The uncluttered SIDs and zoomed out views of the systems for the three groups were also compared in terms of their systemic properties from a structural perspective. The affinities, comprising the SIDs, were compared and the SIDs (composite systems) themselves were compared. Group 1's (learning designers) affinities were focused more on technology-based educational interventions (pure similations, gaming for education and other enabling tools), the design of the intervention and the changing learning environment. Although group 2 (educators) also mentioned several technology-based educational interventions (simulations, gamification, case studies), they placed more emphasis on the readiness of the educator and the student to engage with the intervention as well as the outcomes of the intervention. Group 3 also mentioned certain aspects of the development but many of their affinities were, however, focused on technical auditing content knowledge and business knowledge. No similarities could be found in the placement of the affinities among the three groups in the SIDs or zoomed out views.

As part of this comparison, an affinity reconciliation process was performed where the list of 30 affinities was reduced to twenty core concepts (affinities). These include:

- Design and development considerations;
- Technology-based enabling tools;
- Consideration of student diversity;
- Collaboration among stakeholders and disciplines;
- Educational interventions and teaching methods ideal for critical thinking;
- Soft skills and dispositions;
- Discipline-specific skills;
- Learning process;
- Change in pedagogy;
- Challenging conventions;
- Lecturer competence;
- Student readiness;
- Technological challenges;
- Interactive engagement;
- Learning outcomes;
- Ethics;
- Globalisation;
- Technical knowledge;
- Implementation timing; and
- Basic fundamentals.

### 9.2.6 The final conceptual framework

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| **Primary research objective (A)** | To propose a conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions |

| Primary research question (B) | Which concepts, and relationships between these concepts, should be considered when critical thinking is developed in auditing students through technology-based educational interventions? |
|---|---|

The concepts and relationships identified in the preliminary framework provided the foundation for the final conceptual framework. Maxwell (2013: 41), however, asserts that preliminary theories and results can often be incomplete or misleading. It was thus essential to examine the IQA research findings and critically examine whether they validate or add to the preliminary theory. In Chapter 8, the twenty common core concepts (affinities) were further examined to establish whether they validate the concepts and relationships proposed in the preliminary framework or whether they provide insights into concepts and relationships that should be added to the final conceptual framework. I also examined a wider body of knowledge that informed the findings of the IQA where concepts and relationships were added. These new theoretical contributions add to the existing body of knowledge on critical thinking with original contributions. The primary research objective of this study was thus achieved in Chapter 8 where an integrated and robust conceptual framework aimed at the development of critical thinking in auditing students through technology-based educational interventions was proposed. This final conceptual framework is illustrated in Figure 44 and Figure 45 (Chapter 8) and summarised in Annexure O.

## 9.3 CONTRIBUTIONS OF THE STUDY

The contributions of this study are discussed under three separate headings. The theoretical contributions, contextual and policy contributions and methodological contributions of this study are discussed further in sections 9.3.1 to 9.3.3.

### 9.3.1 Theoretical contributions

In Chapter 1 (section 1.3), the need for an integrated and robust framework for the development of critical thinking was identified. Although various researchers have attempted to provide frameworks for critical thinking, these frameworks mainly focus on isolated aspects, elements and/or dimensions of critical thinking and do not provide a holistic view of critical thinking development through technology-based educational interventions. Established theoretical frameworks such as Bloom's taxonomy or Bloom's revised taxonomy can also be used as a foundation for guiding higher order levels of thinking, but they do not provide adequate guidance for the actual development of critical thinking in students. This study thus offers an original contribution in this regard, by providing educators in accounting education with a conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions.

The first theoretical contribution of this study is in Chapter 5 where a preliminary conceptual framework is presented. The foundation for this preliminary framework was derived from established critical thinking concepts, existing theories, conceptualisations of critical thinking and critical thinking development as set out in Chapters 2 to 4. Key concepts on critical thinking, its measurement and development were inductively and deductively derived from the body of knowledge examined in these chapters. I thus consulted existing literature to establish this preliminary framework for developing critical thinking in auditing students through technology-based educational interventions. This is a novel theoretical contribution. The preliminary framework is repeated here as Figure 46 for ease of reference.

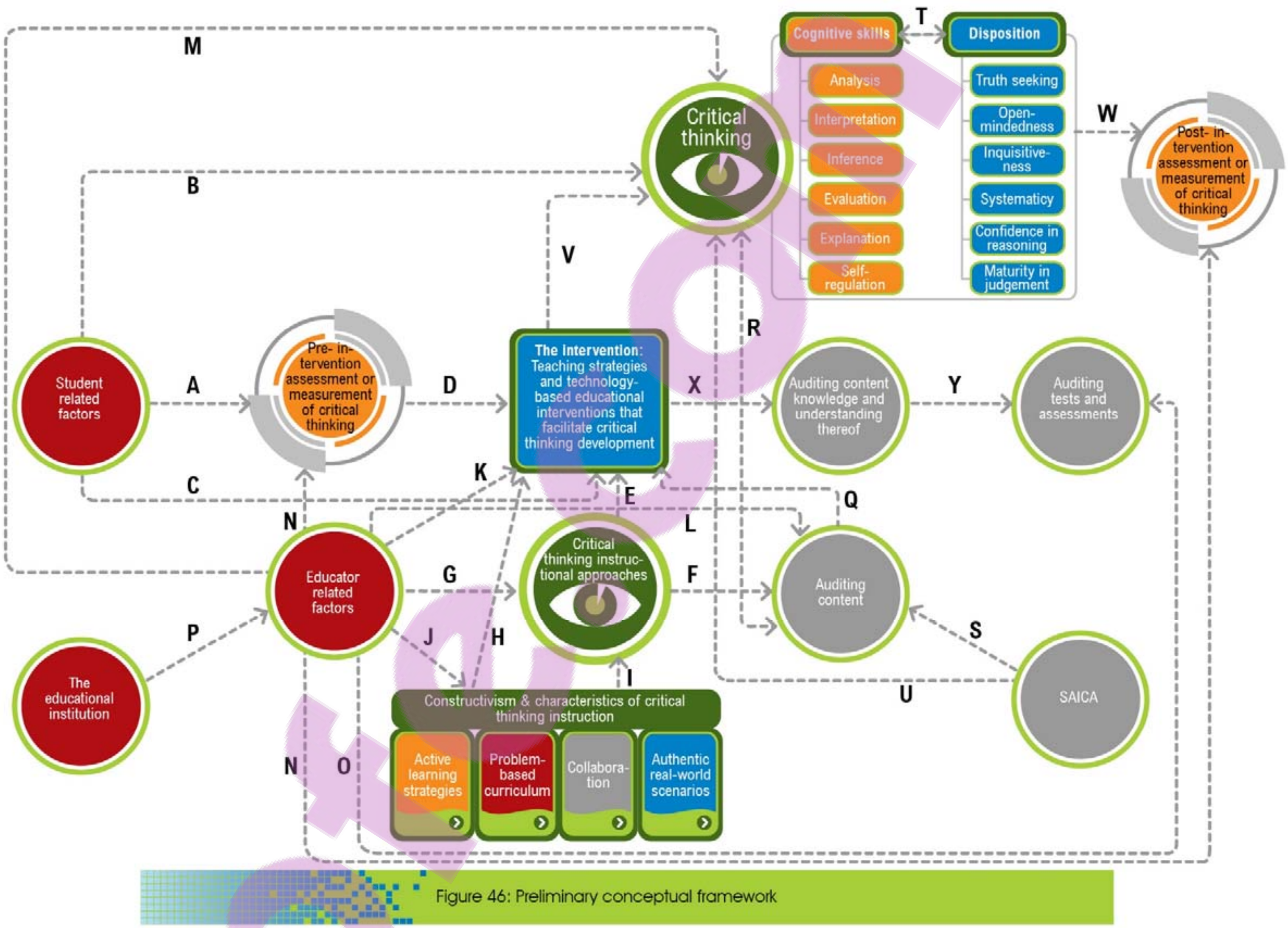


**Figure 46: Preliminary conceptual framework**
**Source:** Author

The second theoretical contribution of this study is presented in Chapter 8. The primary objective of this study was to provide a conceptual framework for the development of critical thinking in auditing students through technology-based educational interventions. The preliminary framework created the foundation for this final framework. The perspectives of three IQA focus groups were obtained on concepts they believed should be considered when critical thinking is developed in auditing students through technology-based educational interventions. These concepts, or affinities, validated the concepts and relationships proposed in the preliminary framework and/or provided insights into additional concepts and relationships that were added to the final framework. I thus added to the existing body of knowledge on critical thinking by obtaining the views of knowledgeable individuals, using an IQA design, and integrating this new knowledge with the existing body of knowledge. I also examined a wider body of knowledge to inform the findings of the IQA. This further added to the original theoretical contribution of this study.

The conceptual framework proposed in this study makes both a disciplinary and interdisciplinary contribution. A disciplinary contribution is made as the framework can be useful to educators who are specifically involved in the teaching of auditing students. This framework also makes an interdisciplinary contribution as it can benefit educators in other fields within the accounting education discipline (for example taxation, management accounting and accounting) as well as educators in other disciplines. Jones (2015: 169) argues that *"critical thinking occurs within the conventions, methodologies and knowledge bases of particular disciplines and fields and within the structures that they provide. Thus it is disciplined in both its subject specificity and its orderliness. This is not to suggest that critical thinking cannot interrogate the subject area in which it resides, or that it cannot transcend disciplinary boundaries".*

Chapter 1 (section 1.6) indicated that this study takes an educational perspective as it is concerned with the development of auditing students' critical thinking through technology-based educational interventions. This study is chiefly concerned with educational development of critical thinking in students and ways in which critical thinking can then benefit the wider society outside the classroom. The study takes interest in the educational value and benefits of critical thinking development in auditing students which may ultimately benefit the student, the auditing profession and society at large. This study thus also offers a pedagogical contribution by enriching the body of knowledge on teaching strategies and technology-based educational interventions that develop critical thinking (Chapter 4). The conceptual framework proposed in this study furthermore identifies the possible relationships between these strategies and interventions as well as other concepts that should be considered in the development of auditing students' critical thinking.

The conceptual framework proposed in this study provides structure to the complex nature of critical thinking and its development. The framework can be used in its entirety as a comprehensive framework for critical thinking development in auditing students. This is, however, a robust framework which may only be fully implemented over an extended period of time. The scope of this framework might thus seem daunting and overwhelming for educators to implement in totality straight away. As Reed (1998: 166) notes *"this is not a 'quick-fix' instructional model that can be superficially applied in a few course activities, nor is it a simple list of elements, standards, and traits to be memorised. Rather, it is an approach to instruction that requires, for most of its practitioners, a readiness to reflect deeply on a course and to rebuild it from its curricular and pedagogic foundations up".* Implementing individual concepts of the framework can assist educators in getting the process of critical thinking development started. Educators can, for example, start off by implementing only the pre-intervention assessment or measurement of critical thinking (refer to section 5.2.2). This would provide valuable information on the level of critical thinking of their students prior to implementing any interventions. Another concept that could be implemented at first is collaboration among educators (academics), stakeholders, IT experts, other disciplines and SAICA (professional bodies) (refer to section 8.2.4). This would provide the educator with information on the needs of the profession in terms of critical thinking and how collaboration with other experts can assist in addressing these needs. Although the complete conceptual framework might take some time to implement in full, educators can thus implement individual elements in the interim. The final conceptual framework is repeated here as Figure 47 for ease of reference.

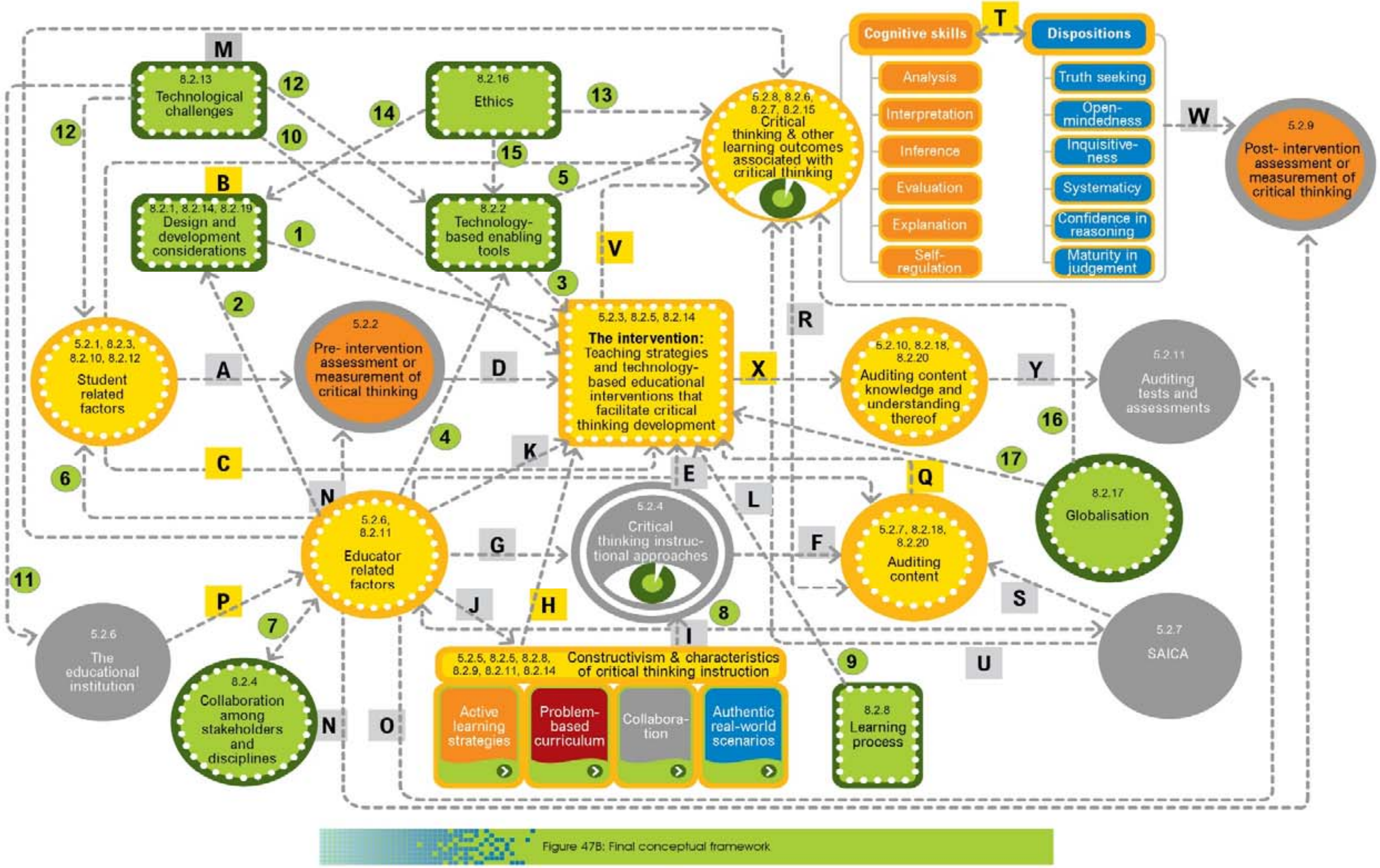


**Figure 47: Final conceptual framework (B)**
**Source:** Author

### 9.3.2 Contextual and policy contributions

The *Education White Paper 3 – A programme for higher education transformation* (South Africa. Department of Education 1997: 10) sets out various goals that should be pursued in implementing a programme for the transformation of higher education in South Africa. One of these goals is for higher education to provide graduates who have the skills and competencies for lifelong learning which include critical thinking skills. The importance of critical thinking skills is thus undisputed in terms of the goals set for higher education institutions in South Africa. This study and the conceptual framework offered in this study, offer both educators and policy makers involved in higher education, direction and guidance in terms of critical thinking development. The insights offered in this study, can assist educators at higher education institutions in the development of their curriculums to include teaching principles that promote critical thinking.

Section 2.2 in Chapter 2 also highlighted the need for more guidance on critical thinking development in accounting education specifically. Apart from the references to judgement and critical assessment, no specific definition for critical thinking could be found in the IAESB or IAASB glossary of terms. The SAICA competency framework does provide a definition of critical thinking (South African Institute of Chartered Accountants 2014a: 35), however, there is no guidance on how to develop this skill. Critical thinking is also needed for success in practical and professional domains, including the accounting and auditing professions (Sin, Jones & Wang 2015: 431–432). Educators involved in chartered accountancy programmes thus have a responsibility to develop critical thinking in their students. Most of the educators involved in chartered accountancy training programmes in South Africa, are chartered accountants themselves, without formal qualifications in education. Most of them have also not received any formal training in critical thinking development and are thus unlikely to be familiar with the pedagogical foundations of critical thinking development. It can therefore not simply be assumed that these educators understand the foundations of critical thinking or how to develop it in their students. The conceptual framework proposed in this study offers a novel contextual contribution to accounting education whereby educators, both internationally and in South Africa, are assisted in developing auditing students' critical thinking. Through this framework, educators can obtain an understanding of concepts that should be considered when critical thinking is developed in students through technology-based educational interventions. The framework can, furthermore, assist educators to design their curricula to include critical thinking.

This study also offers a novel contribution to policy makers who seek to inform the debate on critical thinking development and thereby shape professions. The study provides insights on how critical thinking can be defined, conceptualised, measured and developed in various national policies on higher education in South Africa. It similarly provides guidance on these issues to universities and professional accounting regulatory bodies in shaping their policies and competency frameworks.

### 9.3.3 Methodological contributions

The IQA research flow is a fairly adaptable process. It was mentioned in section 6.6 of Chapter 6 that some researchers have made use of either ARTs or DARTs, with or without IQA interviews, in their studies. Nienaber (2013: 1–509) made use of ARTs and did not include IQA interviews in his study. Du Preez (2015: 1–258) made use of DARTs and also did not conduct individual IQA interviews. Both Plant (2015: 1–386) and Robertson (2015: 1–263), however, made use of ARTs and conducted IQA interviews in their respective studies.

In this study, DARTs were used to obtain detailed reasoning and logic from each participant on the direction of relationships among affinities. The three groups provided rich affinity descriptions with adequate depth. Northcutt and McCoy (2004: 48–49) note that IQA interviews should be performed to enhance the richness and depth of the description of affinities. I did not believe that individual semi-structured interviews would have further enhanced the richness and depth of the affinities and I also did not feel that IQA interviews would have provided additional insights into the direction of the relationships already obtained through these DARTs. Individual IQA interviews were thus not conducted. When IQA interviews are, however, conducted, a process of affinity reconciliation is generally performed to arrive at a single reconciled interview protocol to be used for interviewing participants subsequent to the focus groups (Northcutt & McCoy

2004: 212–215). This is done to identify a common core list of affinities (Northcutt & McCoy 2004: 212–215). Although individual interviews were not conducted with participants in this particular study and no interview protocol prepared, the affinity reconciliation was performed with a slightly different purpose in mind. I performed an affinity reconciliation process (refer to section 7.7 in Chapter 7) whereby the list of 30 affinities produced across the three IQA groups was reconciled to a core list of twenty common core affinities. These twenty common core affinities were further examined in sections 8.2.1 to 8.2.20 to establish whether they validated the concepts and relationships proposed in the preliminary framework, or whether they provided insights into concepts and relationships that should be added to the final framework.

Nienaber (2013: 182–193) performed a thematic analysis and used the qualitative data analysis programme Atlas.ti in this process. He conducted this analysis to incorporate the affinities that were identified by each IQA focus group into a set of combined themes for all the groups. I had the same rationale in mind for this particular study, but decided to make use of the affinity reconciliation process for this purpose, thus offering a novel methodological contribution to IQA research design.

## 9.4 REFLECTIONS ON THE ROLE OF THE RESEARCHER AND THE METHODOLOGY

In Chapter 1 (Table 1 in section 1.4), the cognitive process dimensions were specified that would enable me to respond to the research objectives of this study, in line with Bloom's revised taxonomy (Anderson & Krathwohl 2001: 67–68). I used various cognitive process dimensions throughout this study to achieve these research objectives. I also applied and developed my own critical thinking skills and dispositions throughout the study as the recursive IQA design has also been described as a formal version of critical thinking, permitting the researcher to find answers to a question by obtaining different perspectives on a phenomenon (Northcutt & McCoy 2004: 61). These research objectives are discussed in terms of the cognitive process dimensions described by Anderson and Krathwohl (2001: 67–68), critical thinking skills and dispositions and a reflection on the role of the researcher:

| | |
|---|---|
| **Secondary research objective A1** | To obtain an understanding of what critical thinking is and how it is measured (Chapter 2) |
| **Secondary research objective A2** | To obtain an understanding of factors that may influence students' critical thinking (Chapter 3) |
| **Secondary research objective A3** | To obtain an understanding of how critical thinking is most effectively developed through teaching strategies and technology-based educational interventions (Chapter 4) |

I initially found this part of the study very overwhelming as the literature on critical thinking stretches over several decades, includes various disciplines and fields and diverse aspects. I was primarily concerned about how the information should be structured and presented in the study, given that there were various aspects that needed to be covered. Applying my own critical thinking skills, I worked through the literature in a structured manner. I interpreted, analysed and evaluated the body of knowledge and made inferences where needed. In terms of the cognitive process dimensions described by Anderson and Krathwohl (2001: 67–68), I had to **evaluate** a body of literature on critical thinking which included a process of judging and critiquing the literature. I also had to **analyse** this body of literature to organise the information, distinguish relevant from irrelevant information and to select the most relevant parts of the information. I furthermore had to **understand** and construct meaning from the body of knowledge to convey only relevant information in these three literature chapters. I had to interpret, summarise, compare and explain various concepts and relationships and make inferences throughout these chapters.

| | |
|---|---|
| **Secondary research objective A5** | To obtain an understanding of the concepts that should be considered when critical thinking is developed in auditing students through technology-based educational interventions (Chapter 7) |
| **Secondary research objective A6** | To obtain an understanding of how these concepts relate to one another (Chapter 7) |

I selected and invited the participants of the IQA focus groups. During the IQA focus groups, I acted as a non-participating observer. After the focus group discussion, I formulated the descriptions of the affinities with the assistance of the independent facilitator. I compiled the DARTs and requested participants of each focus group (via e-mail) to articulate their own views of the perceived cause or effect relationships among the various affinities. I performed a Pareto Protocol for each group, compiled the IRDs and created the SIDs for each group. My main role in the IQA process was thus that of data collection, analyses and interpretation of the data. I therefore followed the IQA research design procedures as set out by Northcutt and McCoy (2004: xi-441) and also applied my own critical thinking whereby I interpreted, analysed and evaluated the data obtained through the IQA process. In terms of the cognitive process dimensions described by Anderson and Krathwohl (2001: 67–68), I had to **evaluate** and **analyse** the recordings of the IQA focus groups to formulate the affinity descriptions. I also had to **analyse** the DARTs of the participants, to **understand** and interpret the information presented on these DARTs. During the creation of the IRDs and SIDs, I furthermore had to understand the data by summarising and interpreting the information (changing from one form of presentation to another). I found this part of the study very interesting and thought-provoking. I enjoyed analysing and interpreting the data obtained through the IQA process.

| | |
|---|---|
| **Secondary research objective A4** | To propose a preliminary, literature-based, conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions (Chapter 5) |
| **Primary research objective A** | To propose a conceptual framework for the development of auditing students' critical thinking through technology-based educational interventions (Chapter 8) |

I found this the most difficult part of the study. I had to apply my own critical thinking skills and dispositions throughout this part of the study as I regularly felt challenged on an intellectual level. I had to be prudent in making judgements, clear about issues, orderly in dealing with the issues, diligent in seeking relevant information, focused in inquiry and fair-minded in evaluation. I also applied my own critical thinking skills as I had to interpret, analyse and evaluate the body of knowledge, IQA data and other supporting literature. In terms of the cognitive process dimensions described by Anderson and Krathwohl (2001: 67–68), I had to **create** the preliminary framework as well as the final conceptual framework. This required of me to put the various concepts and relationships together in a coherent or functional way so that they presented a comprehensive model that could be used for critical thinking development in auditing students. I also had to **evaluate** and **analyse** the body of literature to identify (deductively and inductively) key concepts and relationships to be included in the preliminary framework. I had to **evaluate** and **analyse** the IQA results so that the affinities could be presented in an organised manner in the final framework. For this purpose, I **applied** the affinity reconciliation protocol so that the affinities could be reconciled to a core list of affinities. I also had to **understand** the information presented in this study to propose this conceptual framework and summarise and interpret the information in a sensible manner.

Although I do not believe that I am an accomplished thinker yet, I do believe that I have gone through various stages of critical thinking development as this study progressed. I have arrived at a place where I truly understand the value of critical thinking and how vitally important critical thinking development is.

The study adopted a constructivist paradigm where the emphasis is on sense-making and the assignment of meaning (Fincham 2002: 2). I thus believe that the IQA research design was a perfect fit for this particular study. Chapter 6 described the primary purpose of IQA, a qualitative approach to research, as the presentation of the meaning of a phenomenon in terms of its elements (affinities) and the relationships between these affinities. This primary purpose of IQA was achieved when three groups of participants produced 30 affinities and completed DARTs to indicate the possible cause and effect relationships between these affinities. The final uncluttered SIDs represent the group reality which is a mindmap of that group's understanding of the phenomenon. Participants were thus allowed to construct their own meaning of the phenomenon and generate meaning through interaction with others. I took on the role of a constructivist researcher by exploring and interpreting the meanings those individuals had about this particular phenomenon (Creswell 2014: 8). The perspectives obtained from these groups provided crucial insights and significantly enhanced the richness of the final conceptual framework proposed in this study.

## 9.5 RECOMMENDATIONS FOR FURTHER RESEARCH AND LIMITATIONS OF THE STUDY

This section provides recommendations for further research as well as the limitations of this study. The conceptual framework which forms the novel contribution of this study is presented both visually as a concept map in Figure 47 and as a summarised table in Annexure O. This conceptual framework presents the concepts that should be considered when critical thinking is developed in auditing students through technology-based educational interventions as well as the relationships between these concepts. The study did not, however, evaluate the effectiveness of this framework in an educational setting. Future studies could focus on evaluating the effectiveness of this framework in its entirety or explore certain concepts and relationships of the framework. Future research could also focus on a more in-depth analysis of some of the major concepts identified in the framework and/or the affinities identified in this study.

This study focused on the development of critical thinking. Various other skills, competencies and character qualities are also required by students to adapt to the 21st century workforce. Future research could thus be conducted on the development of other pervasive skills, soft skills and non-technical skills.

The study also focused on the development of auditing students' critical thinking. The participants in the IQA focus groups were thus limited to auditing lecturers from various universities in Gauteng and postgraduate auditing students registered at Unisa. The proposed conceptual framework could, however, have similar interdisciplinary value in South Africa and abroad. Further research could thus focus on the effectiveness of this framework in other subjects, for example, taxation. Interdisciplinary research is also encouraged where researchers from other disciplines could evaluate the effectiveness of the framework or concepts of the framework in their disciplines.

This study focused on critical thinking development from an educational perspective. Future research could investigate critical thinking in auditing students from a philosophical or a socially active perspective. Critical pedagogy, political analyses of the role of higher education in society, detailed discussions on approaches to curriculum development and how critical thinking relates to creativity fell outside the scope of this study. Future research could include these aspects.

Certain limitations in terms of the methodology should also be noted. IQA generally uses focus groups, which may have certain inherent limitations. Although IQA is aimed at exploring a phenomenon and the results are not representative of the entire population, the smaller sample sizes of the IQA groups could be viewed as a limitation. The focus group participants also included only individuals from Gauteng. Participants from other provinces may have different views on the concepts that should be considered when critical thinking is developed in auditing students. Future research could explore these matters.

The choice of IQA as research design may also have led to some research bias. My role in the research and a number of other measures taken to address these biases were discussed in Chapters 1 and 6 in an attempt to limit my own subjectivity in collecting and analysing the data.

This study was conducted in a South African context and focused on critical thinking development from a higher education perspective. This particular study did, however, not explore or measure the varying levels of critical thinking among higher education students. Further research studies could attempt to explore or measure these critical thinking levels as students progress through higher education. Critical thinking should also be developed at other levels of education including schooling. Future research could thus explore critical thinking at other levels of education which may, in turn, influence policies related to those levels.

The conceptual framework developed in this study did not differentiate between auditing students studying in a traditional face-to-face learning environment and those studying in a distance learning environment. Advances in computer technologies and the use of blended learning approaches have begun to blur the lines between learning environments. Further research could, however, explore the possible impact of different learning environments on the conceptual framework and critical thinking development.

Chapter 2 provided valuable insights on how critical thinking is defined and contextualised in various disciplines and other seminal works. The definition and dimensions of critical thinking used in the APA Delphi study provided the lens for this study's conceptualisation of critical thinking. However, various other definitions of critical thinking exist in the literature and could be used by policy makers. The ultimate goal is to have a unified definition and conceptualisation of critical thinking for accounting education. Accounting education researchers should thus continue their efforts to explore this.

Auditing students' ability to think critically is no longer a 'nice-to-have' but an all-important necessity if they are to adapt and thrive in the 21st century workplace. Educators can no longer shy away from the use of technology in their teaching practices nor can they shift responsibility for critical thinking development to others. Investing time and effort in critical thinking development of auditing students will have endless benefits, not just for these students but for educators, employers and broader society as well. The benefits of critical thinking are simply too great to ignore and the consequences of not having it, too dire to contemplate.

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# ANNEXURES

## Unisa College of Accounting Sciences Ethics Review Committee – Ethical approval certificate ANNEXURE A

UNISA university of south africa

**COLLEGE OF ACCOUNTING SCIENCES**
**RESEARCH ETHICS REVIEW COMMITTEE**

Date: 24 January 2017

Ref: 2017_CAS_001
Name of applicant:
Ms EAJ Terblanche
Student/Staff #: 90160649

Dear Ms EAJ Terblanche

**Decision: Ethics Approval**

**Name:** Ms EAJ Terblanche
terbleaj@unisa.ac.za

**Tile:** Developing critical thinking in auditing students in an e-learning environment

**Qualification:** Postgraduate student research

Thank you for the application for research ethics clearance by the College of Accounting Sciences Research Ethics Review Committee for the above mentioned research. Final approval is granted for the completion of the research.

***For full approval:*** *The primary data application was reviewed in compliance with the Unisa Policy on Research Ethics by the College of Accounting Sciences Research Ethics Review Committee on 24 January 2017.*

*The proposed research may now commence with the proviso that:*

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
2) *Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the College of Accounting Sciences Research Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*

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3) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*

*Note:*
*The reference number [top right corner of this communiqué] should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the College of Accounting Sciences RERC.*

Kind regards,

Ms L Grebe
(Chairperson of CAS RERC)
grebel@unisa.ac.za
(012) 429 4994

Prof Elmarie Sadler
(Executive Dean of CAS)

**RPSC of the Senate Research, Innovation, Postgraduate Degrees and Commercialisation Committee – Ethical approval certificate ANNEXURE B**

UNISA university of south africa

**RESEARCH PERMISSION SUB-COMMITTEE (RPSC) OF THE SENATE RESEARCH, INNOVATION, POSTGRADUATE DEGREES AND COMMERCIALISATION COMMITTEE (SRIPCC)**

14 March 2017

**Decision: Research Permission Approval from 14 March 2017 until 31 October 2017.**

Ref #: 2017_RPSC_020
Ms. Aletta Terblanche
Student #: N/A
Staff #: 90160649

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**Principal Investigator:**
**Ms. Aletta Terblanche**
Department of Financial Governance
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Supervisors: Prof Bernadene de Clercq
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**A study titled: "Developing critical thinking in Auditing students in an e-learning environment."**

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Your application regarding permission to conduct research involving UNISA employees, students and data in respect of the above study has been received and was considered by the Research Permission Subcommittee (RPSC) of the UNISA Senate, Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC) on 13 March 2017.

It is my pleasure to inform you that permission has been granted for the study. You may:

1. Conduct focus group discussions with 10 to 15 Unisa Instructional designers, online

designers, educational technologists, teaching and learning consultants and any other experts in e-learning environment.

2. Conduct focus group discussions with 10 to 15 Unisa auditing lecturers.
3. Also conduct focus group discussions with 10 to 15 Unisa students registered for the AUE4862 module in 2017.
4. Obtain a list of the working email addresses of the target populations. However, according to the Protection of Personal Information Act No. 4 of 2013, cellphone numbers are classified as personal information and the RPSC is unable to provide you with this information.

You are requested to submit a report of the study to the Research Permission Subcommittee (RPSC@unisa.ac.za) within 3 months of completion of the study.

The personal information made available to the researcher(s)/gatekeeper(s) will only be used for the advancement of this research project as indicated and for the purpose as described in this permission letter. The researcher(s)/gatekeeper(s) must take all appropriate precautionary measures to protect the personal information given to him/her/them in good faith and it must not be passed on to third parties.

*Note:*
*The reference number **2017_RPSC_020** should be clearly indicated on all forms of communication with the intended research participants and the Research Permission Subcommittee.*

We would like to wish you well in your research undertaking.

Kind regards,

RVisagie

pp. Dr Retha Visagie – Manager: Research Integrity
Email: visagrg@unisa.ac.za, Tel: (012) 429-2478

**Prof A Davis – Chairperson: RPSC**
**Email: davisa@unisa.ac.za, Tel: (012) 429-8357**

## Historical overview of critical thinking

## ANNEXURE C

| Key individual and time period | | Major contributions towards critical thinking |
|---|---|---|
| 5th and 4th century BC | **Socrates (470 BCE – 399 BCE)**<br>(Biography.com editors 2016a: 1)<br><br>**Plato (428 BCE – 348 BCE)**<br>(Biography.com editors 2016b: 1)<br><br>**Aristotle (384 BCE – 322 BCE)**<br>(Biography.com editors 2016c: 1) | Socrates, the Greek philosopher known by many as the founder of critical thinking (Denardo 2003: 13). He embraced the questioning critical attitude (probing questioning) as he believed all traditions were open to critical examination (Paul 2014: 1357; Sofos 2005: 1; Staib 2003: 498). He strongly believed in the importance of searching for evidence, analysing reasons and assumptions, investigating basic notions as well as investigating certain consequences of things that were said and done (Sofos 2005: 1; Denardo 2003: 13; Paul & Elder 1997: 1). Paul and Elder (1997: 1) wrote that Socrates aimed to distinguish between beliefs that were rational and logical from those that were not. Socrates' method of inquiry is known as 'Socratic questioning' or the 'Socratic method' and is a renowned teaching strategy for enhancing critical thinking (Jordan D'Ambrisi 2011: 21; Norris 2011: 5–6). Socrates believed that education should ultimately promote the development of skills and habits of thought in order to enable people to think and reason throughout their lives (Elder 2010: 1).<br><br>Greek philosophers such as Plato and Aristotle embraced Socrates' works (Norris 2011: 5–6; Sofos 2005: 1; Paul & Elder 1997: 1) and according to Wood (2012: 1), Plato and the philosophers following him can be credited for the development of critical thinking. Plato, Aristotle and other Greek sceptics highlighted that things are not always as they appear and that it takes a skilled mind to distinguish between deceptive appearances and deeper realities of life (Sofos 2005: 1; Paul & Elder 1997: 1). Plato, a student of Socrates who recorded his thoughts (Paul & Elder 1997: 1), advocated that education should be more than the mere provision of information as its aim should rather be to empower students to question, examine and reflect upon ideas and principles (Staib 2003: 498; Daly 1998: 324). Aristotle believed that there is a strong relationship between thinking and intellect (Staib 2003: 498; Daly 1998: 324) and he also highlighted that critical thinking brings together abstract thinking and logical thinking (Daly 1998: 324). Rules of reasoning, for thinking critically, were established by Aristotle (Sofos 2005: 1). |
| 4th and 5th century AD | **St. Augustine (354 – 430)**<br>(Houghton Mifflin Harcourt 2016: 1) | St. Augustine relentlessly searched for truth and secure knowledge. Through him, critical thinking was brought into the evolving doctrines of Christianity (Wood 2012: 1). |
| 13th century | **St. Aquinas (1225 – 1274)**<br>(Biography.com editors 2016d: 1) | St. Aquinas became known for his systematic way of critical thinking (Jones-Devitt & Smith 2007: 1), his acute awareness of the power of systematic reasoning (Norris 2011: 6) and for ideas to be cross-examined (Sofos 2005: 1–2; Paul & Elder 1997: 1). He believed that a true critical thinker only discards ideas or beliefs that lack rational grounds (Paul & Elder 1997: 1). |

| **15th to18th century** | **Colet (1467 – 1519)** (Kreis 2016: 1)<br><br>**Erasmus (1466 – 1536)** (Biography.com editors 2016e: 1; Kreis 2016: 1)<br><br>**More (1478 – 1535)** (Kreis 2016: 1)<br><br>**Machiavelli (1469 – 1527)** (Biography.com editors 2016f: 1)<br><br>**Bacon (1561 – 1626)** (Biography.com editors 2016g: 1; Kreis 2016: 1)<br><br>**Descartes (1596–1650)** (Biography.com editors 2016h: 1)<br><br>**Hobbes (1588 – 1679)** (Biography.com editors 2016i: 1)<br><br>**Locke (1632 – 1704)** (Biography.com editors 2016j: 1)<br><br>**Boyle (1627 – 1691**) (Principe 2014: 1)<br><br>**Newton (1643 – 1727)** (Biography.com editors 2016k: 1)<br><br>**Bayle (1647 – 1706)** (Britannica 2016: 1)<br><br>**Montesquieu (1689 – 1755)** (Biography.com editors 2016l: 1)<br><br>**Voltaire (1694 – 1778)** (Biography.com editors 2016m: 1)<br><br>**Diderot (1713 – 1784)** (Niklaus 2016: 1)<br><br>**Smith (1723 – 1790)** (Biography.com editors 2016n: 1)<br><br>**Kant (1724 – 1804)** (Biography.com editors 2016o: 1) | During the Renaissance period Colet, Erasmus and More followed the ancients and started to critically question domains such as religion, law, society, art and various others (Norris 2011: 6; Jones-Devitt & Smith 2007: 1–2; Sofos 2005: 1–2).<br><br>Machiavelli wrote *The Prince* during the Italian Renaissance, which critiqued the politics of those days and through this he laid the foundation for modern critical thought in politics. Machiavelli critically questioned politicians and their agendas (Sofos 2005: 2; Paul & Elder 1997: 2).<br><br>Sir Francis Bacon authored *The Advancement of Learning*, through which he advocated the importance of an empirical study of the world and those things that hinder one's ability to think on one's own (Jones-Devitt & Smith 2007: 1–2; Paul & Elder 1997: 1). He set the scene for modern science through an empirical approach (Denardo 2003) and data-gathering. His book is considered one of the earliest known pieces on critical thinking (Norris 2011: 6; Sofos 2005: 1–2; Paul & Elder 1997: 1–2).<br><br>René Descartes, a mathematician and philosopher in France during this time (Serrat 2011: 1), wrote what can be regarded as the second known piece on critical thinking, *Rules for the Direction of the Mind* (Jones-Devitt & Smith 2007: 2; Sofos 2005: 1–2; Denardo 2003: 14; Paul & Elder 1997: 1–2). Descartes developed four rules namely (i) only accepting ideas that are undoubtedly "true"; (ii) separating problems into distinct parts; (iii) making deductions and conclusions following from other conclusions; and (iv) ensuring that the systematic review includes everything it should (Serrat 2011: 1–3). Descartes strongly believed that ideas should be argued, questioned and tested which facilitated the development of critical thinking through systematic doubt (Norris 2011: 6; Denardo 2003: 14; Paul & Elder 1997: 1–2). Descartes established Cartesian Dualism upon which modern medicine was founded (Jones-Devitt & Smith 2007: 2).<br><br>Thomas Hobbes and John Locke in England followed in the footsteps of Machiavelli in terms of the value placed on the critical mind (Sofos 2005: 2; Paul & Elder 1997: 2). This was a period in which social structures and hierarchies were severely challenged (Jones-Devitt & Smith 2007: 2). Hobbes took a naturalistic view and sought evidence and reasons while Locke developed theories for critical thinking regarding basic human rights (Paul & Elder 1997: 2). This type of freedom in critical thinking inspired the likes of Robert Boyle and Sir Isaac Newton. Boyle wrote *Sceptical Chymist* in which he critiqued prior theories of chemistry while Sir Newton established an extensive framework of critical thought regarding world views (Sofos 2005: 2–3; Paul & Elder 1997: 2). Other noteworthy individuals during this period who made great contributions toward the development of critical thinking were the thinkers of the French Enlightenment (during the Age of Reason) (Jones-Devitt & Smith 2007: 2) namely Bayle, Montesquieu, Voltaire and Diderot. These thinkers believed that all views and ideas had to be examined critically and that those in authority should submit to human reason (Norris 2011: 7; Sofos 2005: 2–3; Paul & Elder 1997: 2–3).<br><br>Jones-Devitt and Smith (2007: 2) credit the likes of Hobbes, Locke, Machiavelli and Voltaire for setting the scene in questioning political power and their true agendas. These men aimed to hold those in power to real accountability through scrutiny of their actions (Jones-Devitt & Smith 2007: 2). It was during this period that the American Revolution (1776) as well as the French Revolution (1789) took place and a key driving force seemed to be collective critical thought which drove political change (Jones-Devitt & Smith 2007: 2).<br><br>At the end of the 18th century, critical thinking took a new direction when it was applied in the pre-industrialised world to problems experienced in economics (Jones-Devitt & Smith 2007: 2; Sofos 2005: 2–3; Paul & Elder 1997: 2–3). Adam Smith's *The Wealth of Nations* and the German philosopher Immanuel Kant's *Critique of Pure Reason* are examples of these expansions of critical thinking applied to economic problems (Norris 2011: 7; Jones-Devitt & Smith 2007: 2; Sofos 2005: 2–3; Paul & Elder 1997: 2–3). |
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| **19th and 20th century** | **Marx (1818 – 1883)** (Biography.com editors 2016p: 1)<br><br>**Engels (1820 - 1895)** (Hammen 2014: 1)<br><br>**Freud (1856 - 1939)** (Biography.com editors 2016q: 1)<br><br>**Sumner (1840 – 1910)** (Britannica 2015: 1)<br><br>**Dewey (1859 – 1952)** (Biography.com editors 2016r: 1)<br><br>**Wittgenstein (1889 - 1951)** (Monk 2015: 1)<br><br>**Piaget (1896 - 1980)** (Biography.com editors 2016s: 1)<br><br>**Dreyfus & Dreyfus (1980s)** (Rubenfeld & Scheffer 2015: 29–33)<br><br>**Benner (1980s)** (Rubenfeld & Scheffer 2015: 29–33)<br><br>**Bedford Committee (1984) & report (1986)** (Deppe, Sonderegger, Stice, Clark & Streuling 1991: 257–280)<br><br>**Perspectives on Education (White Paper) (1989)** (French & Coppage 2000: 69–73; Deppe et al. 1991: 258–259)<br><br>**American Philosophical Association (APA) - Delphi study (1990s)** (Facione 1990a: 1–18)<br><br>**Accounting Education Change Commission (1990)** (Bierstaker, Bedard & Biggs 2015: 22–23)<br><br>**International Federation of Accountants' (IFAC) (1994) – discussion paper** (International Federation of Accountants 1994: 1–26)<br><br>**Albrecht and Sack (2000)** (Albrecht & Sack 2000: 43–58) | The industrial era in the 19th century saw individuals such as Karl Marx and Friedrich Engels expanding critical thinking and applying it directly to the economic and capitalism issues of those times (Jones-Devitt & Smith 2007: 2). Both Marx and Engels referred to "False Consciousness' where those in power become so dominant that the people being exploited do not even recognise it and therefore fail to challenge those in power (Jones-Devitt & Smith 2007: 2–3). During this time Sigmund Freud's as well as other psycho-analysts' work also reflected critical thought as demonstrated by the unconscious mind (Jones-Devitt & Smith 2007: 3; Paul & Elder 1997: 2). William Graham Sumner advocated the important need for critical thinking not just in life in general but also in education. Sumner believed that education is good not only for producing critical thinkers but also for producing good citizens (Sofos 2005: 3–4; Paul & Elder 1997: 2–3).<br><br>It was, however, during the 20th century that a number of thinkers started focusing their attention on expanding the ideas and concepts of critical thinking (Jones-Devitt & Smith 2007: 3; Sofos 2005: 3–4; Paul & Elder 1997: 2–3). John Dewey was a major role player in the development of critical thinking (Simpson & Courtney 2002: 89–98) and is known as the father of modern critical thinking tradition (Jordan D'Ambrisi 2011: 22). Dewey believed that critical thinking comprises judgement and scepticism (Simpson & Courtney 2002: 89–98; Daly 1998: 324). He advocated that critical thinking formed part of higher-order sense making and that critical thinking was crucial for effective judgements to be made (Jones-Devitt & Smith 2007: 3; Daly 1998: 324). According to Daly (1998: 324), Dewey was the author *of How we Think* and *Quest for Certainty* in which he described his own ideas on how we think as well as how critical thinking can be applied to real-world problems (Denardo 2003: 14; Rodgers 2002: 842–866). Dewey emphasised the importance of reflective thinking which is a systematic and orderly way of thinking (Rodgers 2002: 842–866). After Dewey, various persons have attempted to define and interpret critical thinking (Daly 1998: 324–325).<br><br>Other individuals that also made great contributions during the 20th century towards critical thinking development were Ludwig Wittgenstein and Jean Piaget. Wittgenstein focussed on human thoughts and the analysis of concepts while Piaget made people aware of the need for critical thinking development which is able to reason within multiple perspectives (Paul & Elder 1997: 2–3). Norris (2011: 19) credits Sumner, Dewey, Wittgenstein and Piaget for the development of critical thinking and human thought, with their specific focus on education, during this period.<br><br>The aviation industry started focusing on critical thinking of human pilots during the 1980s as it started experimenting with aircraft's autopilot functions. It was soon realised that the autopilot functions could not replace human critical thinking during emergency situations. Hubert Dreyfus and Stuart Dreyfus authored *Mind over Machine: The power of human intuition and expertise in the era of the computer* in 1986 in this regard (Rubenfeld & Scheffer 2015: 29–33).<br><br>It was also during this period that the nursing profession started focusing on critical thinking. Patricia Benner, a nursing theorist, wrote *From novice to expert: Power and excellence in nursing practice* in 1984 after collaboration with Dreyfus and Dreyfus. From the 1990s critical thinking became a major drive in nursing education (Rubenfeld & Scheffer 2015: 29–33).<br><br>As early as 1984, the accounting profession also started showing support for the development of critical thinking amongst other competencies. During 1984 the American Accounting Association' Executive Committee established a committee often referred to as the *Bedford Committee.* This committee published a paper in 1986, *Future Accounting Education: Preparing for the Expanding Profession,* in which the importance of the development of accounting students' thinking capabilities was specifically stressed (Marshall, Smith, Dombrowski & Garner 2012: 73–91; Deppe et al. 1991: 257–290).<br><br>The efficiency of accounting education came under the spotlight in 1989. The partners of the then eight largest international accounting firms issued the *Perspectives on Education: Capabilities for success in the Accounting Profession* paper in which required capabilities of accounting professionals were listed, including a list of intellectual skills (French & Coppage 2000: 69–73; Deppe et al. 1991: 257–290).<br><br>Critical thinking in education spread during the 1990s from an initial focus on schools to higher education (Rubenfeld & Scheffer 2015: 29–35). A first degree of expert consensus in the fields of philosophy, education, social science and physical science on the definition of critical thinking was reached through the Delphi study conducted by the American Philosophical Association (APA) in 1990 (Carter et al. 2015: 864; Rubenfeld & Scheffer 2015: 29–35; Facione 1990a: 1–18). |

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| | **Rubenfeld and Scheffer - Nursing Delphi study (2000s)** (Rubenfeld & Scheffer 2015: vii-371; Scheffer & Rubenfeld 2000: 352–359) | During 1990 the Accounting Education Change Commission requested accounting educators to research methods that could be used to develop students' critical thinking (Bierstaker et al. 2015: 21–36). A need for change from knowledge-based to a competency-based approach in the accounting profession was highlighted as early as 1994 by the International Federation of Accountants' (IFAC) discussion paper *2000 and beyond: A strategic framework for prequalification education for the accountancy profession in the year 2000 and beyond* (Streng 2011: 25; International Federation of Accountants 1994: 1–26). This view was supported by Albrecht and Sack (2000: 43–58) who viewed a change in accounting education imperative for the survival of the profession. In the research conducted by Albrecht and Sack (2000: 43–58), educators and practitioners rated critical thinking specifically, as one of the most important skills to be developed in accounting education.<br><br>The APA's definition of critical thinking has been widely used in the nursing profession (Rubenfeld & Scheffer 2015: 29–35). A similar Delphi study was, however, conducted during a three-year study by Rubenfeld and Scheffer, hereafter referred to as the Nursing Delphi study, to develop a nursing-specific definition and conceptualisation of critical thinking. This study included a panel of 55 nursing experts from practice, education and research from various countries (Rubenfeld & Scheffer 2015: 29–35; Scheffer & Rubenfeld 2000: 352–359). |

**Source:** Author

## Critical thinking cognitive skills

## ANNEXURE D

| Core cognitive skill<br>(Facione 1990a: 2–11) | APA consensus description of cognitive skill<br>(Facione 1990a: 2–11) | Sub-skills related to cognitive skill<br>(Facione 1990a: 2–11) |
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| **<u>APA's Delphi report consensus statement:</u>**<br><br>**We understand critical thinking to be purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation and inference, as well as explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgement is based** (Facione 1990a: 2). | | |
| **Interpretation** | **To comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgements, conventions, beliefs, rules, procedures or criteria.** | **Categorisation:**<br>• To apprehend or appropriately formulate categories, distinctions or frameworks for understanding, describing or characterising information; and<br>• To describe experiences, situations, beliefs, events, etc. so that they take on comprehensible meanings in terms of appropriate categorisations, distinctions or frameworks.<br>*For example: to recognise a problem and define its character without prejudice to inquiry; to determine a useful way of sorting and sub-classifying information; to make an understandable report of what one experienced in a given situation; to classify data, findings or opinions using a given classification schema.*<br><br>**Decoding significance**<br>• To detect, attend to and describe the informational content, affective purport, directive functions, intentions, motives, purposes, social significance, values, views, rules, procedures, criteria or inferential relationships expressed in convention-based communication systems, such as in language, social behaviours, drawings, numbers, graphs, tables, charts, signs and symbols.<br>*For example: to detect and describe a person's purposes in asking a given question; to appreciate the significance of a particular facial expression or gesture used in a given social situation; to discern the use of irony or rhetorical questions in debate; to interpret the data displayed or presented using a particular form of instrumentation.*<br><br>**Clarifying meaning**<br>• To paraphrase or make explicit, through stipulation, description, analogy or figurative expression, the contextual, conventional or intended meanings of words, ideas, concepts, statements, behaviours, drawings, numbers, signs, charts, graphs, symbols, rules, events or ceremonies; and<br>• To use stipulation, description, analogy or figurative expression to remove confusing, unintended vagueness or ambiguity or to design a reasonable procedure for so doing.<br>*For example: to restate what a person said using different words or expressions while preserving that person's intended meanings; to find an example which helps explain something to someone; to develop a distinction which makes clear a conceptual difference or removes a troublesome ambiguity.* |
| **Analysis** | **To identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express beliefs, judgements, experiences, reasons, information or opinions.** | **Examining ideas:**<br>• To determine the role various expressions play or are intended to play in the context of argument, reasoning or persuasion;<br>• To define terms;<br>• To compare or contrast ideas, concepts or statements; and |

| Core cognitive skill (Facione 1990a: 2–11) | APA consensus description of cognitive skill (Facione 1990a: 2–11) | Sub-skills related to cognitive skill (Facione 1990a: 2–11) |
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| | | • To identify issues or problems and determine their component parts and also to identify the conceptual relationships of those parts to each other and to the whole.<br>*For example: to identify a phrase intended to trigger a sympathetic emotional response which might induce an audience to agree with an opinion; to examine closely related proposals regarding a given problem and to determine their points of similarity and divergence; given a complicated assignment, to determine how it might be broken up into smaller, more manageable tasks; to define an abstract concept.*<br><br>**Detecting arguments:**<br>• Given a set of statements, descriptions, questions or graphic representations, to determine whether or not the set expresses or is intended to express, a reason or reasons in support of or contesting some claim, opinion or point of view.<br>*For example, given a paragraph, determine whether a standard reading of that paragraph in the context of how and where it is published, would suggest that it presents a claim as well as a reason or reasons in support of that claim; given a passage from a newspaper editorial, determine if the author of that passage intended it as an expression of reasons for or against a given claim or opinion; given a commercial announcement, identify any claims being advanced along with the reasons presented in their support.*<br><br>**Analysing arguments:**<br>• Given the expression of a reason or reasons intended to support or contest some claim, opinion or point of view, to identify and differentiate: (a) the intended main conclusion, (b) the premises and reasons advanced in support of the main conclusion, (c) further premises and reasons advanced as backup or support for those premises and reasons intended as supporting the main conclusion, (d) additional unexpressed elements of that reasoning, such as intermediary conclusions, unstated assumptions or presuppositions, (e) the overall structure of the argument or intended chain of reasoning and (f) any items contained in the body of expressions being examined which are not intended to be taken as part of the reasoning being expressed or its intended background.<br>*For example: given a brief argument, paragraph-sized argument or a position paper on a controversial social issue, to identify the author's chief claim, the reasons and premises the author advances on behalf of that claim, the background information used to support those reasons or premises and crucial assumptions implicit in the author's reasoning; given several reasons or chains of reasons in support of a particular claim, to develop a graphic representation which usefully characterises the inferential flow of that reasoning.* |
| **Evaluation** | **To assess the credibility of statements or other representations which are accounts or descriptions of a person's perception, experience, situation, judgement, belief or opinion; and to assess the logical strength of the actual or intend inferential relationships among statements, descriptions, questions or other forms of representation.** | **Assessing claims:**<br>• To recognise the factors relevant to assessing the degree of credibility to ascribe to a source of information or opinion;<br>• To assess the contextual relevance of questions, information, principles, rules or procedural directions; and<br>• To assess the acceptability, the level of confidence to place in the probability or truth of any given representation of an experience, situation, judgement, belief or opinion.<br>For example: to recognise the factors which make a person a credible witness regarding a given event or credible authority on a given topic; to determine if a given principle of conduct is applicable to deciding what to do in a given situation; to determine if a given claim is likely to be true or false based on what one knows or can reasonably find out. |

| **Core cognitive skill** (Facione 1990a: 2–11) | **APA consensus description of cognitive skill** (Facione 1990a: 2–11) | **Sub-skills related to cognitive skill** (Facione 1990a: 2–11) |
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| | | **Assessing arguments:**<br>• To judge whether the assumed acceptability of the premises of a given argument justify one's accepting as true (deductively certain) or very probably true (inductively justified), the expressed conclusion of that argument;<br>• To anticipate or to raise questions or objections and to assess whether these point to significant weakness in the argument being evaluated;<br>• To determine whether an argument relies on false or doubtful assumptions or presuppositions and then to determine how crucially these affect its strength;<br>• To judge between reasonable and fallacious inferences;<br>• To judge the probative strength of an argument's premises and assumptions with a view toward determining the acceptability of the argument;<br>• To determine and judge the probative strength of an argument's intended or unintended consequences with a view toward judging the acceptability of the argument; and<br>• To determine the extent to which possible additional information might strengthen or weaken an argument.<br>*For example: given an argument to judge if its conclusion follows either with certainty or with a high level of confidence from its premises; to check for identifiable formal and informal fallacies; given an objection to an argument to evaluate the logical force of that objection; to evaluate the quality and applicability of analogical arguments; to judge the logical strength of arguments based on hypothetical situations or causal reasoning; to judge if a given argument is relevant or applicable or has implications for the situation at hand; to determine how possible new data might lead logically to the further confirmation or disconfirmation of a given opinion.* |
| **Inference** | **To identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to educe the consequences flowing from data, statements, principles, evidence, judgements, beliefs, opinions, concepts, descriptions, questions or other forms of representation.** | **Querying evidence:**<br>• In particular, to recognise premises which require support and to formulate a strategy for seeking and gathering information which might supply that support; and<br>• In general, to judge that information relevant to deciding the acceptability, plausibility or relative merits of a given alternative, question, issue, theory, hypothesis or statement is required and to determine plausible investigatory strategies for acquiring that information.<br>*For example: when attempting to develop a persuasive argument in support of one's opinion, to judge what background information it would be useful to have and to develop a plan which will yield a clear answer as to whether or not such information is available; after judging that certain missing information would be germane in determining if a given opinion is more or less reasonable than a competing opinion, to plan a search which will reveal if that information is available.*<br><br>**Conjecturing alternatives:**<br>• To formulate multiple alternatives for resolving a problem, to postulate a series of suppositions regarding a question, to project alternative hypotheses regarding an event, to develop a variety of different plans to achieve some goal; and<br>• To draw out presuppositions and project the range of possible consequences of decisions, positions, policies, theories or beliefs.<br>*For example: given a problem with technical, ethical or budgetary ramifications, to develop a set of options for addressing and resolving that problem; given a set of priorities with which one may or may not agree, to project the difficulties and the benefits which are likely to result if those priorities are adopted in decision-making.*<br><br>**Drawing conclusions:**<br>• To apply appropriate modes of inference in determining what position, opinion or point of view one should take on a given matter or issue; |

| **Core cognitive skill** (Facione 1990a: 2–11) | **APA consensus description of cognitive skill** (Facione 1990a: 2–11) | **Sub-skills related to cognitive skill** (Facione 1990a: 2–11) |
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| | | • Given a set of statements, descriptions, questions or other forms of representation, to educe, with the proper level of logical strength, their inferential relationships and the consequences or the presuppositions which they support, warrant, imply or entail;<br>• To employ successfully various sub-species of reasoning, as for example to reason analogically, arithmetically, dialectically, scientifically, etc.; and<br>• To determine which of several possible conclusions is most strongly warranted or supported by the evidence at hand or which should be rejected or regarded as less plausible by the information given.<br>*For example: to carry out experiments and to apply appropriate statistical inference techniques in order to confirm or disconfirm an empirical hypothesis; given a controversial issue to examine informed opinions, consider various opposing views and the reasons advanced for them, gather relevant information and formulate one's own considered opinion regarding that issue; to deduce a theorem from axioms using prescribed rules of inference.* |
| **Explanation** | **To state the results of one's reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological and contextual considerations upon which one's results were based; and to present one's reasoning in the form of cogent arguments.** | **Stating results:**<br>• To produce accurate statements, descriptions or representations of the results of one's reasoning activities so as to analyse, evaluate, infer from or monitor those results.<br>*For example: to state one's reasons for holding a given view; to write down for one's own future use one's current thinking about an important or complex matter; to state one's research findings; to convey one's analysis and judgement regarding a work of art; to state one's considered opinion on a matter of practical urgency.*<br><br>**Justifying procedures:**<br>• To present the evidential, conceptual, methodological, criteriological and contextual considerations which one used in forming one's interpretations, analyses, evaluation or inferences, so that one might accurately record, evaluate, describe or justify those processes to one's self or to others or so as to remedy perceived deficiencies in the general way one executes those processes.<br>*For example: to keep a log of the steps followed in working through a long or difficult problem or scientific procedure; to explain one's choice of a particular statistical test for purposes of data analysis; to state the standards one used in evaluating a piece of literature; to explain how one understands a key concept when conceptual clarity is crucial for further progress on a given problem; to show that the prerequisites for the use of a given technical methodology have been satisfied; to report the strategy used in attempting to make a decision in a reasonable way; to design a graphic display which represents the quantitative or spatial information used as evidence.*<br><br>**Presenting arguments:**<br>• To give reasons for accepting some claim; and<br>• To meet objections to the method, conceptualisations, evidence, criteria or contextual appropriateness of inferential, analytical or evaluative judgements.<br>*For example: to write a paper in which one argues for a given position or policy; to anticipate and to respond to reasonable criticisms one might expect to be raised against one's political views; to identify and express evidence and counter-evidence intended as a dialectical contribution to one's own or another person's thinking on a matter of deep personal concern.* |
| **Self-regulation** | **Self-consciously to monitor one's cognitive activities, the elements used in those activities and the results educed, particularly by applying skills in analysis and evaluation to one's own** | **Self-examination:**<br>• To reflect on one's own reasoning and verify both the results produced and the correct application and execution of the cognitive skills involved;<br>• To make an objective and thoughtful metacognitive self-assessment of one's opinions and reasons for holding them; |

| **Core cognitive skill** (Facione 1990a: 2–11) | **APA consensus description of cognitive skill** (Facione 1990a: 2–11) | **Sub-skills related to cognitive skill** (Facione 1990a: 2–11) |
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| | **inferential judgments with a view toward questioning, confirming, validating or correcting either one's reasoning or one's results.** | • To judge the extent to which one's thinking is influenced by deficiencies in one's knowledge or by stereotypes, prejudices, emotions or any other factors which constrain one's objectivity or rationality; and<br>• To reflect on one's motivations, values, attitudes and interests with a view toward determining that one has endeavoured to be unbiased, fair-minded, thorough, objective, respectful of the truth, reasonable and rational in coming to one's analyses, interpretations, evaluations, inferences or expressions.<br>*For example: to examine one's views on a controversial issue with sensitivity to the possible influences of one's personal bias or self-interest; to review one's methodology or calculations with a view to detecting mistaken applications or inadvertent errors; to reread sources to assure that one has not overlooked important information; to identify and review the acceptability of the facts, opinions or assumptions one relied on in coming to a given point of view; to identify and review one's reasons and reasoning processes in coming to a given conclusion.*<br><br>**Self-correction:**<br>• Where self-examination reveals errors or deficiencies, to design reasonable procedures to remedy or correct, if possible, those mistakes and their causes.<br>*For example: given a methodological mistake or factual deficiency in one's work, to revise that work so as to correct the problem and then to determine if the revisions warrant changes in any position, findings or opinions based thereon.* |

**Source:** (Facione 1990a: 2–11) **-** adapted

## Standardised critical thinking measurement instruments ANNEXURE E

| Standardised measurement | Description and characteristics |
|---|---|
| **Cornell Critical Thinking Test (CCTT)** | The CCTT was developed by Ennis to measure critical thinking ability. The CCTT-X produces a total score and four scale scores for induction, deduction, credibility and identification of assumptions. The test could be a 50-minute timed evaluation or an untimed evaluation. The test includes 71 multiple choice questions (The critical thinking co. 2016: 1) The CCTT-X utilises a story approach for assessing critical thinking ability. Each question in the test has three response options with only one option being correct. Each correct response is assigned one point (Kwan & Wong 2014: 197). |
| **California Critical Thinking Skills Test (CCTST)** | The CCTST is based on the APA's Delphi study's definition of critical thinking. It is considered the leading critical thinking skills test. It is widely used internationally, particularly in the United States, to measure critical thinking skills in graduate students, executive level adult populations and undergraduate students in all fields. Various versions exist that cater for specific professional fields which include health sciences, business, law as well as military and defence. It is considered to be a discipline-neutral measure. The CCTST is ideal for educational settings where it can be used to evaluate critical thinking skills of students, for learning outcomes assessment, programme evaluation and research purposes (California Academic Press 2016a: 1). Rubenfeld and Scheffer (2015: 287–288) note that this tool is widely used in research studies and educational settings across disciplines across the world.<br><br>The CCTST uses multiple choice items linked to everyday scenarios. These questions range in difficulty and complexity. Information presented in the scenario range from text, charts and images. They are aimed to engage the participant's reasoning skills. The test generally takes 45-50 minutes to complete. The CCTST measures the following skills: analysis, evaluation, inference, deduction, induction and overall reasoning skills. The test is available in an application format, in a browser-based format, online or in paper format. The online version includes a CCTST numeracy test which is a measurement of a participant's quantitative reasoning skills. Individual and group scores are provided in a report. Benchmarks are also provided against a variety of pre-selected external comparison or norm groups. A test manual is provided on how to interpret individual and group results (California Academic Press 2016a: 1).<br><br>A Kuder-Richardson (KR-20) estimate of internal consistency of r=0.70 is reported in the test manual. A maximum total score of 34 can be achieved. A score of 24 or higher is an indication of very strong critical thinking skills. A score between 13 and 23 is an indication of a medium score. Scores of 12 and below indicate great weaknesses in critical thinking skills (Carter et al. 2015: 866). Critical thinking involves both skills and dispositions. It is thus advised to use the CCTST to measure the skills and the CCTDI to measure dispositions (California Academic Press 2016a: 1). |
| **California Critical Thinking Disposition Inventory (CCTDI)** | The CCTDI is based on the APA's Delphi study expert definition of critical thinking and the ideal critical thinker. It has been utilised internationally, especially in the United States. The CCTDI is considered the leading critical thinking dispositions test and is intended for use with the general adult population. It can be used at all levels and students in grades 10 and above (including undergraduates, professional school students and graduate students). A high score on this test indicates the participant's strong willingness to apply his or her critical thinking skills (California Academic Press 2016b: 1). Rubenfeld and Scheffer (2015: 287–288) note that this tool is widely used in research studies and educational settings across disciplines across the world.<br><br>The CCTDI is in the form of a Likert-type instrument with agree or disagree answers to certain statements. The test takes approximately 20-30 minutes to complete. Seven dispositions are measured with this test, namely: 'an individual's capacity to learn and to effectively apply critical thinking skills: the disposition toward truth-seeking or bias, toward open-mindedness or intolerance, toward anticipating possible consequences or being heedless of them, toward proceeding in a systematic or unsystematic way, toward being confident in the powers of reasoning or mistrustful of thinking, toward being inquisitive or resistant to learning and toward mature and nuanced judgement or toward rigid simplistic thinking'. The test is available online or in paper |

| Standardised measurement | Description and characteristics |
|---|---|
| | format. Individual and group scores are provided in a report. Benchmarks are also provided against a variety of pre-selected external comparison or norm groups. A test manual is provided on how to interpret individual and group results (California Academic Press 2016b: 1).<br><br>A Cronbach's alpha of 0.90 for the overall instrument and 0.71 to 0.80 for the seven subscales are acceptable ranges. The maximum score is 60 in each domain and a negative disposition is a score below 30. The total maximum score is 420 points. Scores above 350 indicate a high critical thinking disposition. Total scores below 280 indicate paucity of critical thinking (Carter et al. 2015: 866). |
| **Watson-Glaser Critical Thinking Appraisal (WGCTA)** | The WGCTA dates back to 1925 where it was designed to measure critical thinking skills. It has since been used by organisations and academics to measure the gains in the development of critical thinking as a result of instructional interventions, coursework or programmes. The WGCTA II, which is an updated version, consists of two 40-multiple choice item forms that can be administered in approximately 40 minutes. Each WGCTA II subtest comprises scenarios with problems, statements, arguments and interpretations related to real-life situations. These scenarios are followed by certain items to which the participant has to respond. The WGCTA II introduced the RED model which measures a participants ability to recognise assumptions, evaluate arguments and draw conclusions (Watson & Glaser 2010). In terms of psychometric testing reliability is reported to be higher than 0.80. Using the Spearmen–Brown formula, reliability for the total score of this tool was established at 0.77. The test takes approximately 40-50 minutes to complete (Carter et al. 2015: 866). |
| **Health Sciences Reasoning Test (HSRT)** | The HSRT is specifically aimed at measuring critical thinking skills in trainees in health sciences educational programmes (undergraduate and graduate) as well as professional health science practitioners. It is a multiple-choice type format which takes approximately 50 minutes to complete. Test items range in difficulty and complexity. Test items require no health science knowledge. The HSRT measures certain critical skills which include analysis, inference, evaluation, induction and deduction. The online HSRT-Numeracy measures quantitative reasoning. The test is available online or in paper format. Individual and group scores are provided in a report. Benchmarks are also provided against a variety of pre-selected external comparison or norm groups. A test manual is provided on how to interpret individual and group results (California Academic Press 2016c: 1).<br><br>The maximum score is 33. An overall score of 25 or above indicates strong critical thinking skills while a score of 14 or below indicates serious weaknesses in critical thinking skills. A score between 15 and 24 is considered a medium score. Internal consistency (Kuder-Richardson-20) ranges from 0.77 to 0.84 with an overall internal consistency of 0.81. A KR-20 above 0.70 is an indication of acceptable internal consistency (Cone et al. 2016: 2; Allaire 2015: 1086; Carter et al. 2015: 866).<br><br>Critical thinking involves both skills and dispositions. It is thus advised to use the CCTST to measure the skills and the CCTDI to measure dispositions (California Academic Press 2016c: 1). |
| **Ennis-Weir Critical Thinking Essay Test** | This measurement requires participants to read a letter to the editor of a fictional newspaper. The letter holds various reasoning inaccuracies and the participants are then required to write an essay building their own response based on this. This essay test is commercially available and tests general critical thinking skills. The proposed level of participant is high school and higher education students (college students). The test takes approximately 40 minutes to administer (Reed 1998: 59; Ennis & Weir 1985: 1–14). |

**Source:** Author

## MAIN MODELS OF STUDENT LEARNING STYLES — ANNEXURE F

| Model | Student learning styles or type of learner |
|---|---|
| **The Honey-Mumford model** | • **Activists:** Students who prefer to learn by doing rather than by reading or listening. Like to work in groups and share ideas, not interested in planning, do not like repetition. Are often open-minded and enthusiastic.<br>• **Reflectors:** Usually stand back and observe. Collect information before making decisions and look at the big picture. Slow to decide due to long data collection and analysis process. Their decisions are, however, based on sound considerations.<br>• **Theorists:** Adapt and integrate own observations into frameworks to make connections. New learning is added to existing frameworks after careful consideration to see where it fits in. Tidy and well-organised thoughts. Not comfortable with subjective or ambiguous ideas. Usually sound in approaches to problem-solving with logical steps.<br>• **Pragmatists:** Keen to find new ideas but find practical implications of new ideas or theories before judging their value. Very comfortable in problem-solving situations. |
| **Neuro-linguistic programming** | • **Visual learners:** Prefer learning by seeing. Good visual recall and prefer for information to be presented visually. Diagrams, graphs, maps, posters and displays are examples of visuals that work well with these learners.<br>• **Auditory learners:** Prefer learning by listening. Good auditory memory and prefer discussions, lectures, interviews, listening to stories and audio tapes. Prefer sequence and repetition as well as summaries.<br>• **Kinaesthetic learners:** Prefer learning by doing. Good at recalling events and associated physical experiences with memory. Prefer physical activity, field trips, working with objects and practical experiences. |
| **The Myers-Briggs model (Myers-Briggs Type Indicator instrument)** | • **Extrovert learners:** Prefer talking to understand information, working in groups, seeing results, trying things and thinking about it later. Learn best when working with others and trying something themselves as opposed to watching and listening.<br>• **Introvert learners:** Prefer studying alone, listening to others talk and thinking about information in private, thinking about something before trying it, listening, observing, writing and reading.<br>• **Sensing learners:** Prefer to have clear goals, careful planning and attention to detail. Prefer using computers, watch films and other ways of seeing, hearing and touching what they learn.<br>• **Intuitive learners:** Prefer reading and listening, problem-solving that requires imagination, variety, big ideas and new projects. Imaginative, creative and prefer following instincts. |

| Model | Student learning styles or type of learner |
|---|---|
| | • **Thinking learners:** Prefer to be treated fairly, like educators who are organised, need to feel a sense of achievement and skill, clear thinking when solving problems, clear and logic direction. Prefer limited time to complete work and to put information in logical order.<br>• **Feeling learners:** Prefer to have friendly relationship with educator, learn by helping others and want to get along with others. Work well in groups and prefer tasks with which they have personal connections.<br>• **Judging learners:** Prefer to have a plan, work in orderly way, finish projects, take learning seriously and know exactly what is expected of them.<br>• **Perceiving learners:** Open to new experiences in learning, prefer to have choices, are flexible, want learning to be fun and like to discover new information. |
| **Kolb's Learning Style Inventory** | • **Diverging (concrete, reflective):** Prefer to learn by observation, brainstorming and obtaining information. Seek explanations. Are imaginative and sensitive.<br>• **Assimilating (abstract, reflective):** Respond well to information in an organised, logical manner. Need time for reflection. Prefer to put information in concise and logical order using reflective observation.<br>• **Converging (abstract, active):** Respond well to having opportunities to work actively. Prefer to learn by trial and error. Prefer to solve problems and performing technical tasks.<br>• **Accommodating (concrete, active):** Prefer to apply new material in problem-solving situations. Are people-orientated and hands-on students. Prefer feelings rather than logic. |
| **The Felder-Silverman model** | • **Sensing learners:** Prefer concrete, practical, factual information; **Intuitive learners:** prefer the conceptual, are innovative and prefer theories and meanings.<br>• **Visual learners:** Prefer visual representations or material (pictures, diagrams, flowcharts); **Verbal learners:** prefer written and spoken explanations.<br>• **Active learners:** Learn by trying things and working with others OR **Reflective learners:** Learn by thinking things through and working alone.<br>• **Sequential learners:** Prefer to work in a linear and orderly fashion. Learn in small steps OR **Global learners:** Prefer to take a holistic view and learn by taking large steps forward. |

**Source:** (Pritchard 2014: 48–56) - adapted

**Participant information sheet** **ANNEXURE G**

UNISA college of accounting sciences
*Excellence in accountancy*

Department of Financial Governance

School of Accounting Sciences

*Excellence in accountancy*

**PARTICIPANT INFORMATION SHEET: PROFESSIONAL SUBJECT MATTER EXPERT**

**TITLE:** A technology-based educational intervention aimed at developing critical thinking in auditing students

**DATE:** 16 January 2017

Dear Prospective Participant

My name is Mrs Alet Terblanche from the Department of Financial Governance at the University of South Africa. I am inviting you to participate in a study entitled "A technology-based educational intervention aimed at developing critical thinking in students".

**AIM/PURPOSE OF THE STUDY**

There is an increasing expectation gap between the skills with which graduates are actually equipped with and that which potential employers expect. Many employers emphasise the importance of newly hired employees already having certain critical thinking capabilities. Evidence, however, indicates that most students' critical thinking capabilities are still considered inadequate as they are not being taught to be critical thinkers. This is also true in South Africa where there is a growing need for critical thinking in chartered accountancy graduates. Advances in Information and Communication Technologies (ICTs) should be utilised to support teaching in the 21$^{st}$ century as they could provide the platforms for the development of students' critical thinking. This project attempts to close the expectation gap in terms of critical thinking by examining how a technology-based educational intervention can be employed to facilitate critical thinking development in auditing students. This project aims to determine the knowledge, skills/abilities, dispositions/habits of the mind that students require for critical thinking development as well as the knowledge, pedagogies, learning theories, design characteristics and instructional design features that are required for a technology-based educational intervention aimed at developing critical thinking in auditing students.

**WHO CAN PARTICIPATE IN THE RESEARCH PROJECT?**

Professionals with knowledge pertaining to online learning environments as well as higher education in the 21st century (technologies and pedagogies). The research project requires 10 to 15 of these professionals for purposes of this focus group discussion.

**WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?**

The study requires participation in a three-hour focus group with possibly a follow up semi-structured interview, should it be required. The interview will be scheduled after the focus group and will require approximately 1 hour. The focus groups and interviews will be recorded for accuracy of data analysis. Participants will be asked about their perceptions pertaining to a technology-based educational intervention aimed at developing critical thinking in students.

**CAN I WITHDRAW FROM THIS STUDY?**

Being in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason.

**WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?**

This project forms part of a larger study (PhD study) which will provide a theoretical contribution in terms of an evaluation framework that could serve as guidance for educators when they are designing, developing and evaluating educational interventions that are aimed at the development of critical thinking in auditing students. The evaluation framework could also provide educators with practical criteria and design aids when critical thinking educational interventions are being designed and developed. There will also be a practical contribution in the form of a technology-based educational intervention with the purpose of developing critical thinking in auditing students in an e-learning environment. This intervention could lay the foundation for future implementation in auditing courses at SAICA accredited programme providers as well as auditing courses internationally with the purpose of developing auditing students' critical thinking capabilities in e-learning environments.

**WHAT IS THE ANTICIPATED INCONVENIENCE OF TAKING PART IN THIS STUDY?**

Participants will be out of the office for several hours, which may cause some inconvenience.

**WILL WHAT I SAY BE KEPT CONFIDENTIAL?**

While every effort will be made by the researcher to ensure that you will not be connected to the information that you share during the focus group, I cannot guarantee that other participants in the focus group will treat information confidentially. I shall, however, encourage all participants to do so. Information obtained during the interviews will only be seen by the researcher and the research support personnel of the research project. In reporting data pseudonyms will be used for any places, names or events that could be linked to the participant.

**HOW WILL INFORMATION BE STORED AND ULTIMATELY DESTROYED?**

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard on the premises of Mrs Alet Terblanche. For future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Paper-based documents will be shredded after the period of five years and electronic data will be permanently deleted from the hard drive of the researcher.

**HAS THE STUDY RECEIVED ETHICAL APPROVAL?**

This study has received written approval from the Research Ethics Committee of the College of Accounting Sciences, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

**HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS?**

Participants will be informed via e-mail communication. Should you require any further information or want to contact the researcher about any aspect of this study, please call or email me at 082 565 9096 or terbleaj@unisa.ac.za.

Thank you for taking time to read this information sheet and for participating in this study.

Kind regards

**Mrs Alet Terblanche**

DEPARTMENT OF FINANCIAL GOVERNANCE

**Invitation letter to participants** **ANNEXURE H**

DEPARTMENT OF FINANCIAL GOVERNANCE

**INVITATION TO PARTICIPANTS**

**Title of the study**

*A technology-based educational intervention aimed at developing critical thinking in auditing students*

Research conducted by:

Mrs Alet Terblanche (personnel number 90160649)

Cell: 082 565 9096

Dear Participant

Thank you for your willingness to participate in my academic research study with the purpose of the study being the gathering of information to obtain clarity on a technology-based educational intervention aimed at developing critical thinking in auditing students. Your time is very valuable and therefore I am grateful for your kind participation in this project.

This email serves as a reminder of the date and also communicates the logistics of the focus group. I have planned the facilitation of this focus group meeting to be as efficient as possible.

**The focus group interview:**

Date: To be confirmed

Time: 09h00 to 12h00 ***(Refreshments will be provided but if you have any dietary requirements, please inform me thereof)***

Venue: Tax Chambers, Unisa Main Campus (see attached map for details).

**Planned participation involvement:**

- Attend a focus group meeting on (date to be confirmed) at 09h00. No preparation is necessary.
- After the initial focus group meeting, I will articulate the findings of the meeting by e-mail in order for you to provide me with further feedback on these findings.
- Lastly, I may request your time for a short follow-up interview, if further information is required from you.

▪ Please note that your responses during the focus group meeting will be used in aggregate with the responses of the other participants. Your identity will remain anonymous.

▪ The results of the study will be used for academic purposes only and may be published in an academic journal. We will provide you with a summary of our findings on request.

It is of the utmost importance that you send me your vehicle registration number before (date to be confirmed). This will ensure that there are no problems when you enter the gate and that you have reserved parking on campus.

If you have any further enquiries or questions regarding the focus group meeting you can contact me on my mobile phone: 082 565 9096 or via e-mail: terbleaj@unisa.ac.za

Kind regards

**Mrs Alet Terblanche**

Department of Financial Governance

College of Accounting Sciences

UNISA

**Informed consent** **ANNEXURE I**

DEPARTMENT OF FINANCIAL GOVERNANCE

**INFORMED CONSENT**

**Title of the study**

*A technology-based educational intervention aimed at developing critical thinking in auditing students*

Research conducted by:

Mrs Alet Terblanche (personnel number 90160649)

Cell: 082 565 9096

Dear Participant

You are invited to participate in an academic research study conducted by Mrs Alet Terblanche, a researcher from the Department of Financial Governance at the University of South Africa. The purpose of the study is to gather clarity on a technology-based educational intervention aimed at developing critical thinking in auditing students.

Please note the following:

- Your participation in this study is very important to us. You may, however, choose not to participate and you may also stop participating at any time without any negative consequences.
- Please participate in this focus group with open-mindedness and honesty. This should not take more than 3 hours of your time.
- The results of the study will be used for academic purposes and may be published locally or internationally. The results of the study may also be considered for future research purposes. I will provide you with a summary of the findings on request.

Please sign the form to indicate that:

- You have read and understand the information provided above.
- You give your consent to participate in the study on a voluntary basis.

**Participant's signature** Date

**Researcher's signature** Date

Kind regards

**Mrs Alet Terblanche**

Department of Financial Governance

College of Accounting Sciences

UNISA

## Focus group information sheet ANNEXURE J

**Research question**

Thinking about a technology-based educational intervention to develop critical thinking in auditing students, what comes to mind?

**Aim/Purpose of the study**

There is an increasing expectation gap between the skills with which graduates are actually equipped with and that which potential employers expect. Many employers emphasise the importance of newly hired employees already having certain critical thinking capabilities. Evidence, however, indicates that most students' critical thinking capabilities are still considered inadequate as they are not being taught to be critical thinkers. This is also true in South Africa where there is a growing need for critical thinking in chartered accountancy graduates. Advances in Information and Communication Technologies (ICTs) should be utilised to support teaching in the 21st century as they could provide the platforms for the development of students' critical thinking.

This project attempts to close the expectation gap in terms of critical thinking by examining how a technology-based educational intervention can be employed to facilitate critical thinking development in auditing students. This project aims to determine the knowledge, skills/abilities, dispositions/habits of the mind that students require for critical thinking development as well as the knowledge, pedagogies, learning theories, design characteristics and instructional design features that are required for a technology-based educational intervention aimed at developing critical thinking in auditing students.

**Critical thinking definition for this study**

Critical thinking consists of a cognitive skills dimension and a dispositions dimension. The definition of critical thinking, as arrived at by the American Philosophical Association's (APA's) panel of experts, has been selected for purposes of this study.

The working definition of critical thinking as per the APA is set out as follows:

> *We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential,*

*conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. Critical thinking is essential as a tool of inquiry. As such, critical thinking is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, critical thinking is a pervasive and self-rectifying human phenomenon.*

*The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating good critical thinkers means working toward this ideal. It combines developing critical thinking skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society* (Facione 1990a: 2).

**Detailed Affinity Relationship Table – Group 1** **ANNEXURE K**

UNISA university of south africa

Department of Financial Governance

School of Accounting Sciences

*Excellence in accountancy*

18 April 2017

**TECHNOLOGY-BASED EDUCATIONAL INTERVENTION AIMED AT DEVELOPING CRITICAL THINKING IN AUDITING STUDENTS**

Dear participant

Your continuous support for my research is highly appreciated.

You are invited to participate in the final stage of this phase of the research project aimed at determining possible relationships between the themes/ideas/concepts/affinities that emerged from the focus group conducted on the 23rd of March 2017.

Your participation in this research project is voluntary and confidential. You will not be asked to reveal any information that will allow your identity to be determined.

If you are willing to participate in this study, please sign this letter as a declaration of your consent, i.e. that you participate in this project willingly and that you understand that you may withdraw from the research project at any time.

Participant's signature ................................................................ : Date:

Researcher's signature ................................................................ : Date:

Yours sincerely

Mrs Alet Terblanche

Department of Financial Governance

College of Accounting Sciences

UNISA

**TECHNOLOGY-BASED EDUCATIONAL INTERVENTION TO DEVELOP CRITICAL THINKING IN AUDITING STUDENTS**
**List of affinities, themes, ideas, concepts, etc. which emerged from the focus group**

**1 DESIGN PROCESS**
With this affinity the focus group emphasised the importance of the design process. Principles of quality design must be evaluated and followed. This intervention should be user-friendly and based on knowledge creation. Industry leaders in software design must be consulted. Applications, databases, software as well as new technologies should be repurposed regularly and customised for specific needs and purposes.

---

**2 ENABLING TOOLS**
With this affinity the focus group indicated the importance of enabling tools such as blogs, forums, wikis, podcasts, jingles, animation and photo captions. The group highlighted the principle that these tools only enable teaching and do not teach themselves.

---

**3 PURE SIMULATION**
The focus group indicated the significance of pure simulations. These pure simulations do not include gaming elements, yet include augmented reality, virtual reality and virtual worlds such as Second Life as examples of such interventions.

---

**4 GAMING FOR EDUCATION → GAMIFICATION**
With this affinity the focus group indicated the importance of using gaming principles for educational purposes. User-friendly, interactive games could provide effective platforms for the development of critical thinking in students. Within auditing, they proposed games of deception as well as role play where the aim is to distinguish between claims that are true and those that are false. Gaming principles also provide the opportunity for peer versus peer interaction/competition.

---

**5 SOFT SKILLS AND DISPOSITIONS**
Through this affinity the focus group identified several soft skills and dispositions that can be associated with critical thinking. They highlighted metacognition (thinking about one's thinking) and also noted empathy, ethical behaviour, intrinsic motivation, a positive attitude and good communication skills. Within auditing, the ability to assess a situation and ask the right questions, were seen as vital critical thinking skills.

---

**6 DISCIPLINE SPECIFIC SKILLS**
Through this affinity the focus group identified judgement as a core discipline specific skill and related it to making informed decisions. Other auditing specific skills noted were the ability to make constant critical comparisons, to be systematic, to be organised and to follow certain standards.

---

**7 LEARNING PROCESS**

With this affinity the focus group highlighted the importance of changing old ways of thinking and adapting current learning processes in order to address the growing gap between basic and higher education. Authentic learning takes place where knowledge is applied in real-life contexts and situations and vital within the development of critical thinking. The transferability and application of knowledge in different settings should be a focus point. Collaborative learning, information sharing, creative thinking, interactivity, student engagement, progressive enquiry, autodidactic learning as well as rhizomatic learning are all important. The group also indicated that the intervention should avoid didactic/rote learning and emphasised deep learning approaches, considering the locus of control.

**8 CHANGE IN PEDAGOGY**

With this affinity the focus group highlighted that most education fields including pedagogy, andragogy, heutagogy and paragogy have changed significantly over the last few years. In recent years the focus has shifted to students obtaining knowledge from peer students. The group raised the question of who teaches who and noted that the role of the educator has shifted significantly in recent years.

**9 MULTI-LINGUISTIC ENVIRONMENT**

The focus group indicated that the multi-linguistic environment within South Africa is an important aspect that should be considered. Cognisance should be taken of the language (first, second or third language) in which critical thinking is developed. Advanced machine translation software could be used to translate between languages in order to facilitate critical thinking within this environment. The group further noted that the power discourse within language should be considered.

**10 CROSS-FUNCTIONALITY**

The focus group highlighted that integration of interdisciplinary skills sets and collaboration between disciplines are important in the design of this educational intervention. Collaboration between information technology (IT) experts, educational technologists and academics is required when an interdisciplinary educational intervention is being designed as this allows for effective systems integration. Supportive infrastructure should also lay the foundation for such intervention.

**11 CHALLENGING CONVENTIONS**

The focus group stressed the importance of using dialectic methods to challenge conventional ways of teaching auditing students. Alternative frameworks should be developed to adapt to the changing landscape in the auditing profession. The group mentioned that auditors might not be naturally inclined to think critically as a result of current didactical educational practices. If the auditing profession is to address the current skills gap, the focus of teaching should not only be on teaching explicit knowledge (content knowledge) but should also be on the development of implicit knowledge which includes skills such as critical thinking. Conventions should also be challenged by paying attention to other nuances which include gender and racial differences, language barriers, to name only a few. All students should thus be empowered through this intervention.

**DETAILED AFFINITY (PRINCIPLE) RELATIONSHIP TABLE (DART)**

Please complete the attached table below by indicating what you think the direction of the relationship between two principles is. Use the principle descriptions that are supplied with this table to help you with this task.

For example:

If you think that 1 influences 2, then indicate 1 → 2
If you think that 2 influences 1, then indicate 1← 2
If you think that there is no relationship between 1 and 2, then indicate 1 < > 2.

**PLEASE NOTE: An arrow may only go in one direction. Although you may feel that the direction of the relationship can go both ways, you must indicate the direction you think illustrates the strongest or most important influence.**

**Example:**

An example of an IF/THEN statement in the case where 1 → 2 may look as follows:
*If principles of quality design are followed in the design of educational interventions, then enabling tools could provide more effective platforms for critical thinking development in students.*

**Below is the list of the principles you are requested to consider. Please also refer to the list of principle descriptions for completing the Detailed Affinity Relationship Table (DART) below. Remember that an arrow can go either left or right, but not in both directions.**

| **Principles** | **Possible relationships** |
|---|---|
| 1. Design process | If Principle 1 influences Principle 2 then: |
| 2. Enabling tools | |
| 3. Pure simulation | 1 → 2 |
| 4. Gaming for education – Gamification | |
| 5. Soft skills and dispositions | If Principle 2 influences Principle 1 then: |
| 6. Discipline specific skills | |
| 7. Learning process | 1 ← 2 |
| 8. Change in pedagogy | |
| 9. Multi-linguistic environment | If there is no relationship between principles: |
| 10. Cross-functionality | |
| 11. Challenging conventions | 1 < > 2 |

*Thank you for the time and effort that you are willing to put into this research project.*

| FOCUS GROUP 1 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Design process | 1 | | 2 | Enabling tools | |
| Design process | 1 | | 3 | Pure simulation | |
| Design process | 1 | | 4 | Gaming for education - Gamification | |
| Design process | 1 | | 5 | Soft skills and dispositions | |
| Design process | 1 | | 6 | Discipline specific skills | |
| Design process | 1 | | 7 | Learning process | |
| Design process | 1 | | 8 | Change in pedagogy | |
| Design process | 1 | | 9 | Multi-linguistic environment | |
| Design process | 1 | | 10 | Cross-functionality | |
| Design process | 1 | | 11 | Challenging conventions | |
| Enabling tools | 2 | | 3 | Pure simulation | |
| Enabling tools | 2 | | 4 | Gaming for education - Gamification | |

| FOCUS GROUP 1 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Enabling tools | 2 | | 5 | Soft skills and dispositions | |
| Enabling tools | 2 | | 6 | Discipline specific skills | |
| Enabling tools | 2 | | 7 | Learning process | |
| Enabling tools | 2 | | 8 | Change in pedagogy | |
| Enabling tools | 2 | | 9 | Multi-linguistic environment | |
| Enabling tools | 2 | | 10 | Cross-functionality | |
| Enabling tools | 2 | | 11 | Challenging conventions | |
| Pure simulation | 3 | | 4 | Gaming for education - Gamification | |
| Pure simulation | 3 | | 5 | Soft skills and dispositions | |
| Pure simulation | 3 | | 6 | Discipline specific skills | |
| Pure simulation | 3 | | 7 | Learning process | |
| Pure simulation | 3 | | 8 | Change in pedagogy | |

| FOCUS GROUP 1 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Pure simulation | 3 | | 9 | Multi-linguistic environment | |
| Pure simulation | 3 | | 10 | Cross-functionality | |
| Pure simulation | 3 | | 11 | Challenging conventions | |
| Gaming for education – Gamification | 4 | | 5 | Soft skills and dispositions | |
| Gaming for education – Gamification | 4 | | 6 | Discipline specific skills | |
| Gaming for education – Gamification | 4 | | 7 | Learning process | |
| Gaming for education – Gamification | 4 | | 8 | Change in pedagogy | |
| Gaming for education – Gamification | 4 | | 9 | Multi-linguistic environment | |
| Gaming for education – Gamification | 4 | | 10 | Cross-functionality | |
| Gaming for education - Gamification | 4 | | 11 | Challenging conventions | |

| FOCUS GROUP 1 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Soft skills and dispositions | 5 | | 6 | Discipline specific skills | |
| Soft skills and dispositions | 5 | | 7 | Learning process | |
| Soft skills and dispositions | 5 | | 8 | Change in pedagogy | |
| Soft skills and dispositions | 5 | | 9 | Multi-linguistic environment | |
| Soft skills and dispositions | 5 | | 10 | Cross-functionality | |
| Soft skills and dispositions | 5 | | 11 | Challenging conventions | |
| Discipline specific skills | 6 | | 7 | Learning process | |
| Discipline specific skills | 6 | | 8 | Change in pedagogy | |
| Discipline specific skills | 6 | | 9 | Multi-linguistic environment | |
| Discipline specific skills | 6 | | 10 | Cross-functionality | |
| Discipline specific skills | 6 | | 11 | Challenging conventions | |

| FOCUS GROUP 1 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Learning process | 7 | | 8 | Change in pedagogy | |
| Learning process | 7 | | 9 | Multi-linguistic environment | |
| Learning process | 7 | | 10 | Cross-functionality | |
| Learning process | 7 | | 11 | Challenging conventions | |
| Change in pedagogy | 8 | | 9 | Multi-linguistic environment | |
| Change in pedagogy | 8 | | 10 | Cross-functionality | |
| Change in pedagogy | 8 | | 11 | Challenging conventions | |
| Multi-linguistic environment | 9 | | 10 | Cross-functionality | |
| Multi-linguistic environment | 9 | | 11 | Challenging conventions | |
| Cross-functionality | 10 | | 11 | Challenging conventions | |

**Detailed Affinity Relationship Table – Group 2** **ANNEXURE L**

UNISA university of south africa

Department of Financial Governance

School of Accounting Sciences

*Excellence in accountancy*

18 April 2017

**TECHNOLOGY-BASED EDUCATIONAL INTERVENTION AIMED AT DEVELOPING CRITICAL THINKING IN AUDITING STUDENTS**

Dear participant

Your continuous support for my research is highly appreciated.

You are invited to participate in the final stage of this phase of the research project aimed at determining possible relationships between the themes/ideas/concepts/affinities that emerged from the focus group conducted on the 29th of March 2017.

Your participation in this research project is voluntary and confidential. You will not be asked to reveal any information that will allow your identity to be determined.

If you are willing to participate in this study, please sign this letter as a declaration of your consent, i.e. that you participate in this project willingly and that you understand that you may withdraw from the research project at any time.

Participant's signature ................................................................ : Date:

Researcher's signature .............................................................. : Date:

Yours sincerely

Mrs Alet Terblanche

Department of Financial Governance

College of Accounting Sciences

UNISA

**TECHNOLOGY-BASED EDUCATIONAL INTERVENTION TO DEVELOP CRITICAL THINKING IN AUDITING STUDENTS**
**List of affinities, themes, ideas, concepts, etc. which emerged from the focus group**

**1 LECTURER COMPETENCE**

With this affinity the focus group emphasised the importance of overall lecturer competence in the use of technology and staying up to date with technological advancements, thus being technologically savvy. Lecturers should also receive the necessary training and skills development enabling them to effectively use technology-based educational interventions. Lecturers furthermore need to act as facilitators and mentors of students within these interventions, as they see it as a completely different platform of teaching which students might not be familiar with.

**2 DIVERSE STUDENT PROFILE**

Through this affinity the focus group noted the importance of obtaining an understanding of the nature and diversity of the student body before developing educational interventions. A one-size-fits-all approach should not be followed, thus taking into account whether students have a residential (face-to-face) or a distance learning background. It should also not be assumed that all the younger generation students are technologically empowered, for students from rural areas might not have been exposed to technological advancements in the same way others have.

**3 STUDENT READINESS**

Through this affinity the focus group identified several challenges that may influence students' readiness when a technology-based educational intervention is introduced. Students might not 'buy in'/see the benefits of such intervention and/or show resistance to it. Students might lack the required reading skills or information technology (IT) skills required to effectively develop their critical thinking through such an intervention. Possible risks related to online exposure should be taken into account. In order to overcome some of these challenges, training should be provided to equip students with specific IT related skills.

**4 TECHNOLOGICAL CHALLENGES**

With this affinity the focus group identified various technological challenges that could be present when a technology-based educational intervention is introduced. Possible challenges include emerging problems during the initial implementation phase of the intervention; the university and its IT department that might lack sufficient resources/structures to successfully support the technology-based educational intervention; and how the effectivity of the intervention could be affected by students' lack of required resources to operate the intervention. The latter might include slow internet connections, internet downtime, a lack of personal computers and/or other required hardware.

**5 TECHNOLOGY ENABLERS**

With this affinity the focus group identified technology enablers (hardware and software tools/resources) that could facilitate the critical thinking development process in students. These enablers include the internet, Google, social media, data sources, CaseWare, computer assisted audit techniques (CAATs), ULink, advanced Excel, software applications (including various student-related applications), ipads, laptops, etc.

| | |
|---|---|
| **6** | **INTERVENTION METHODS**<br>With this affinity the focus group consider simulations, gamification and case studies as effective intervention methods for critical thinking development in students, where all could be provided through computer-based platforms. These intervention methods should contain real-life scenarios, case studies and examples to contextualise learning. Experiential learning principles and guidelines should also be considered. |
| **7** | **INTERACTIVE ENGAGEMENT**<br>With this affinity the focus group noted that communication, dialogue and discussions should form the foundation of an interactive learning environment where critical thinking is developed. This interactive engagement should not only take place between the lecturer and the student but also between the students themselves. Online interactive discussion forums, discussion groups, interactive communities and chat rooms all provide effective platforms for interactive engagement between these parties. Students should be encouraged to share their thoughts and ask questions on these interactive platforms which could provide them with real-time feedback. Connectivity between students can also be promoted by providing them with assignments/podcasts that require online feedback and discussions. |
| **8** | **TOOL DESIGN**<br>With this affinity the focus group indicated that the intervention design should be user-friendly with clear instructions and outcomes built into the software. The intervention should provide certain triggers which allow the students to progress through various levels of the learning process, as well as incorporating decision trees within the design. The intervention should enable students to reflect on their learning and should provide feedback to the student. Students should be exposed to technology-based educational interventions as early as possible, preferably from first year. |
| **9** | **LEARNING OUTCOMES**<br>With this affinity the focus group indicated that once a student has developed their critical thinking abilities through the intervention, they should be able to think out of the box and adapt their thinking in different situations to come up with solutions to problems. Other learning outcomes associated with critical thinking development include pervasive skills, problems solving abilities, discretionary thinking, reflecting on one's own thinking, the ability to identify and deal with ethical issues as well as the ability to interrogate information. The ability to know how to use and apply new technologies should also be included as an ultimate learning outcome. |
| **10** | **ETHICS**<br>With this affinity the focus group felt that ethical considerations should form an overarching theme in all aspects of critical thinking development, the design of educational interventions and in the use of technologies. Ethics are considered to be a pillar of the chartered accountancy profession and should drive the habits of the mind as well as the critical thinking skills of students. |
| **11** | **STAKEHOLDER ENGAGEMENT**<br>Through this affinity the focus group noted that there should be collaboration and engagement between academia, professional bodies and practice to identify the demands in the workplace, to remain relevant and to identify the best possibly ways of addressing current challenges in the profession. |

**12 GLOBALISATION**

With this affinity the focus group accentuated the importance of a continuous comparison with global/international approaches and best practices to enhance the development of students' critical thinking. A process of benchmarking technology-based educational interventions aimed at developing students' critical thinking with international standards should be in place.

**DETAILED AFFINITY RELATIONSHIP TABLE (DART)**

Please complete the attached table below by indicating what you think the direction of the relationship between two affinities is. Use the affinity descriptions that are supplied with this table to help you with this task.

For example:

If you think that 1 influences 2, then indicate 1 → 2
If you think that 2 influences 1, then indicate 1← 2
If you think that there is no relationship between 1 and 2, then indicate 1 < > 2.

**PLEASE NOTE: An arrow may only go in one direction. Although you may feel that the direction of the relationship can go both ways, you must indicate the direction you think illustrates the strongest or most important influence.**

**Example:**

An example of an IF/THEN statement in the case where 1 → 2 may look as follows:
*If lecturers receive the necessary training and skills development in the use of technology-based educational interventions, then they might be more empowered to develop interventions that take student diversities into account.*

**Below is the list of the affinities (themes, ideas, concepts, etc.) you are requested to consider. Please also refer to the affinity descriptions for completing the table below. Remember that an arrow can go either left or right, but not in both directions.**

| **Affinity** | **Possible affinities** |
|---|---|
| 1. Lecturer competence<br>2. Diverse student profile<br>3. Student readiness<br>4. Technological challenges<br>5. Technology enablers<br>6. Intervention methods<br>7. Interactive engagement<br>8. Tool design<br>9. Learning outcomes<br>10. Ethics<br>11. Stakeholder engagement<br>12. Globalisation | If affinity 1 influences affinity 2 then:<br><br>1 → 2<br><br>If affinity 2 influences affinity 1 then:<br><br>1 ← 2<br><br>If there is no relationship between affinities:<br><br>1 < > 2 |

*Thank you for the time and effort that you are willing to put into this research project.*

| FOCUS GROUP 2 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| **Affinity Pair Relationship** | | | | | **GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE** |
| Lecturer competence | 1 | | 2 | Diverse student profile | |
| Lecturer competence | 1 | | 3 | Student readiness | |
| Lecturer competence | 1 | | 4 | Technological challenges | |
| Lecturer competence | 1 | | 5 | Technology enablers | |
| Lecturer competence | 1 | | 6 | Intervention methods | |
| Lecturer competence | 1 | | 7 | Interactive engagement | |
| Lecturer competence | 1 | | 8 | Tool design | |
| Lecturer competence | 1 | | 9 | Learning outcomes | |
| Lecturer competence | 1 | | 10 | Ethics | |
| Lecturer competence | 1 | | 11 | Stakeholder engagement | |
| Lecturer competence | 1 | | 12 | Globalisation | |
| Diverse student profile | 2 | | 3 | Student readiness | |
| Diverse student profile | 2 | | 4 | Technological challenges | |

| FOCUS GROUP 2 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Diverse student profile | 2 | | 5 | Technology enablers | |
| Diverse student profile | 2 | | 6 | Intervention methods | |
| Diverse student profile | 2 | | 7 | Interactive engagement | |
| Diverse student profile | 2 | | 8 | Tool design | |
| Diverse student profile | 2 | | 9 | Learning outcomes | |
| Diverse student profile | 2 | | 10 | Ethics | |
| Diverse student profile | 2 | | 11 | Stakeholder engagement | |
| Diverse student profile | 2 | | 12 | Globalisation | |
| Student readiness | 3 | | 4 | Technologica l challenges | |
| Student readiness | 3 | | 5 | Technology enablers | |

| FOCUS GROUP 2 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| **Affinity Pair Relationship** | | | | | **GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE** |
| Student readiness | 3 | | 6 | Intervention methods | |
| Student readiness | 3 | | 7 | Interactive engagement | |
| Student readiness | 3 | | 8 | Tool design | |
| Student readiness | 3 | | 9 | Learning outcomes | |
| Student readiness | 3 | | 10 | Ethics | |
| Student readiness | 3 | | 11 | Stakeholder engagement | |
| Student readiness | 3 | | 12 | Globalisation | |
| Technological challenges | 4 | | 5 | Technology enablers | |
| Technological challenges | 4 | | 6 | Intervention methods | |
| Technological challenges | 4 | | 7 | Interactive engagement | |
| Technological challenges | 4 | | 8 | Tool design | |
| Technological challenges | 4 | | 9 | Learning outcomes | |
| Technological challenges | 4 | | 10 | Ethics | |
| Technological challenges | 4 | | 11 | Stakeholder engagement | |

| FOCUS GROUP 2 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Technological challenges | 4 | | 12 | Globalisation | |
| Technology enablers | 5 | | 6 | Intervention methods | |
| Technology enablers | 5 | | 7 | Interactive engagement | |
| Technology enablers | 5 | | 8 | Tool design | |
| Technology enablers | 5 | | 9 | Learning outcomes | |
| Technology enablers | 5 | | 10 | Ethics | |
| Technology enablers | 5 | | 11 | Stakeholder engagement | |
| Technology enablers | 5 | | 12 | Globalisation | |
| Intervention methods | 6 | | 7 | Interactive engagement | |
| Intervention methods | 6 | | 8 | Tool design | |
| Intervention methods | 6 | | 9 | Learning outcomes | |
| Intervention methods | 6 | | 10 | Ethics | |
| Intervention methods | 6 | | 11 | Stakeholder engagement | |
| Intervention methods | 6 | | 12 | Globalisation | |

| FOCUS GROUP 2 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Interactive engagement | 7 | | 8 | Tool design | |
| Interactive engagement | 7 | | 9 | Learning outcomes | |
| Interactive engagement | 7 | | 10 | Ethics | |
| Interactive engagement | 7 | | 11 | Stakeholder engagement | |
| Interactive engagement | 7 | | 12 | Globalisation | |
| Tool design | 8 | | 9 | Learning outcomes | |
| Tool design | 8 | | 10 | Ethics | |
| Tool design | 8 | | 11 | Stakeholder engagement | |
| Tool design | 8 | | 12 | Globalisation | |
| Learning outcomes | 9 | | 10 | Ethics | |
| Learning outcomes | 9 | | 11 | Stakeholder engagement | |
| Learning outcomes | 9 | | 12 | Globalisation | |
| Ethics | 10 | | 11 | Stakeholder engagement | |
| Ethics | 10 | | 12 | Globalisation | |
| Stakeholder engagement | 11 | | 12 | Globalisation | |

**Detailed Affinity Relationship Table – Group 3** **ANNEXURE M**

Department of Financial Governance

School of Accounting Sciences

*Excellence in accountancy*

18 April 2017

**TECHNOLOGY-BASED EDUCATIONAL INTERVENTION AIMED AT DEVELOPING CRITICAL THINKING IN AUDITING STUDENTS**

Dear participant

Your continuous support for my research is highly appreciated.

You are invited to participate in the final stage of this phase of the research project aimed at determining possible relationships between the themes/ideas/concepts/affinities that emerged from the focus group conducted on the 31st of March 2017.

Your participation in this research project is voluntary and confidential. You will not be asked to reveal any information that will allow your identity to be determined.

If you are willing to participate in this study, please sign this letter as a declaration of your consent, i.e. that you participate in this project willingly and that you understand that you may withdraw from the research project at any time.

Participant's signature ................................................................ : Date:

Researcher's signature .............................................................. : Date:

Yours sincerely

Mrs Alet Terblanche

Department of Financial Governance

College of Accounting Sciences

UNISA

**TECHNOLOGY-BASED EDUCATIONAL INTERVENTION TO DEVELOP CRITICAL THINKING IN AUDITING STUDENTS**
**List of affinities, themes, ideas, concepts, etc. which emerged from the focus group**

**1 TECHNICAL KNOWLEDGE**

With this affinity the focus group prioritised technical knowledge specifically relating to controls as well as assertions. Segregation of duties within an information technology (IT) division and controls over the storing of client data is important. Technical knowledge on the payroll and personnel cycle; revenue and receipt cycle, as well as the acquisition and payments cycle should be illustrated through videos.

---

**2 CONSIDERATION OF DIVERSITY**

Through this affinity the focus group noted that the diversity of students should be considered. This may include students' prior knowledge, personal backgrounds (for example culture and ethnicity) and prior exposure to technology. Interventions should be inclusive and take the above mentioned into consideration.

---

**3 IMPLEMENTATION TIMING**

The focus group emphasised that the development of critical thinking in students is a process that should start as early as possible, preferably at undergraduate level. Students should be exposed to technology-based educational interventions aimed at this as early as possible. Leadership structures, which include lecturers and tutors, should create an environment where critical thinking can be cultivated in students already when they start their studies.

---

**4 BASIC FUNDAMENTALS**

Through this affinity the focus group emphasised that the technology-based educational intervention should focus on the basic audit fundamentals and principles of a business environment and expose students to these concepts.

---

**5 TEACHING METHODOLOGY**

With this affinity the focus group emphasised specific teaching methodologies as the platform through which the educational intervention can be delivered to the students. This includes lecture videos with questions and answers, computer-based auditing scenarios, technology-based audit tests, videos with audit simulations and workshops. Interventions should move away from memorising theory to encouraging critical thinking through testing scenarios with multiple outcomes.

---

**6 INTERACTIVE TEACHING SIMULATION APPLICATION**

Through this affinity the focus group indicated that the software for this audit application could be made available on smartphones, tablets and computers. It should preferably be available to students through the relevant application (app) stores. The interactive teaching simulation application could feature story boards of audit case studies/scenarios, questions and solutions. It could also include audit cartoons, training software and/or activity-based simulations. Students could also be encouraged to work individually or in teams through these applications.

---

| | |
|---|---|
| **7** | **DEVELOPMENT CONSIDERATIONS**<br>With this affinity the focus group emphasised that the intervention should be adaptable, cost-effective, appealing, interesting and attractive to students, with built in security measures, access settings and continuity controls. Furthermore, the design principles of virtual reality and virtual machines should be considered. |

**DETAILED AFFINITY RELATIONSHIP TABLE (DART)**

Please complete the attached table below by indicating what you think the direction of the relationship between two affinities is. Use the affinity descriptions that are supplied with this table to help you with this task.

For example:

If you think that 1 influences 2, then indicate 1 → 2
If you think that 2 influences 1, then indicate 1← 2
If you think that there is no relationship between 1 and 2, then indicate 1 < > 2.

**PLEASE NOTE: An arrow may only go in one direction. Although you may feel that the direction of the relationship can go both ways, you must indicate the direction you think illustrates the strongest or most important influence.**

**Example:**

An example of an IF/THEN statement in the case where 1 ← 2 may look as follows:
*If a student comes from a background where he/she has not been exposed to business terminology, then that student could struggle to understand certain technical terms used in auditing.*

**Below is the list of the affinities (themes, ideas, concepts, etc.) you are requested to consider. Please also refer to the list of affinity descriptions for completing the table below. Remember that an arrow can go either left or right, but not in both directions.**

| **Affinities** | **Possible relationships** |
|---|---|
| 1. Technical knowledge<br>2. Consideration of diversity<br>3. Implementation timing<br>4. Basic fundamentals<br>5. Teaching methodology<br>6. Interactive teaching simulation application<br>7. Development considerations | If affinity 1 influences affinity 2 then:<br><br>1 → 2<br><br>If affinity 2 influences affinity 1 then:<br><br>1 ← 2<br><br>If there is no relationship between affinities:<br><br>1 < > 2 |

*Thank you for the time and effort that you are willing to put into this research project.*

| FOCUS GROUP 3 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Technical knowledge | 1 | | 2 | Consideration of diversity | |
| Technical knowledge | 1 | | 3 | Implementati on timing | |
| Technical knowledge | 1 | | 4 | Basic fundamentals | |
| Technical knowledge | 1 | | 5 | Teaching methodology | |
| Technical knowledge | 1 | | 6 | Interactive teaching simulation application | |
| Technical knowledge | 1 | | 7 | Development considerations | |
| Consideration of diversity | 2 | | 3 | Implementati on timing | |
| Consideration of diversity | 2 | | 4 | Basic fundamentals | |
| Consideration of diversity | 2 | | 5 | Teaching methodology | |
| Consideration of diversity | 2 | | 6 | Interactive teaching simulation application | |
| Consideration of diversity | 2 | | 7 | Development considerations | |
| Implementati on timing | 3 | | 4 | Basic fundamentals | |

| FOCUS GROUP 3 DETAILED AFFINITY RELATIONSHIP TABLE | | | | | |
|---|---|---|---|---|---|
| Affinity Pair Relationship | | | | | GIVE AN EXAMPLE IN NATURAL LANGUAGE USING AN IF/THEN STATEMENT TO EXPLAIN THE RELATIONSHIP ACCORDING TO YOUR PERSONAL EXPERIENCE |
| Implementation timing | 3 | | 5 | Teaching methodology | |
| Implementation timing | 3 | | 6 | Interactive teaching simulation application | |
| Implementation timing | 3 | | 7 | Development considerations | |
| Basic fundamentals | 4 | | 5 | Teaching methodology | |
| Basic fundamentals | 4 | | 6 | Interactive teaching simulation application | |
| Basic fundamentals | 4 | | 7 | Development considerations | |
| Teaching methodology | 5 | | 6 | Interactive teaching simulation application | |
| Teaching methodology | 5 | | 7 | Development considerations | |
| Interactive teaching simulation | 6 | | 7 | Development considerations | |

## Summary of preliminary, literature-based, conceptual framework

## ANNEXURE N

| Section | Key concepts | Key concepts<br>Chapter references and literature references | Relationships | Relationships<br>Chapter and literature references |
|---|---|---|---|---|
| Section 5.2.1 | ***Student-related factors.*** These include:<br><br>• Age;<br>• Gender;<br>• Academic performance;<br>• Prior knowledge or experience;<br>• Type of academic programme or field of study;<br>• Academic grade or level;<br>• Student learning styles; and<br>• Other student-related factors including self-concept, feelings, culture, personal characteristics, nationality, ethnicity, type of high school attended, income level of parents, mother's educational level, native English language and reading ability. | Section 3.3 in Chapter 3<br><br>(Mortellaro 2015: 33–47; Rubenfeld & Scheffer 2015: 59–76; Tiruneh et al. 2014: 6–10; Purvis 2009: 70; Elder 2004: 1; Facione 1990b)<br><br>Refer to Table 10 in section 3.3 in Chapter 3 for a summary of literature references on student-related factors. | ***Relationship A:*** Student-related factors may influence critical thinking scores, as measured by critical thinking measurement instruments. | Section 3.3 in Chapter 3<br><br>(Facione 1990b: 1)<br><br>Refer to Table 10 in section 3.3 in Chapter 3 for a summary of literature references on the correlation between these student-related factors and critical thinking. |
| | | | ***Relationship B:*** Students' critical thinking in general and their critical thinking development may be influenced by student-related factors. | Section 3.3 in Chapter 3<br><br>(Mortellaro 2015: 33–47; Rubenfeld & Scheffer 2015: 59–76) |
| | | | ***Relationship C:*** The effectiveness of critical thinking educational interventions may be influenced by student-related factors. | Section 3.3 in Chapter 3<br><br>(Tiruneh et al. 2014: 6–10) |
| Section 5.2.2 | ***Pre-intervention assessment or measurement of critical thinking.*** This includes:<br><br>• Standardised instruments; or<br>• Non-standardised instruments. | Section 2.3 in Chapter 2<br><br>(Carter et al. 2015: 864–865; Tiruneh et al. 2014: 3–8; Abrami et al. 2008: 1109)<br><br>Refer to section 2.3.1 and 2.3.2 for literature references | ***Relationship D:*** The pre-intervention critical thinking assessment or measurement can be performed prior to the introduction of the intervention. These instruments allow comparison over time. | Section 2.3 in Chapter 2<br><br>(Carter et al. 2015: 864–865; Tiruneh et al. 2014: 3–8) |

| Section | Key concepts | Key concepts<br>Chapter references and literature references | Relationships | Relationships<br>Chapter and literature references |
|---|---|---|---|---|
| | | on standardised and non-standardised instruments. | | |
| Section 5.2.3 | ***The intervention: Teaching strategies and technology-based educational interventions that facilitate critical thinking development.*** These include:<br><br>• Case studies;<br>• PBL;<br>• Simulations;<br>• Concept maps;<br>• Socratic questioning;<br>• AODs;<br>• Debates;<br>• Conference learning;<br>• Role plays;<br>• Modelling; and<br>• Video vignettes. | Section 3.5.2 in Chapter 3 and section 4.3 in Chapter 4 | The intervention is the focus point of the preliminary, literature-based, conceptual framework. It influences various concepts and is influenced by various others. Refer to the other sections for a discussion on these relationships (see relationships C, D, E, H, K, Q, V and X for example). | Section 3.5.2 in Chapter 3 and section 4.3 in Chapter 4 |
| Section 5.2.4 | ***Critical thinking instructional approaches.*** These include:<br><br>• The general approach;<br>• The infusion approach;<br>• The immersion approach; and<br>• The mixed approach. | Section 3.5.1 in Chapter 3<br><br>(Abrami et al. 2008: 1105–1121, 2015: 281–302; Bensley & Spero 2014: 56–58; Tiruneh et al. 2014: 2–8; Lai 2011: 30–32; Prawat 1991: 3–30; Ennis 1989: 4–6) | ***Relationship E:*** Critical thinking instructional approaches may influence the effectiveness of critical thinking instruction and educational interventions aimed at critical thinking development. | Section 3.5.1 in Chapter 3<br><br>(Tiruneh et al. 2014: 2) |
| | | | ***Relationship F:*** The choice of instructional approach influences whether auditing content forms part of the educational intervention. | Concluded from the literature as described in section 3.5.1 in Chapter 3. |

| Section | Key concepts | Key concepts<br>Chapter references and literature references | Relationships | Relationships<br>Chapter and literature references |
|---|---|---|---|---|
| | | | ***Relationship G:*** In general, the educator has an influence on, or makes the decision regarding which instructional approach to follow. | Concluded from the literature as described in section 3.5.1 in Chapter 3 |
| Section 5.2.5 | ***Constructivism and characteristics of critical thinking instruction.*** These include:<br>• The promotion of active learning;<br>• The use of a problem-based curriculum;<br>• The stimulation of interaction or collaboration among students; and<br>• The use of authentic real-world scenarios. | Sections 4.1 and 4.2 in Chapter 4<br><br>(Kwan & Wong 2014: 192; Alzaghoul 2012: 28–29; Harasim 2012: 12; Mohamed 2004: 18–21; Ten Dam & Volman 2004: 370; Alessi & Trollip 2001: 16–32) | ***Relationship H:*** Principles of constructivism, that align with the characteristics of critical thinking instruction, form the basis of and inform the teaching strategies and technology-based educational interventions that facilitate critical thinking development. | Sections 4.1 and 4.2 in Chapter 4<br><br>(Harasim 2012: 4–29; Alessi & Trollip 2001: 41) |
| | | | ***Relationship I:*** Principles of constructivism provide the ideal foundation for critical thinking instructional approaches. | Sections 4.1 and 4.2 in Chapter 4<br><br>(Jones & Brader-Araje 2002: 4) |
| | | | ***Relationship J:*** The educator should have a proper understanding of learning theories. | Sections 4.1 and 4.2 in Chapter 4<br><br>(Mohamed 2004: 6) |
| Section 5.2.6 | ***Educator-related factors.*** These include:<br>• Being trained in critical thinking instruction;<br>• Prior experience in critical thinking instruction;<br>• Support that the educator receives from the | Section 3.4 in Chapter 3<br><br>(Gharib et al. 2016: 275–277; De Villiers 2015: 58–69; Tiruneh et al. 2014: 1–17; Lai 2011: 36; Abrami et al. 2008: 1121; Van Erp 2008: 114–116; Paul & Elder 2007: 5; | ***Relationship K:*** The educator generally has an influence on the selection or design of the teaching strategies and educational interventions. With a proper understanding of the principles of constructivism and characteristics of critical thinking instruction (see relationships G and J), the educator is better equipped to | Concluded from the literature as described in section 3.4 in Chapter 3, and sections 4.1 and 4.2 in Chapter 4. |

| Section | Key concepts | Key concepts Chapter references and literature references | Relationships | Relationships Chapter and literature references |
|---|---|---|---|---|
| | educational institution or management related to critical thinking development;<br>• Attributes, characteristics, teaching philosophy, attitude and values; and<br>• Ability to model critical thinking. | Facione 1990b: 13, 2000: 80; Reed 1998: 166) | select or design suitable teaching strategies and technology-based educational interventions that facilitate critical thinking development. | |
| | | | ***Relationship L:*** The SAICA competency framework is not prescriptive on how teaching should be done at SAICA-accredited programme providers. The educator can thus influence how auditing content is incorporated into the educational intervention. | Concluded from the literature as described in section 2.2.1.3 in Chapter 2 |
| | | | ***Relationship M:*** Certain educator-related factors may influence students' critical thinking and critical thinking development. | Section 3.4 in Chapter 3<br><br>(Gharib et al. 2016: 275–277; De Villiers 2015: 58–69; Tiruneh et al. 2014: 1–17; Lai 2011: 36; Abrami et al. 2008: 1121; Van Erp 2008: 114–116; Paul & Elder 2007: 5; Facione 1990b: 13, 2000: 80; Reed 1998: 166) |
| | | | ***Relationship N:*** The educator generally selects the instrument that measures or assesses the students' critical thinking. The educator is generally also involved in evaluating the results of these assessments. | Concluded from the literature as described in section 2.3 in Chapter 2<br><br>(Chan 2013: 239) |
| | | | ***Relationship O:*** The educator generally has an influence on the auditing tests and assessments | Concluded from the literature as described in section 2.2.1.3 in Chapter 2 |

| Section | Key concepts | Key concepts<br>Chapter references and literature references | Relationships | Relationships<br>Chapter and literature references |
|---|---|---|---|---|
| | | | that are used to assess students' auditing content knowledge. | |
| | | | ***Relationship P:*** The educational institution has to support educators in the development of critical thinking. The educational institution also has to support the educator in understanding how to teach for critical thinking and allow educators time to achieve this goal. | Section 3.4 in Chapter 3<br><br>(Gharib et al. 2016: 274; Van Erp 2008: 114–116; Paul & Elder 2007: 5) |
| Section 5.2.7 | ***Auditing content.*** Auditing forms part of specific competencies prescribed by the SAICA competency framework. | Section 2.2.1.3 in Chapter 2<br><br>(South African Institute of Chartered Accountants 2014a: 2–24) | ***Relationship Q:*** Critical thinking is considered to be an active process, developed through active learning strategies. To foster a sound understanding of auditing content and effectively develop critical thinking, auditing content should preferably be delivered through active learning strategies. | Concluded from the literature as described in section 2.2.1.3 in Chapter 2, section 3.5.2 in Chapter 3 and sections 4.1 and 4.2 in Chapter 4<br><br>(Mortellaro 2015: 17–123) |
| | | | ***Relationship R:*** The most effective way of developing critical thinking is considered to be within the context of a specific subject or discipline. Knowledge about a specific subject or discipline's methods, techniques, contexts, criteria, theories and principles assist in teaching students to think critically. On the other end, content cannot be further developed, analysed or | Section 3.5 in Chapter 3<br><br>(Nair & Stamler 2013: 132; Facione 1990a: 4–5, 2000: 65) |

| Section | Key concepts | Key concepts<br>Chapter references and literature references | Relationships | Relationships<br>Chapter and literature references |
|---|---|---|---|---|
| | | | transformed without the application of critical thought. | |
| | | | ***Relationship S:*** SAICA, through its SAICA competency framework, prescribes the competencies that chartered accountants in South Africa should possess when they enter the profession. SAICA, thus has a significant influence on the auditing content prescribed and the level of competence required of chartered accountants in South Africa. | Concluded from the literature as described in section 2.2.1.3 in Chapter 2<br><br>(South African Institute of Chartered Accountants 2014a: 9–24) |
| Section 5.2.8 | ***Critical thinking (cognitive skills and dispositions)***<br><br>The cognitive skills include:<br><br>• Analysis;<br>• Interpretation;<br>• Inference;<br>• Evaluation;<br>• Explanation; and<br>• Self-regulation.<br><br>The dispositions include:<br><br>• Truth seeking;<br>• Open-mindedness;<br>• Inquisitiveness;<br>• Systematicy; | Section 2.2 in Chapter 2<br><br>(Facione 1990a: 2–19) | ***Relationship T:***. A good critical thinker has to possess both cognitive skills and dispositions as they cannot function without one another. | Section 2.2 in Chapter 2<br><br>(Facione 1990a: 2–18, 2011: 5) |
| | | | ***Relationship U:*** The SAICA competency framework prescribes the pervasive qualities and skills that chartered accountants in South Africa should possess when they enter the profession. Pervasive qualities and skills includes professional skills which include critical thinking under professional skills. | Section 2.2.1.3 in Chapter 2<br><br>(South African Institute of Chartered Accountants 2014a: 35–37) |

| Section | Key concepts | Key concepts<br>Chapter references and literature references | Relationships | Relationships<br>Chapter and literature references |
|---|---|---|---|---|
| | • Confidence in reasoning; and<br>• Maturity in judgement. | | ***Relationship V:*** Various types of teaching strategies and technology-based educational interventions facilitate critical thinking development (for example PBL, case studies and simulations). There are in many instances also a strong correlation between teaching strategies (and technology-based educational interventions) and critical thinking scores measured by critical thinking measurement instruments. | Section 3.5.2 in Chapter 3 and section 4.3 in Chapter 4<br><br>Refer to Table 13 in section 3.5.2 in Chapter 3 for a summary of literature references on active learning strategies and their influence on critical thinking. |
| Section 5.2.9 | ***Post-intervention assessment or measurement of critical thinking.*** This includes:<br><br>• Standardised instruments; or<br>• Non-standardised instruments. | Section 2.3 in Chapter 2<br><br>(Carter et al. 2015: 864–865; Tiruneh et al. 2014: 3–8; Abrami et al. 2008: 1109)<br><br>Refer to section 2.3.1 and 2.3.2 for literature references on standardised and non-standardised instruments. | ***Relationship W:*** A post-intervention critical thinking assessment or measurement could be used to evaluate the effectiveness of the teaching strategies and technology-based educational interventions, in developing students' critical thinking. The educator is then also in a position to determine students' progression through the six stages of critical thinking as mentioned in section 5.2.2. These instruments allow comparison over time. | Concluded from the literature as described in section 2.3 in Chapter 2 |
| Section 5.2.10 | ***Auditing content knowledge and its understanding (outcome).*** Auditing forms part of specific competencies prescribed by the SAICA competency framework. | Section 2.2.1.3 in Chapter 2<br><br>(South African Institute of Chartered Accountants 2014a: 2–24) | ***Relationship X:*** Active learning strategies stimulate cognitive processes and critical thinking. The teaching strategies and technology-based educational interventions that are aimed at critical thinking development, | Concluded from the literature as described in section 2.2.1.3 in Chapter 2<br><br>(Mortellaro 2015: 122–123; Barac & Du Plessis 2014: 60; Fratto 2011: 13) |

| Section | Key concepts | Key concepts<br>Chapter references and literature references | Relationships | Relationships<br>Chapter and literature references |
|---|---|---|---|---|
| | | | should thus focus on students' understanding of auditing content, not mere memorisation of content. | |
| Section 5.2.11 | ***Auditing tests and assessments*** | Section 2.2.1.3 in Chapter 2<br><br>(South African Institute of Chartered Accountants 2014a: 1–167) | ***Relationship Y:*** Students' auditing content knowledge and understanding thereof should be assessed. Most of the teaching strategies and technology-based educational interventions aimed at critical thinking, use unstructured, contextualised, real-world problems and scenarios that can integrate auditing content. | Concluded from the literature as described in section 2.2.1.3 in Chapter 2 |

**Summary of final conceptual framework** **ANNEXURE O**

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| Section 8.2.1<br><br>Section 8.2.14<br><br>Section 8.2.19 | **CONCEPT ADDED TO FINAL FRAMEWORK**<br><br>**CONCEPT VALIDATED BY INTERACTIVE ENGAGEMENT**<br><br>**CONCEPT VALIDATED BY IMPLEMENTATION TIMING**<br><br>***Design and development considerations***. These include:<br><br>• Principles of quality design must be evaluated and followed;<br>• The intervention should be user-friendly;<br>• The intervention should have clear instructions and outcomes built into the software;<br>• The intervention should provide triggers to allow students to progress through various levels of learning and incorporate decision trees;<br>• The intervention should enable students to reflect on their learning;<br>• The intervention should provide feedback to students; | Section 8.2.1 in Chapter 8<br><br>Design and development considerations – reconciled affinity<br><br>Section 8.2.14 in Chapter 8<br><br>Interactive engagement – group 2 (educators)<br><br>Section 8.2.19 in Chapter 8<br><br>Implementation timing – group 3 (students)<br><br>Design and development considerations:<br><br>• Principles of quality design must be evaluated and followed (Kim et al. 2006: 867–876)<br>• The intervention should be user-friendly (Van Wyk 2015: 200–208; De Villiers 2005: 351)<br>• The intervention should have clear instructions and outcomes built into the software (Van Wyk 2015: 200–208; Felker 2014: 19–23)<br>• The intervention should provide triggers to allow | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 1:*** The principles of quality design, design features, as well as design and development considerations of technology-based educational interventions aimed at critical thinking development, are all aimed at the educational intervention. These design and development considerations thus directly influence how the intervention is designed and developed. | Section 8.2.1 in Chapter 8<br><br>Design and development considerations – reconciled affinity<br><br>(Herrington & Reeves 2011: 594) |
| | | | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>**RELATIONSHIP VALIDATED BY LECTURER COMPETENCE**<br><br>***Relationship 2:*** To effectively design and develop technology-based educational interventions, that are effective in critical thinking development, the educator would need a proper understanding of design and development considerations related to the intervention. To obtain an understanding of the design and development | Section 8.2.1 in Chapter 8<br><br>Design and development considerations – reconciled affinity<br><br>Section 8.2.11 in Chapter 8<br><br>Lecturer competence – group 2 (educators)<br><br>(Felker 2014: 19–23; Yang 2014: 748) |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | • The intervention should be introduced to students as early as possible, preferably from first year of studies;<br>• Applications, databases, software and new technologies should be repurposed regularly and customised for specific needs. The intervention should be adaptable;<br>• The intervention should be cost-effective;<br>• The intervention should be appealing, interesting and attractive to students; and<br>• The intervention should have built-in security measures, access settings and continuity controls. | students to progress through various levels of learning and incorporate decision trees (Kim et al. 2006: 867–876)<br>• The intervention should enable students to reflect on their learning (Hepner 2015: 73–74; Alzaghoul 2012: 28–29; Mödritscher 2006: 7–8; Mohamed 2004: 18–21; Alessi & Trollip 2001: 32; Scheffer & Rubenfeld 2000: 358; Facione 1990a: 2–16; Ennis 1985: 45)<br>• The intervention should provide feedback to students (Van Wyk 2015: 200–208; Peddle 2011: 648–649; Rush et al. 2008: 501–508; Goldenberg et al. 2005: 310–314)<br>• The intervention should be introduced to students as early as possible, preferably for first year of studies. Refer to section 8.2.19 for more detail.<br>• Applications, databases, software and new technologies should be repurposed regularly and customised for specific needs (Felker 2014: 19–23)<br>• The intervention should be cost-effective (Salleh et al. 2012: 377; Peddle 2011: 648–649; Bell et al. 2008: 1430) | considerations, the educator could consider consulting industry leaders in software design. | |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | | • The intervention should be appealing, interesting and attractive to students (Van Wyk 2015: 200–208)<br>• The intervention should have built-in security measures, access settings and continuity controls | | |
| Section 8.2.2 | **CONCEPT ADDED TO FINAL FRAMEWORK**<br><br>***Technology-based enabling tools.*** These include:<br><br>• Blogs;<br>• Wikis;<br>• Podcasts;<br>• Jingles;<br>• Animation;<br>• Photo captions;<br>• The internet;<br>• Google;<br>• Social media;<br>• Data sources;<br>• CaseWare;<br>• Computer assisted audit techniques (CAATs);<br>• ULink;<br>• Advanced Excel;<br>• Software applications (including student-related applications);<br>• Forums;<br>• Ipads; and<br>• Laptops. | Section 8.2.2 in Chapter 8<br><br>Technology-based enabling tools – reconciled affinity<br><br>(Majumdar 2015: 1) | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 3:*** Enabling tools enable teaching. Technology-based enabling tools can thus support the delivery of the teaching strategies and technology-based educational interventions that are aimed at critical thinking development. | Section 8.2.2 in Chapter 8<br><br>Technology-based enabling tools – reconciled affinity<br><br>(De Villiers 2005: 354) |
| | | | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 4:*** It is important for the educator to consider and select the enabling tools, as they facilitate the lesson. The educator generally has an influence on the selection of these tools. | Section 8.2.2 in Chapter 8<br><br>Technology-based enabling tools – reconciled affinity<br><br>(Yang 2014: 748) |
| | | | **RELATIONSHIP ADDED TO FINAL FRAMEWORK** | Section 8.2.2 in Chapter 8 |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | | | ***Relationship 5:*** Technology-based enabling tools could facilitate the critical thinking development process in students. | Technology-based enabling tools – reconciled affinity<br><br>(Mansbach 2015: 1) |
| Section 5.2.1<br><br>Section 8.2.3<br><br>Section 8.2.10<br><br>Section 8.2.12 | **CONCEPT VALIDATED BY CONSIDERATION OF STUDENT DIVERSITY**<br><br>**CONCEPT VALIDATED BY CHALLENGING CONVENTIONS**<br><br>**CONCEPT VALIDATED BY STUDENT READINESS**<br><br>***Student-related factors.*** These include:<br><br>• Age;<br>• Gender;<br>• Academic performance;<br>• Prior knowledge or experience;<br>• Type of academic programme or field of study;<br>• Academic grade or level;<br>• Student learning styles; and<br>• Other student-related factors including self-concept, feelings, culture, personal characteristics, | Section 3.3 in Chapter 3<br><br>(Mortellaro 2015: 33–47; Rubenfeld & Scheffer 2015: 59–76; Tiruneh et al. 2014: 6–10; Purvis 2009: 70; Elder 2004: 1; Facione 1990b)<br><br>Refer to Table 10 in section 3.3 in Chapter 3 for a summary of literature references on student-related factors.<br><br>Section 8.2.3 in Chapter 8<br><br>Consideration of student diversity – reconciled affinity<br><br>Section 8.2.10 in Chapter 8<br><br>Challenging conventions – group 1 (leaning designers)<br><br>Section 8.2.12 in Chapter 8<br><br>Student readiness – group 2 (educators) | ***Relationship A:*** Student-related factors may influence critical thinking scores, as measured by critical thinking measurement instruments. | Section 3.3 in Chapter 3<br><br>(Facione 1990b: 1)<br><br>Refer to Table 10 in section 3.3 in Chapter 3 for a summary of literature references on the correlation between these student-related factors and critical thinking. |
| | | | **RELATIONSHIP VALIDATED BY CONSIDERATION OF STUDENT DIVERSITY**<br><br>***Relationship B:*** Students' critical thinking in general and their critical thinking development may be influenced by student-related factors. | Section 3.3 in Chapter 3<br><br>(Mortellaro 2015: 33–47; Rubenfeld & Scheffer 2015: 59–76)<br><br>Section 8.2.3 in Chapter 8<br><br>Consideration of student diversity – reconciled affinity |
| | | | **RELATIONSHIP VALIDATED BY CONSIDERATION OF STUDENT DIVERSITY**<br><br>**RELATIONSHIP VALIDATED STUDENT READINESS** | Section 3.3 in Chapter 3<br><br>(Tiruneh et al. 2014: 6–10)<br><br>Section 8.2.3 in Chapter 8 |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | nationality, ethnicity, type of high school attended, income level of parents, mother's educational level, native English language and reading ability.<br><br>Added factors (from IQA groups):<br><br>• Whether students are from residential or distance learning backgrounds;<br>• Whether students are technologically empowered (prior exposure to technology);<br>• Student readiness;<br>• Students might not 'buy-in' in or see the benefits of such an intervention and/or show resistance to intervention; and<br>• Students might not have the required reading skills or IT skills required to effectively develop their critical thinking through an intervention. | (Bharuthram 2012: 208; Franklin & Van Harmelen 2007: 1–27; Elder 2004: 1; Arif 2001: 32) | ***Relationship C:*** The effectiveness of critical thinking educational interventions may be influenced by student-related factors. | Consideration of student diversity – reconciled affinity<br><br>Section 8.2.12 in Chapter 8<br><br>Student readiness – group 2 (educators) |
| | | | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 6:*** The educator should have a proper understanding of the diversity of the student body and should consider this diversity when the intervention is selected or designed. | Section 8.2.3 in Chapter 8<br><br>Consideration of student diversity – reconciled affinity<br><br>(Felder & Brent 2005: 72) |
| Section 8.2.4 | **CONCEPT ADDED TO FINAL FRAMEWORK**<br><br>***Collaboration among stakeholders and disciplines.*** | Section 8.2.4 in Chapter 8 | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 7:*** Academics have to collaborate or engage with | Section 8.2.4 in Chapter 8<br><br>Collaboration among stakeholders and disciplines – reconciled affinity |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | This includes collaboration among:<br><br>• Academia;<br>• IT experts;<br>• Educational technologists;<br>• Professional bodies;<br>• Other disciplines and<br>• Practice. | Collaboration among stakeholders and disciplines – reconciled affinity<br><br>(National Estuarine Research Reserve Assosiation 2018: 1; South African Institute of Chartered Accountants 2018: 18–19; Adams et al. 2017: 2) | other stakeholders and disciplines in the design of intervention. The educator, who is considered an academic, is thus part of this collaboration. | (McKee et al. 2017: 1–13) |
| | | | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 8:*** Collaboration among academics (educator) and professional bodies (SAICA) is necessary to identify demands in the workplace, remain relevant and identify ways of addressing current challenges in the profession. | Section 8.2.4 in Chapter 8<br><br>Collaboration among stakeholders and disciplines – reconciled affinity<br><br>(South African Institute of Chartered Accountants 2018: 18–19; Evans et al. 2011: 1–34) |
| Section 8.2.8 | **CONCEPT ADDED TO FINAL FRAMEWORK**<br><br>***Learning process.*** The principles of the learning process include:<br><br>• The transferability and application of knowledge in different settings;<br>• Creative thinking;<br>• Interactivity;<br>• Progressive enquiry;<br>• Autodidactic learning;<br>• Rhizomatic learning;<br>• Deep learning approaches (avoid didactic or rote learning); and | Section 8.2.8 in Chapter 8<br><br>Learning process – group 1 (learning designers)<br><br>Principles of learning process:<br><br>• The transferability and application of knowledge in different settings (Jones 2015: 169–178; Baril et al. 1998: 392–396; Halpern 1998: 451)<br>• Creative thinking (Mojica 2010: 16; | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 9:*** The principles of the learning process should preferably form part of the intervention. The teaching strategies and technology-based educational interventions should thus include some, or all of these principles. | Section 8.2.8 in Chapter 8<br><br>Learning process – group 1 (learning designers) |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | • Locus of control. | Facione 1990a: 5; Bozik 1987: 1–13)<br>• Interactivity (Study.com 2018a: 1; Alzaghoul 2012: 28–29; McHaney 2011: 183; Mödritscher 2006: 7–8; Mohamed 2004: 18–21)<br>• Progressive enquiry (Lakkala 2008: 1–3)<br>• Autodidactic learning (Klauer 1988: 360–361)<br>• Rhizomatic learning (Cormier 2017: 1)<br>• Deep learning approaches (avoid didactic or rote learning) (Harrington 2018: 1; South African Institute of Chartered Accountants 2014a: 16–23)<br>• Locus of control (Study.com 2018b: 1) | | |
| Section 8.2.13 | **CONCEPT ADDED TO FINAL FRAMEWORK**<br><br>***Technological challenges*.** These include:<br><br>• Emerging problems during the implementation phase of the intervention; | Section 8.2.13 in Chapter 8<br><br>Technological challenges – group 2 (educators)<br><br>(South African Institute for Distance Education 2013: | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 10:*** Some technological challenges could be experienced during the implementation phase of the intervention. These challenges relate to the intervention itself. | Section 8.2.13 in Chapter 8<br><br>Technological challenges – group 2 (educators) |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | • The university and its IT department might lack sufficient resources or structures to successfully support the technology-based educational intervention;<br>• The effectiveness of the intervention could be affected by students' lack of required resources to operate the intervention. This could include slow internet connections, internet downtime, a lack of personal computers and/or other required hardware. | 18–36; Peddle 2011: 648–649) | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 11:*** These challenges could also include the university and its IT department as there might be a lack of adequate resources or structures to effectively support the technology-based educational intervention. These challenges thus relate to the educational institution. | Section 8.2.13 in Chapter 8<br><br>Technological challenges – group 2 (educators) |
| | | | **RELATIONSHIP ADDED TO FINAL FRAMEWORK**<br><br>***Relationship 12:*** The effectiveness of the intervention could be affected by students' lack of required resources to operate the intervention. This could include slow internet connections, internet downtime, a lack of personal computers and/or other required hardware. These challenges relate to the student and the technology-based enabling tools. | Section 8.2.13 in Chapter 8<br><br>Technological challenges – group 2 (educators) |
| Section 8.2.16 | **CONCEPT ADDED TO FINAL FRAMEWORK** | Section 8.2.16 in Chapter 8<br><br>Ethics – group 2 (educators) | ***Relationship 13:*** Ethical considerations should form an overarching theme in all aspects of critical thinking development. Ethics are considered to be a | Section 8.2.16 in Chapter 8<br><br>Ethics – group 2 (educators) |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | ***Ethics.*** Ethical considerations should form an overarching theme in all aspects of:<br><br>• Critical thinking development;<br>• The design of educational interventions; and<br>• The use of technologies. | (Melillo 2010: 1; Fasko 1994: 3–12) | pillar of the chartered accountancy profession and should drive the habits of the mind as well as the critical thinking skills of students. | (Zivera 2011: 32; Fasko 1994: 3–12) |
| | | | ***Relationship 14:*** Ethical considerations should form an overarching theme in all aspects of the design of educational interventions. | Section 8.2.16 in Chapter 8<br><br>Ethics – group 2 (educators)<br><br>(Stahl et al. 2017: 369–377; Institute of Electrical and Electronics Engineers n.d.: 55) |
| | | | ***Relationship 15:*** Ethical considerations should form an overarching theme in all aspects relating to the use of technologies. | Section 8.2.16 in Chapter 8<br><br>Ethics – group 2 (educators)<br><br>(Stahl et al. 2017: 369–377) |
| Section 8.2.17 | **CONCEPT ADDED TO FINAL FRAMEWORK**<br><br>***Globalisation.*** This includes:<br><br>• A continuous comparison with global or international approaches and best practices to enhance the development of students' critical thinking; and<br>• A process of benchmarking technology-based educational | Section 8.2.17 in Chapter 8<br><br>Globalisation – group 2 (educators)<br><br>(The Foundation for Critical Thinking 2018: 1; Paul & Elder 2005: 1–66) | ***Relationship 16:*** A continuous comparison with global or international approaches and best practices to enhance the development of students' critical thinking. | Section 8.2.17 in Chapter 8<br><br>Globalisation – group 2 (educators)<br><br>(Heft & Scharff 2017: 48–49) |
| | | | ***Relationship 17:*** A process of benchmarking technology-based educational interventions aimed at developing students' critical | Section 8.2.17 in Chapter 8<br><br>Globalisation – group 2 (educators)<br><br>(Felker 2014: 19–23) |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | interventions aimed at developing students' critical thinking with international standards. | | thinking with international standards. | |
| Section 5.2.2 | ***Pre-intervention assessment or measurement of critical thinking.*** This includes:<br><br>• Standardised instruments; or<br>• Non-standardised instruments. | Section 2.3 in Chapter 2<br><br>(Carter et al. 2015: 864–865; Tiruneh et al. 2014: 3–8; Abrami et al. 2008: 1109)<br><br>Refer to section 2.3.1 and 2.3.2 for literature references on standardised and non-standardised instruments. | ***Relationship D:*** The pre-intervention critical thinking assessment or measurement can be performed prior to the introduction of the intervention. These instruments allow comparison over time. | Section 2.3 in Chapter 2<br><br>(Carter et al. 2015: 864–865; Tiruneh et al. 2014: 3–8) |
| Section 5.2.3<br><br>Section 8.2.5<br><br>Section 8.2.14 | **CONCEPT VALIDATED BY EDUCATIONAL INTERVENTIONS AND TEACHING METHODS IDEAL FOR CRITICAL THINKING DEVELOPMENT**<br><br>**CONCEPT VALIDATED BY INTERACTIVE ENGAGEMENT**<br><br>***The intervention: Teaching strategies and technology-based educational interventions that facilitate critical thinking development.*** These include:<br><br>• Case studies;<br>• PBL;<br>• Simulations; | Section 3.5.2 in Chapter 3 and section 4.3 in Chapter 4<br><br>Section 8.2.5 in Chapter 8<br><br>Educational interventions and teaching methods ideal for critical thinking development – reconciled affinity<br><br>Section 8.2.14 in Chapter 8<br><br>Interactive engagement – group 2 (educators) | The intervention is the focal point of the preliminary, literature-based, conceptual framework. It influences various concepts and is influenced by various others. Refer to the other sections for a discussion on these relationships (see relationships C, D, E, H, K, Q, V and X for example). | Section 3.5.2 in Chapter 3 and section 4.3 in Chapter 4 |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | • Concept maps;<br>• Socratic questioning;<br>• AODs;<br>• Debates;<br>• Conference learning;<br>• Role plays;<br>• Modelling; and<br>• Video vignettes.<br><br>Added examples (from IQA groups):<br><br>• Pure simulations (including augmented reality, virtual reality and virtual worlds);<br>• User-friendly, interactive games (including games of deception and role play).<br>• Lecture videos;<br>• Computer-based auditing scenarios;<br>• Technology-based auditing tests;<br>• Videos with audit simulations and workshops; and<br>• An interactive teaching simulation application (could feature story boards of audit case studies or scenarios, questions and solutions. This application could also include audit cartoons, training software and | | | |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | activity-based simulations). | | | |
| Section 5.2.4 | ***Critical thinking instructional approaches.*** These include:<br>• The general approach;<br>• The infusion approach;<br>• The immersion approach; and<br>• The mixed approach. | Section 3.5.1 in Chapter 3<br><br>(Abrami et al. 2008: 1105–1121, 2015: 281–302; Bensley & Spero 2014: 56–58; Tiruneh et al. 2014: 2–8; Lai 2011: 30–32; Prawat 1991: 3–30; Ennis 1989: 4–6) | ***Relationship E:*** Critical thinking instructional approaches may influence the effectiveness of critical thinking instruction and educational interventions aimed at critical thinking development. | Section 3.5.1 in Chapter 3<br><br>(Tiruneh et al. 2014: 2) |
| | | | ***Relationship F:*** The choice of instructional approach influences whether auditing content forms part of the educational intervention. | Concluded from the literature as described in section 3.5.1 in Chapter 3. |
| | | | ***Relationship G:*** In general, the educator has an influence on, or makes the decision regarding which instructional approach to follow. | Concluded from the literature as described in section 3.5.1 in Chapter 3 |
| Section 5.2.5<br><br>Section 8.2.5<br><br>Section 8.2.8<br><br>Section 8.2.9<br><br>Section 8.2.11 | **CONCEPT VALIDATED BY EDUCATIONAL INTERVENTIONS AND TEACHING METHODS IDEAL FOR CRITICAL THINKING DEVELOPMENT**<br><br>**CONCEPT VALIDATED BY LEARNING PROCESS** | Sections 4.1 and 4.2 in Chapter 4<br><br>(Kwan & Wong 2014: 192; Alzaghoul 2012: 28–29; Harasim 2012: 12; Mohamed 2004: 18–21; Ten Dam & Volman 2004: 370; Alessi & Trollip 2001: 16–32) | **RELATIONSHIP VALIDATED BY EDUCATIONAL INTERVENTIONS AND TEACHING METHODS IDEAL FOR CRITICAL THINKING DEVELOPMENT**<br><br>**RELATIONSHIP VALIDATED BY LEARNING PROCESS** | Sections 4.1 and 4.2 in Chapter 4<br><br>(Harasim 2012: 4–29; Alessi & Trollip 2001: 41)<br><br>Section 8.2.5 in Chapter 8<br><br>Educational interventions and teaching methods ideal for critical thinking development – reconciled affinity |

| Section | Key concepts | Key Concepts<br><br>**Chapter references, affinity refernces and literature references** | Relationships | Relationships<br><br>**Chapter and literature references** |
|---|---|---|---|---|
| Section 8.2.14 | **CONCEPT VALIDATED BY CHANGE IN PEDAGOGY**<br><br>**CONCEPT VALIDATED BY LECTURER COMPETENCE**<br><br>**CONCEPT VALIDATED BY INTERACTIVE ENGAGEMENT**<br><br>***Constructivism and characteristics of critical thinking instruction.*** These include:<br><br>• The promotion of active learning;<br>• The use of a problem-based curriculum;<br>• The stimulation of interaction or collaboration among students; and<br>• The use of authentic real-world scenarios.<br><br>Added examples (from IQA groups):<br><br>• Peer versus peer interaction or competition;<br>• Work individually or in teams;<br>• Real-life scenarios, case studies and examples to contextualise learning; and<br>• Experiential learning principles and guidelines . | Section 8.2.5 in Chapter 8<br><br>Educational interventions and teaching methods ideal for critical thinking development – reconciled affinity<br><br>Section 8.2.8 in Chapter 8<br><br>Learning process – group 1 (learning designers)<br><br>Section 8.2.9 in Chapter 8<br><br>Change in pedagogy – group 1 (learning designers)<br><br>Section 8.2.11 in Chapter 8<br><br>Lecturer competence – group 2 (educators)<br><br>Section 8.2.14 in Chapter 8<br><br>Interactive engagement – group 2 (educators) | **RELATIONSHIP VALIDATED BY INTERACTIVE ENGAGEMENT**<br><br>***Relationship H:*** Principles of constructivism, that align with the characteristics of critical thinking instruction, form the basis of and inform the teaching strategies and technology-based educational interventions that facilitate critical thinking development. | Section 8.2.8 in Chapter 8<br><br>Learning process – group 1 (learning designers)<br><br>Section 8.2.14 in Chapter 8<br><br>Interactive engagement – group 2 (educators) |
| | | | ***Relationship I:*** Principles of constructivism provide the ideal foundation for critical thinking instructional approaches. | Sections 4.1 and 4.2 in Chapter 4<br><br>Jones and Brader-Araje (2002: 4) |
| | | | ***Relationship J:*** The educator should have a sound understanding of learning theories. | Sections 4.1 and 4.2 in Chapter 4<br><br>(Mohamed 2004: 6) |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
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| Section 5.2.6<br><br>Section 8.2.11 | **CONCEPT VALIDATED BY LECTURER COMPETENCE**<br><br>***Educator-related factors.*** These include:<br><br>• Being trained in critical thinking instruction;<br>• Prior experience in critical thinking instruction;<br>• Support that the educator receives from the educational institution or management related to critical thinking development;<br>• Attributes, characteristics, teaching philosophy, attitude and values; and<br>• Ability to model critical thinking.<br><br>Added examples (from IQA groups):<br><br>• Overall competence in the use of technology and staying up to date with technological advancements, thus being tech-savvy. Should receive necessary training and skills development that would enable them to use technology-based | Section 3.4 in Chapter 3<br><br>(Gharib et al. 2016: 275–277; De Villiers 2015: 58–69; Tiruneh et al. 2014: 1–17; Lai 2011: 36; Abrami et al. 2008: 1121; Van Erp 2008: 114–116; Paul & Elder 2007: 5; Facione 1990b: 13, 2000: 80; Reed 1998: 166)<br><br>Section 8.2.11 in Chapter 8<br><br>Lecturer competence – group 2 (educators) | ***Relationship K:*** The educator generally has an influence on the selection or design of the teaching strategies and educational interventions. With a proper understanding of the principles of constructivism and characteristics of critical thinking instruction (see relationships G and J), the educator is better equipped to select or design suitable teaching strategies and technology-based educational interventions that facilitate critical thinking development. An understanding of design features can also guide the educator in the selection and design of these teaching strategies and interventions, suitable for critical thinking development. | Concluded from the literature as described in section 3.4 in Chapter 3, and sections 4.1 and 4.2 in Chapter 4.<br><br>(Yang 2014: 748) |
| | | | ***Relationship L:*** The SAICA competency framework is not prescriptive on how teaching should be done at SAICA-accredited programme providers. The educator can thus influence how auditing content is incorporated into the educational intervention. | Concluded from the literature as described in section 2.2.1.3 in Chapter 2 |
| | | | ***Relationship M:*** Certain educator-related factors may influence students' critical | Section 3.4 in Chapter 3<br><br>(Gharib et al. 2016: 275–277; De Villiers 2015: 58–69; Tiruneh et al. 2014: 1–17; |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | educational interventions effectively. | | thinking and critical thinking development. | Lai 2011: 36; Abrami et al. 2008: 1121; Van Erp 2008: 114–116; Paul & Elder 2007: 5; Facione 1990b: 13, 2000: 80; Reed 1998: 166) |
| | | | ***Relationship N:*** The educator generally selects the instrument that measures or assesses the students' critical thinking. The educator is generally also involved in evaluating the results of these assessments. | Concluded from the literature as described in section 2.3 in Chapter 2<br><br>(Chan 2013: 239) |
| | | | ***Relationship O:*** The educator generally has an influence on the auditing tests and assessments that are used to assess students' auditing content knowledge. | Concluded from the literature as described in section 2.2.1.3 in Chapter 2 |
| | | | **RELATIONSHIP VALIDATED BY LECTURER COMPETENCE**<br><br>***Relationship P:*** The educational institution has to support educators in the development of critical thinking. The educational institution also has to support the educator in understanding how to teach for critical thinking and allow educators time to achieve this goal. | Section 3.4 in Chapter 3<br><br>(Gharib et al. 2016: 274; Van Erp 2008: 114–116; Paul & Elder 2007: 5)<br><br>Section 8.2.11 in Chapter 8<br><br>Lecturer competence – group 2 (educators) |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| Section 5.2.7<br><br>Section 8.2.18<br><br>Section 8.2.20 | **CONCEPT VALIDATED BY TECHNICAL KNOWLEDGE**<br><br>**CONCEPT VALIDATED BY BASIC FUNDAMENTALS**<br><br>***Auditing content.*** Auditing forms part of specific competencies prescribed by the SAICA competency framework.<br><br>Added examples (from IQA groups) relating to technical knowledge on:<br><br>• Controls;<br>• Assertions;<br>• Segregation of duties within an IT division;<br>• Controls over the storing of client data;<br>• Payroll and personnel cycle;<br>• Revenue and receipt cycle; and<br>• Acquisition and payments cycle. | Section 2.2.1.3 in Chapter 2<br><br>(South African Institute of Chartered Accountants 2014a: 2–24)<br><br>Section 8.2.18 in Chapter 18<br><br>Technical knowledge – group 3 (students)<br><br>Section 8.2.20 in Chapter 18<br><br>Basic fundamentals – group 3 (students)<br><br>(South African Institute of Chartered Accountants 2014a: 7; Baril et al. 1998: 395) | **RELATIONSHIP VALIDATED BY TECHNICAL KNOWLEDGE**<br><br>***Relationship Q:*** Critical thinking is considered to be an active process, developed through active learning strategies. To foster a proper understanding of auditing content and effectively develop critical thinking, auditing content should preferably be delivered through active learning strategies. | Concluded from the literature as described in section 2.2.1.3 in Chapter 2, section 3.5.2 in Chapter 3 and sections 4.1 and 4.2 in Chapter 4<br><br>(Mortellaro 2015: 17–123)<br><br>Section 8.2.18 in Chapter 18<br><br>Technical knowledge – group 3 (students)<br><br>(Jordan D'Ambrisi 2011: 36) |
| | | | ***Relationship R:*** The most effective way of developing critical thinking is considered to be within the context of a specific subject or discipline. Knowledge about a specific subject or discipline's methods, techniques, contexts, criteria, theories and principles assist in teaching students to think critically. On the other end, content cannot be further developed, analysed or transformed without the application of critical thought. | Section 3.5 in Chapter 3<br><br>(Nair & Stamler 2013: 132; Facione 1990a: 4–5, 2000: 65) |
| | | | ***Relationship S:*** SAICA, through its SAICA competency framework, prescribes the competencies that chartered accountants in South Africa should possess when they enter | Concluded from the literature as described in section 2.2.1.3 in Chapter 2<br><br>(South African Institute of Chartered Accountants 2014a: 9–24) |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
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| | | | the profession. SAICA, thus has a significant influence on the auditing content prescribed and the level of competence required of chartered accountants in South Africa. | |
| Section 5.2.8<br><br>Section 8.2.6<br><br>Section 8.2.7<br><br>Section 8.2.15 | **CONCEPT VALIDATED BY SOFT SKILLS AND DISPOSITIONS**<br><br>**CONCEPT VALIDATED BY DISCIPLINE-SPECIFIC SKILLS**<br><br>**CONCEPT VALIDATED BY LEARNING OUTCOMES**<br><br>***Critical thinking (cognitive skills and dispositions) and other learning outcomes associated with critical thinking.***<br><br>The cognitive skills include:<br><br>• Analysis;<br>• Interpretation;<br>• Inference;<br>• Evaluation;<br>• Explanation; and<br>• Self-regulation.<br><br>The dispositions include:<br><br>• Truth seeking;<br>• Open-mindedness; | Section 2.2 in Chapter 2<br><br>(Facione 1990a: 2–19)<br><br>Section 8.2.6 in Chapter 8<br><br>Soft skills and dispositions – group 1 (learning designers)<br><br>Section 8.2.7 in Chapter 8<br><br>Discipline specific skills – group 1 (learning designers)<br><br>Section 8.2.15 in Chapter 8<br><br>Learning outcomes – group 2 (educators)<br><br>Other critical thinking cognitive skills, dispositions and learning outcomes associated with critical thinking (from IQA groups):<br><br>• Metacognition (Draeger 2015: 1; Hepner 2015: 73–74; Facione 1990a: 2–11, 2011: 5–9; Bell & Kozlowski 2008: 302) | **RELATIONSHIP VALIDATED BY SOFT SKILLS AND DISPOSITIONS**<br><br>***Relationship T:***. A good critical thinker has to possess both cognitive skills and dispositions as they cannot function without one another. | Section 2.2 in Chapter 2<br><br>(Facione 1990a: 2–18, 2011: 5)<br><br>Section 8.2.6 in Chapter 8<br><br>Soft skills and dispositions – group 1 (learning designers) |
| | | | ***Relationship U:*** The SAICA competency framework prescribes the pervasive qualities and skills that chartered accountants in South Africa should possess when they enter the profession. Pervasive qualities and skills includes professional skills which includes critical thinking under professional skills. | Section 2.2.1.3 in Chapter 2<br><br>(South African Institute of Chartered Accountants 2014a: 35–37) |
| | | | **RELATIONSHIP VALIDATED BY EDUCATIONAL INTERVENTIONS AND TEACHING METHODS IDEAL** | Section 3.5.2 in Chapter 3 and section 4.3 in Chapter 4<br><br>Refer to Table 13 in section 3.5.2 in Chapter 3 for a summary of literature |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | • Inquisitiveness;<br>• Systematicy;<br>• Confidence in reasoning; and<br>• Maturity in judgement.<br><br>Other critical thinking cognitive skills, dispositions and learning outcomes associated with critical thinking (from IQA groups):<br><br>• Metacognition (thinking about one's thinking or reflecting on one's own thinking);<br>• Empathy;<br>• Ethical behaviour;<br>• The ability to deal with ethical issues;<br>• Intrinsic motivation;<br>• A positive attitude;<br>• Good communication skills;<br>• The ability to assess a situation and ask the right questions;<br>• Judgement (making informed decisions);<br>• Making constant critical comparisons;<br>• To be systematic;<br>• To be organised;<br>• To follow certain standards;<br>• Ability to think out of the box; | • Empathy (Vilen 2015: 1; Paul & Elder 2005: 34; Paul 1992: 12–13)<br>• Ethical behaviour and the ability to deal with ethical issues. Described in more detail in section 8.2.16.<br>• Intrinsic motivation (Weiler 2005: 48; Baril et al. 1998: 398)<br>• A positive attitude (Facione 1990a, 2011: 10; Halpern 1998: 452)<br>• Good communication skills (Chartered Accountants Worldwide 2017: 12; World Economic Forum 2015: 1–3; Yusuf & Adeoye 2012: 311–314)<br>• The ability to assess a situation and ask the right questions (Facione 1990a: 2–11, 2011: 5–9; Paul & Elder 2005: 43)<br>• Judgement (Hepner 2015: 73–74; South African Institute of Chartered Accountants 2014a: 18; Facione 1990a: 2)<br>• Making constant critical comparisons (Baril et al. 1998: 393)<br>• To be systematic (Elder & Paul 2010: 1)<br>• To be organised (Facione 1990a: 13)<br>• To follow certain standards (Scheffer & | **FOR CRITICAL THINKING DEVELOPMENT**<br><br>**RELATIONSHIP VALIDATED BY LEARNING OUTCOMES**<br><br>***Relationship V:*** Various types of teaching strategies and technology-based educational interventions facilitate critical thinking development (for example PBL, case studies and simulations). There are in many instances also a strong correlation between teaching strategies (and technology-based educational interventions) and critical thinking scores measured by critical thinking measurement instruments. | references on active learning strategies and their influence on critical thinking.<br><br>Section 8.2.5 in Chapter 8<br><br>Educational interventions and teaching methods ideal for critical thinking development – reconciled affinity<br><br>Section 8.2.15 in Chapter 8<br><br>Learning outcomes – group 2 (educators) |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | • Ability to adapt thinking in different situations to come up with solutions to problems;<br>• Pervasive skills;<br>• Problem-solving abilities (this is associated with critical thinking); and<br>• Discretionary thinking;<br>• The ability to interrogate information;<br>• The ability to know how to use and apply new technologies. | Rubenfeld 2000: 357–358)<br>• Ability to think out of the box (Samarji 2014: 1; Baril et al. 1998: 396)<br>• Problem-solving abilities (Hepner 2015: 77; Turner 2005: 275; Reed 1998: 22)<br>• Discretionary thinking (Ennis 1985: 45)<br>• The ability to interrogate information (Guthrie 2017: 1–2; World Economic Forum 2015: 2)<br>• The ability to know how to use and apply new technologies (Guthrie 2017: 1–2; World Economic Forum 2015: 1–3; Papageorgiou 2014: 71–74) | | |
| Section 5.2.9 | ***Post-intervention assessment or measurement of critical thinking.*** This includes:<br><br>• Standardised instruments; or<br>• Non-standardised instruments. | Section 2.3 in Chapter 2<br><br>(Carter et al. 2015: 864–865; Tiruneh et al. 2014: 3–8; Abrami et al. 2008: 1109)<br><br>Refer to section 2.3.1 and 2.3.2 for literature references on standardised and non-standardised instruments. | ***Relationship W:*** A post-intervention critical thinking assessment or measurement could be useful to evaluate the effectiveness of the teaching strategies and technology-based educational interventions, in developing students' critical thinking. The educator is then also in a position to determine students' progression through the six stages of critical thinking as mentioned in section 5.2.2. These | Concluded from the literature as described in section 2.3 in Chapter 2 |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | | | instruments allow comparison over time. | |
| Section 5.2.10<br><br>Section 8.2.18<br><br>Section 8.2.20 | **CONCEPT VALIDATED BY TECHNICAL KNOWLEDGE**<br><br>**CONCEPT VALIDATED BY BASIC FUNDAMENTALS**<br><br>***Auditing content knowledge and understanding thereof (outcome).*** Auditing forms part of specific competencies prescribed by the SAICA competency framework.<br><br>Added examples (from IQA groups) relating to technical knowledge on:<br>• Controls;<br>• Assertions;<br>• Segregation of duties within an IT division;<br>• Controls over the storing of client data;<br>• Payroll and personnel cycle;<br>• Revenue and receipt cycle; and<br>• Acquisition and payments cycle. | Section 2.2.1.3 in Chapter 2<br><br>(South African Institute of Chartered Accountants 2014a: 2–24)<br><br>Section 8.2.18 in Chapter 8<br><br>Technical knowledge – group 3 (students)<br><br>Section 8.2.20 in Chapter 8<br><br>Basic fundamentals – group 3 (students)<br><br>(South African Institute of Chartered Accountants 2014a: 7; Baril et al. 1998: 395) | **RELATIONSHIP VALIDATED BY TECHNICAL KNOWLEDGE**<br><br>**RELATIONSHIP VALIDATED BY BASIC FUNDAMENTALS**<br><br>***Relationship X:*** Active learning strategies stimulate cognitive processes and critical thinking. The teaching strategies and technology-based educational interventions that are aimed at critical thinking development, should thus focus on students' understanding of auditing content, not mere memorisation of content. | Concluded from the literature as described in section 2.2.1.3 in Chapter 2<br><br>(Mortellaro 2015: 122–123; Barac & Du Plessis 2014: 60; Fratto 2011: 13)<br><br>Section 8.2.18 in Chapter 8<br><br>Technical knowledge – group 3 (students)<br><br>Section 8.2.20 in Chapter 8<br><br>Basic fundamentals – group 3 (students) |
| Section 5.2.11 | ***Auditing tests and assessments*** | Section 2.2.1.3 in Chapter 2 | ***Relationship Y:*** Students' auditing content knowledge and understanding thereof should be | Concluded from the literature as described in section 2.2.1.3 in Chapter 2 |

| Section | Key concepts | Key Concepts<br><br>Chapter references, affinity refernces and literature references | Relationships | Relationships<br><br>Chapter and literature references |
|---|---|---|---|---|
| | | (South African Institute of Chartered Accountants 2014a: 1–167) | assessed. Most of the teaching strategies and technology-based educational interventions aimed at critical thinking, use unstructured, contextualised, real-world problems and scenarios that can integrate auditing content. | |