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## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ACE | Advanced Certificate in Education |
| AR | Action Research |
| AS | Assessment standard |
| CAPS | Curriculum and Assessment Policy Statement |
| CCAR | Centre for Collaborative Action Research |
| CDE | Centre for Development and Enterprise |
| CEDU | College of Education at Unisa |
| CT | Critical Theory |
| CTA | circuit Technology advisor |
| C2005 | Curriculum 2005 |
| DBE | Department of Basic Education |
| DEd | Doctorate in Education |
| DeSTE | Department of Science & Technology Education at CEDU |
| DME | Design-Make-Evaluate |
| DoE | Department of Education |
| D & T | Design and Technology |
| EFA-FTI | Education For All Fast Track Initiative |
| FET | Further Education and Training |
| GDE | Gauteng Department of Education |
| GET | General Education and Training |
| Fig | Figure |
| HEDCOM | Heads of Education Department Committee |
| HEI | Higher Education Institute |
| HODS | Heads of Department |
| IDEA | Identify-Disassemble-Evaluate-Assemble |
| IDMEC | Investigate – Design – Make – Evaluate – Communicate |
| ITEEA | International Technology and Engineering Educators Association |
| LA | Learning Area |
| LimDoE | Limpopo Department of Education |
| LO | Learning Outcomes |
| M.A | Mechanical Advantage |

| | |
|---|---|
| MST | Mathematics-Science-Technology |
| MSTE | Mathematics, Science and Technology Education |
| MST HOD | Mathematics, Sciences and Technology - Head of Department |
| MTech.Ed | Masters in Technology Education |
| NAPTOSA | National Professional Teacher's Organization of South Africa |
| NCS | National Curriculum Statement |
| NTF | national Technology facilitator |
| OBE | Outcomes – Based Education |
| ODL | Open – Distance – Learning |
| PAR | Participatory Action Research |
| PEAR | Participatory Emancipation Action Research |
| PCK | pedagogic content knowledge |
| PhD | Doctor of Philosophy |
| PTF | provincial Technology facilitator |
| RNCS | Revised National Curriculum Statement |
| RSA | Republic of South Africa |
| RTF | regional Technology facilitator |
| SA | South Africa |
| SAARMSTE | Southern African Association for Research in Mathematics, Science and Technology Education |
| SADTU | South African Teachers Union |
| SANPAD | The South Africa Netherlands research Programme on Alternative in Development. |
| Sec | secondary |
| SGB | School Governing Body |
| SI | System International units |
| SMTs | School Management Teams |
| TCK | Technology Content Knowledge |
| TE | Technology Education |
| TLA | Technology Learning Area |
| TLP | Technology Learning Programme |
| T2005 | Technology 2005 |
| UL | University of Limpopo |

UNISA/Unisa University of South Africa

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## CHANGES TO NOTE

## CHANGES THAT TOOK PLACE BETWEEN COMMENCEMENT AND SUBMISSION OF THIS RESEARCH REPORT

**Study title**

When I initially registered for this DEd study my title approved by the university research committee in my college was: "Investigating the teaching of Technology in specified schools of the Limpopo Province". Having realized a need to change the title with my promoter, the final title is presented as: "The teaching practice of senior phase Technology Education teachers in selected schools of Limpopo Province: An action research study".

**Personal**

I have applied for name change through the national ministry of home affairs. I was initially known as TA for Tlou Albert, Mapotse. Now I am TA for Tomé Awshar, Mapotse. These are originally Hebrew names and can be googled for their meaning.

**Educational structure**

The state president thought it wise, as part of education reformation, to split the education ministry into two departments viz, the Department of Basic Education (DBE) and the Department of Higher Education and Training (DHET). The DBE oversees the schooling years of the learners from Grade R - 12, whereas the DHET manages the tertiary education sector. Each of these two structures is run independently by its own minister.

At the beginning of my study the minister of DBE signalled an end to the Outcomes Based Education (OBE) approach, and in the middle of the study the DBE minister cancelled Technology as a stand-alone subject in the intermediate phase. Technology was therefore merged with Science. Towards the completion of my study, Curriculum and Assessment Policy Statement (CAPS) was introduced as an alternative approach to the South African curriculum and a guide to implement the National Curriculum Statement (NCS).

**Educational terminology**

The terminologies used during NATED 550 were reinstated by the Ministry of Education, for instance:

- Educator → teacher
- Learning area → subject
- Outcome → aims and objectives
- Curriculum → syllabus

Many other changes can be found in the CAPS document.

**Internal structural changes at Unisa**

When I registered to start my doctoral studies I was under the College of Human Science (CHS) in the Department of Further Teacher Education (DFTE) at the University of South Africa (Unisa). Unisa established a new college just as I was about to submit my report, namely the College of Education (CEDU), to which I am currently attached. From henceforth I serve under the new established Department of Science and Technology (also include Environmental) Education (DeSTE).

# CHAPTER ONE

# ORIENTATION INTO THE STUDY

*All education is continuous dialogue – question and answer that pursue every problem to the horizon,* Douglas (in le Roux & Schaller, 2005:56).

## 1.1 INTRODUCTION AND MOTIVATION FOR THE STUDY

The intended introduction of Technology Education, or 'Technology Learning Area' (TLA) as it known within the South African context, has raised a number of interesting issues, including continuous discourse on technology[1] and a conceptual understanding of Technology itself (Schafër, 1999:1). Rauscher (2010:219-305) also argues that the advent of Technology Education, nationally and internationally, has posed challenges different from those experienced in other learning areas. The introduction of TLA was prompted by the new era in South Africa following the first elections to be held with universal suffrage in 1994 and accompanying Constitution adopted in 1996. These changes inspired the development and introduction of a new curriculum (Chisholm, 2005; HEDCOM, 1996; Pudi, 2007:09; Subject Didactic Technology Subjects, 2008:5).

South Africa introduced Outcomes-based education (OBE) in 1998 through Curriculum 2005 (C2005), the implementation of which proceeded from Grades R to 9 up to 2005 (Department of Education - DoE, 1997; Mapotse, 2001:41; Pudi, 2002:5 & 26; Vassy, Ankiewicz, De Swart, and Gross, 2003:27; de Jager, 2011:144). At its inception, C2005 was built on the critical and developmental outcomes inspired by the Constitution and tailored according to the General Education and Training (GET) band, which ranges from Grades R to 9, and Further Education and Training (FET) band, from Grades 10 - 12 (DoE, 1995; 1996; 2002; SDTECSY, 2008:5).

[1] I use upper case T for Technology as a subject in the curriculum, and lower case for the generic term.

This curriculum included eight learning areas in the GET band, of which TLA was introduced as a compulsory subject. The majority of in-service teachers found this initial change to OBE and the introduction of C2005 to be very complicated, confusing and demoralising, with much new terminology and content to be learned per phase and not per grade (de Jager, 2011:144). To make it more user-friendly, more changes followed in 2002 after the review of C2005 in 2000, renamed the National Curriculum Statement (NCS). Following consultations with the unions, public hearings in 2001, presentations within the main organ of government and further refinement in the light of these public processes (DoE, 2002), the Revised National Curriculum Statement (RNCS) became official policy in 2002, scheduled for implementation from 2004 (Chisholm, 2005).

Seeing that a review was a process, the Minister of Basic Education, Angie Motshekga initiated yet another curriculum review in 2009, of which some recommendations as spelt out from the review report began to be implemented at the beginning of 2010. The academic year of 2010 started with the minister’s withdrawal of Technology as a stand-alone learning area in the intermediate phase (Grades 4-6) as recommended by the review committee (Motshekga, 2009:9). Technology has therefore been merged with Science in the intermediate phase as from 2010, a turn of events that will probably compromise the basic Technology content to be learned in preparing learners for senior phase, and will challenge teachers in teaching fairly this new subject within the reduced weekly time allocation. The merger was carried out as a way of reducing teachers’ workload, as recommended by the review committee (Curriculum News, May 2010:3) and the NCS was once more renamed, this time as Curriculum and Assessment Policy Statement (CAPS). Although this study focuses on the senior phase Technology teaching (Grades 7 – 9), It is important here to highlight these developments as they impact on the broader context demands of teacher training in Technology Education.

According to a survey carried out by the DoE (2003a), teachers and parents still felt that the curriculum had too many challenges, despite changes that were made between 2009 and 2011. The NCS remains as a policy, while the new CAPS will give clear guidelines for the implementation of the NCS (Curriculum News, May 2010:6; de Jager, 2011:144). These developments around Technology Education, which are muddled with the broader curriculum change and review, compound the problem that this study seeks to pursue. As from 2012, the Department of Basic Education (DBE), based on the continual review process, is set to introduce CAPS into the education system (DBE, 2010). The NCS will remain as policy, while CAPS will give clear guidelines for the implementation of the NCS. Most of the changes between these two policies are in their terminologies, e.g., the term 'learning area' in the NCS will now be 'subject' in CAPS, 'learning outcomes' and 'assessment standards' will now be 'topics' and 'core content areas' in CAPS, respectively. Systems and control used to cover both electrical and mechanical systems in NCS, but in CAPS they have been separated. All this brought about a new hope that this move would reduce some clustered terminologies in NCS, but the training of teachers in CAPS is still a prerequisite for its successful phasing in.

Teachers are the largest single occupational group and profession in the country, numbering close to 390,000 in public and private schools (DoE, 2006a:6). De Jager (2011:149) reports that South Africa has 387,837 teachers in public schools and 25,230 in the independent schools. These Figures would make training difficult if a cascade model for teacher training were to be considered (De Jager, 2011:149). Technology teachers will be affected by this type of a training model, as Technology is a learning area that requires skilled teachers. It is therefore problematic that 99% of them have no qualification to teach Technology (Gauteng Department of Education – GDE, Memo 202, 2004:4).

The next section motivates my study through tracing the process of becoming aware of the problem relating to the training needs of senior phase technology teachers.

## 1.2 PROBLEM STATEMENT AND RESEARCH QUESTION

Employed by the University of Limpopo between 2004 and 2007, I lectured pre-service student teachers enrolled for the Bachelor of Education in Technology Education. During the evaluation of student teachers' practice teaching I observed lack of knowledge in the teaching and practice of technology by veteran teachers in the field, manifested in:

- **Analysis and interpretation of the TLA curriculum policy document:** I observed that the assigned mentor teachers to pre-service student's teachers were not using the Technology policy document to serve as a guide to what to teach each phase and grade. This suggested either that they saw it as unnecessary or had not received a copy, although the DoE had dispatched it to schools nationally. Furthermore, I realized that veteran teachers of each grade shared a textbook which was incongruent with the policy document.
- **Planning of the learning programme, Technology work schedule and lesson plans:** I observed that there was no phase or grade joint planning as teachers were teaching different topics within a term and learners were writing tests on different topics. This was slightly cumbersome for the student teachers from the University of Limpopo (UL) as they had to prepare different lessons for the same grades but different classes. Student teachers had to have the Technology work schedule from their mentor teachers within their teaching practice portfolios, but claimed they could not find any.
- **Absence of creativity in utilizing material resources available in the local context:** I observed that senior phase learners were without any textbook and relied on their teachers. I also observed that different schools within Mankweng district did not display any

> Technology posters or projects made by Technology learners. Veteran teachers were not working on any projects with their learners, lamenting that they would not have the resources until University of Limpopo student teachers came for teaching practice. Student teachers engaged both their mentor teachers and learners in creatively utilizing the material resources available in their localities.

I further observed that student teachers were more knowledgeable about their subject of Technology than their assigned mentor teachers. They eventually changed their role to mentors and their mentors became their mentees as the situation demanded. This reversal confirms the DoE's (2003b:31) declaration that: "Whilst educators in South African schools are qualified to teach a variety of subjects, many of the educators of Technology are uncomfortable with the pedagogy of Technology". A reporter (*This Day*, 2004:13) wrote that teachers' statistics on empowerment showed that about 10,000 of Limpopo Province's 54,298 teachers were under-qualified.

Against this background, the question arises as to how senior phase Technology teachers in Limpopo Province can offer a different scenario regarding their teaching without any qualification. While some have qualified as teachers, research by the Centre for Development and Enterprise (CDE, 2011:2) has revealed that, "many of the existing teachers in mathematics, science and technology are not teaching well, and are also poorly managed. This is partly because many of them have been badly trained". One possible scenario to be considered in this thesis is that they are uncomfortable with the pedagogy of TLA as declared by DoE.

In seeking to answer this and the research question (below), I sought the participation of senior phase TLA teachers in Grades 8 and 9 in Limpopo Province. Nkosi (2008) has conducted a study in Mpumalanga, concentrating on Grade 7 Technology teachers and using the technological process as a framework for improvement of Technology instruction, whilst Letsoalo (2007) has studied the Mpumalanga–Thulamahashe Circuit with

Grade 9 Technology learners to develop an instrument to monitor the technological process during the making of a technological product. Ndlovu (2004) has conducted an action research study with Grade 7 teachers in two schools of KwaZulu-Natal on the Umbombo circuit, and found that teachers lacked skills needed to align assessment with teaching and learning in the Technology learning area. My study was designed to emancipate teachers in the teaching of Technology, and to expand on both Ndlovu's and Nkosi's small-scale interventions.

Teachers anywhere in the country can implement Technology with confidence and every chance of success within their context only if they can be shown how. Action Research (AR) attempted to bring that to surface as this study endeavoured to respond to the following specific research question:

- **What would constitute effective action research intervention strategy for the senior phase Technology teachers in Limpopo Province?**

## 1.3 AIM AND PURPOSE OF THE STUDY

The aim of this study was to establish intervention strategies to empower and emancipate senior phase Technology teachers in the Mankweng Circuit of Limpopo Province from the challenges that they faced in teaching Technology. These were implemented through AR, the principles of which are to empower and emancipate teachers.

The purpose of the study was thus to understand the Technology teaching practice from Technology teachers' perspectives. The objectives were:

- to discuss the nature of teaching Technology
- to explore how senior phase teachers at selected schools in Limpopo Province teach Technology

- to design, implement and evaluate intervention strategies to improve teachers' Technology teaching
- to emancipate teachers in teaching TLA
- to suggest, based on the intervention strategies and findings of the study, a guide for Technology teacher empowerment in teaching Technology.

In the following section I expose the problem as seen from my own perspective and assumptions, and the consulted scholarship.

## 1.4 ASSUMPTIONS AND CLAIMS ABOUT THE PROBLEM

Researchers usually enter research with certain claims and assumptions, i.e., important claims presumed to be true but not yet verified empirically (Gay, 1987:86; Mauer, 1996:8). In this study the following assumptions and claims relating to the identified problem regarding the teaching of Technology and their antecedent claims are made:

**Assumption 1:** After TLA was introduced in the South African school curriculum more than a decade ago TLA teachers are still grappling with its knowledge and pedagogy.

**Claim 1:** Many teachers teach Technology without the appropriate qualifications or prior knowledge of the subject.

**Assumption 2:** AR processes with Technology teachers will empower them with the necessary content knowledge and pedagogy.

**Claim 2:** Contact sessions and application of the AR intervention strategies will improve Technology teachers' teaching.

My claims are supported by Reddy (2001:1), who wrote that no established tradition of TLA teaching and the country, and that this is likely to pose major problems not only to TLA teachers but to the DoE at large. Pudi (2007:i) has also realised this challenge and wrote that the implementation of TLA has been a hurdle for both teachers and learners. Pudi (2007:34) goes on to comment about the challenges that TLA teachers encountered by arguing that, of the eight learning areas, TLA are relatively new. There is a generally low capacity in TLA teachers' content knowledge, cognitive and manual skills, which, coupled with the low morale of some teachers' owing to curriculum transmutation, has exacerbated the teaching related problems that the TLA teachers experience. I believe that AR offered a platform to strategise solutions to this, as to build capacity teachers need to begin to understand Technology and how to teach it (DoE, 2003b:31). The DoE acknowledges the low capacity in Technology teachers' basic technological insight, thus confirming a need for intervention.

Because of its newness, Technology Education is prone to misunderstanding, misinterpretation and, to some extent, resentment (Pudi, 2007). The resentment has been clearly demonstrated by the endeavour to have it scrapped from the curriculum, as was recommended by the review committee in their first review of 2000 chaired by Chisholm (Chisholm, 2000; DoE, 2001). This is quite challenging to Technology teachers at senior phase level since most are either unqualified or under-qualified to teach TLA (Nkosi, 2008:27; Lovington, 2009:5).

There follows the research methodology used during a reconnaissance study considered necessary to answer the research question, the findings of which are presented in Chapter Two.

## 1.5 RESEARCH DESIGN FOR THE RECONNAISSANCE STUDY

In the words of Kemmis and McTaggart (1988:54), reconnaissance is the initial reflection of the research situation in the light of the researcher's thematic concern. I reflected on my observations at the Mankweng District as to whether senior phase Technology teaching had changed.

### 1.5.1 Research approach

An Action research (AR) approach was used during the reconnaissance study, the purpose of which was to solve classroom problems through the application of a scientific method. It was concerned with a local problem and conducted in a local setting. The primary goal of AR is to find a solution to a given problem, its value being confined primarily to those conducting it (Gay, 1987: 8-9). I applied the AR approach as follows:

- Purpose: In my first meeting with Technology teachers I realised that they acknowledged their lack of knowledge in the teaching of TLA. AR was proposed and explained to them, and their consent given. The purpose was to solve the TLA challenges that they encountered in their Technology classrooms.
- Concern: The teachers were advised to contextualise their teaching of Technology, and told that AR would be applied in their local schools.
- Goal: I negotiated contact sessions with the teachers in order to address their challenges and called for their commitment to the AR activities. A two-year programme of contact sessions was jointly drafted and communicated to all senior personnel, at their schools and district office. I also presented this to my seniors and supervisor at work. The main activities of the programme are included in Chapter Four and a copy of the programme in Appendix 1.1.
- Value: The teachers and I valued our availability to the course of emancipation and committed to contribute positively to all the AR cycles and activities. We agreed to be present at all the contact sessions.

I hoped that both the novice and experienced teachers involved in this AR study would be empowered to teach Technology in the GET band, irrespective of their contextual setting. The study would contribute significantly to action research studies in the field of Technology Education.

The next section focuses on the limitations of the study based on population and sampling procedure.

### 1.5.2 Population and sample as the parameters of the study

I started by identifying the province, region, district, circuit and schools to be used for data collection so as to limit the study. This investigation focused on TLA for Grades 8 and 9 at GET band. The aim of delineating the scope of the study was to implement intervention strategies to a manageable sample of senior phase Technology teachers. The sample was drawn from the Capricorn Region at Mankweng Circuit of Mankweng District (see attached regional map in Appendix 1.2), a choice prompted by the lack of technology knowledge I had observed during the evaluation of University of Limpopo's student teachers on teaching practice in the Capricorn Region. It is against this backdrop that this study was deemed crucial to making a contribution to emancipate unqualified and/or under-qualified teachers of Technology.

With the guidance of the circuit manager, the five schools indicated in Table 1.1 (below) from Mankweng Circuit were chosen for their contextual location, convenience in conducting interviews and ease of convening a common venue for contact sessions of AR cycles and activities.

**Table 1.1: Sample of selected schools and TLA teachers**

| SCHOOL NAME | TLA TEACHERS | | | | SCHOOL MILIEU |
|---|---|---|---|---|---|
| | Total | Grade 8 | Grade 9 | Both grades | |
| KMK Sec | 7 | 2 | 2 | 3 | Rural |
| VMV Sec | 3 | 1 | 2 | None | Urban |
| RMR Sec | 3 | 1 | 1 | 1 | Rural |
| BMB Sec | 3 | 1 | 2 | None | Rural |
| WHW Sec | 2 | 2 | 2 | 2 | Urban |

With pseudonyms assigned for the purposes of anonymity, they were chosen in 2010 within a radius of not more than 100 kilometres. The sampling varied in terms of their milieus, i.e., rural and urban, in order to gain biographical information on the need for intervention and degree of challenges they faced. The number of TLA teachers and their teaching varied, with some teaching only Grade 8, some only Grade 9 and others assigned to both. According to Tashakkori and Teddlie (2003:715), sampling involves selecting units of analysis (people, groups, artefacts, settings) in a manner that maximises the researcher's ability to answer the research question. In this study, I used cluster sampling among the cohort of teachers who were together in the GET band, namely senior phase Technology teachers (Gay, 1987: 110). Members of the selected groups had homogeneous characteristics in that they all faced some challenges in their teaching of Technology (Maree and Pietersen, 2010:176). In cluster sampling the researcher identifies convenient naturally occurring groups units, such as neighbourhoods, schools, districts, or regions, from which a random selection is made (McMillan and Schumacher, 1989:164).

The circuit manager telephoned the headmasters of the identified schools (units) in my presence, informing them that their schools had been earmarked for participation in Technology research and that I would be joining them shortly for that purpose. I then approached the schools to introduce myself and meet with the school management teams (SMTs) to explain the purpose of the study. The Mathematics, Science and Technology's head of department (MST HOD) would assemble all Technology teachers in each individual school I visited.

### 1.5.3 Ethical protocol

As an ethical requirement I observed the necessary procedures and protocol to gain access to the area of study. After research permission was granted by the DoE Limpopo Province, and all protocol had been observed from regional to district level, I approached the circuit manager for Mankweng, beginning the recruitment of teachers at selected schools in that Circuit. This process was concluded with the signing of a memorandum of agreement (Appendix 1.3) between senior phase Technology teachers and me. After my first meeting with the TLA teachers a consent form was signed as an indication of agreement to participate in the study and to be video-recorded during the Technology lesson presentations. This was done during the first term of 2010, in my first contact sessions with the teachers. The intention of video-recording was part of the intervention mission, that is each participant would have their own two recorded videos in the form of a DVD, one recorded before intervention and the other after, for reference purposes if they wished to see how they fared and work on further improvements.

Since teachers would be conducting their Technology lessons with their learners in specific grades it was ethical to prepare a consent letter for parents or guardians to sign. Learners were also given consent forms to sign (Appendix 1.4) and collected prior to the teacher lesson presentation and video capturing. The teachers assured me that they did not mind if I used data gathered in whatever form for research purposes only. The following ethical viewpoints of Manzo and Brightbill (2007:39) were discussed with the participants and consensus reached about their observance:

- Participant anonymity cannot be guaranteed in group work;
- Giving participants a voice can reveal survival strategies to those that are oppressing them;
- Shared control over the research process creates ethical conundrums that emerge throughout the process and not easily predicted at the outset;
- Participation will not, in and of itself, make research ethical; the approach can be deployed to support a researcher's pre-existing agenda, or to further the interest of a particular group.

All letters requesting permission and their responses are included in Appendices 1.5 and 1.6 respectively.

### 1.5.4 Data collection methods

I embarked on first data collection activity during the first term of 2010 as the participants were now well-known to me. This was in accordance with the agreed upon contact session schedule drafted jointly during my visit to the schools. A variety of data collection techniques were incorporated during the reconnaissance study, namely non-participant observation, structured interviews and qualitative questionnaires. They were used on a small scale as this was only a fact-finding study. For Wadsworth (in Maree, 2010:129), the use of multiple methods is less for triangulation but rather to overtly seek different kinds of views and perspectives. I considered only these three methods as I found them relevant to respond to the identified specific research question. The integration of other techniques for the main study will be presented in Chapter Four.

The interview schedule, observation grid and questionnaire copies (see Appendices 1.7, 1.8 and 1.9 respectively) were prepared in advance, based on my assumptions and claims. I spent the whole working day at each school to observe TLA teachers within their particular contexts, interview them and administer the questionnaire. Analyses of the findings from these three instruments are presented in Chapter Two.

## 1.6 CONCEPTUALIZATION

Only operational definitions are provided in this section, namely action research, Technology learning area, Technology, and technology education. This creates a frame of understanding and definition, and explanation of words is thus not a futile exercise if one wants to communicate effectively (Pudi, 2005:148). Philosophical explanation of words is often found to be more comprehensive than the dictionary definition (Pudi, 2007:36). Terminology was elucidated throughout the study, depending on its application within the AR cycle activities.

### 1.6.1 Action research (AR)

Dick (2010:4) defines Action Research (AR) as a methodology which has the dual aims of action and research, with 'action' meaning to bring about change in a community, organisation or programme, and 'research' as a vehicle to increase understanding on the part of the researcher or client, or both. The AR methods emphasise action, with research as an additional benefit. I took this route of action from the start to bring about change with selected senior phase community of Technology teachers in Limpopo Province, particularly in how they employ Technology teaching and apply technological knowledge in the classroom, even if under-qualified.

Also known as 'participatory research', AR is a form of research whereby the researcher actively involves the participants in solving a problem or achieving a learning objective (Hofstee, 2006:127). The collaborative approach effectively turns participants into co-researchers, in this case reaching an understanding of how to address the lack of knowhow in Technology teaching by both researcher and co-researchers.[2] The purpose, concern, goal and value of AR, as discussed under Section 1.5.1, were the order of every contact session of AR cycles with the participants. A reconnaissance study was employed to confirm or suggest an alternative main research question, as an initial reflection enquiry, preliminary investigation or fact-finding phase used as a catalyst to reflect on the responses from the three instruments to which the participants responded in the first cycle during the first term of 2010.

### 1.6.2 Technology Learning Area (TLA)

The TLA policy document explains learning areas as the eight fields of knowledge in the Revised National Curriculum Statement (RNCS) Grades R to 9 (DoE, 2002:62), namely: Technology, Mathematics, Natural Science, Social Science, Art and Culture, Life Orientation, and Economics and Management Sciences (DoE, 2006b:12). The TLA, called 'Technology' in the South African context, will contribute towards learners' technological literacy by giving them an opportunity to develop and apply specific skills to solve technological problems (DoE, 2002:4).

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[2] With reference to Technology teachers I use the following terms interchangeably: participants, informants, respondents and co-researchers.

The significance of TLA is directly related to the overall goal of the RNCS Grades R to 9, which is to develop citizens who can display the competencies and values encapsulated in critical and developmental outcomes. The essence of TLA activities in the GET band is increasing learners' awareness of their responsibility in the classroom, school, family and society (DoE, 2002:4). They learn to manage the technological resources at their disposal when developing products, and to minimise the potentially negative impact their solutions could have on the environment and human rights. The question then arises, are their teachers equipped to contextualise their learning? The reconnaissance study was intended to bring this to surface.

### 1.6.3 Technology

The term 'technology' is overused and little understood, leading to confusion over its meaning. Many equate it to computers or other technological electronic products in an educational setting (Laufenberg, 2009: 1). Waks (in Mapotse, 2001:7) suggests that rather than look for a single definition, *"… it might be more efficient to refer to a series of dimensions"* when dealing with technology and science issues. Although the two are interrelated, and in many respects depend on one another, technology has its own unique body of knowledge and associated modes of thinking, and thus is not simply applied science. Humans used technology long before scientific laws were discovered and practiced, e.g., wheel and axle, melting of metals, the boat, Stephenson's rocket (De Vries, 1996; Heptinstall, 1998:4; Laufenberg, 2009; Makgato, 2003). The International Technology and Engineering Educators Association (ITEEA) delegates in 2000 reached a consensus (ITEEA, 2011) in defining technology as the way people modify the natural world to suit their own purpose. Generally, it refers to the diverse collection of processes and knowledge that people use to extend human abilities and to satisfy their needs and wants.

As the study is more focused on South Africa, the concept 'technology' is presented from the DoE's perspective as follows:

- … the use of knowledge, skills and resources to meet human needs and wants, and to recognize and solve problems by investigating, designing, developing and evaluating products, processes and systems (DoE - Technology 2005, 1996).
- … the use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration (DBE – Curriculum and Assessment Policy Statement, 2011:06).

The latter definition was evidently adopted by the Ministry of Education in its curriculum for 2011 and beyond since it was reiterated in CAPS. The two definitions are common in that they both epitomise technology as meeting people's needs and want, in line with ITEEA. Even though all these definitions suggest similar processes in addressing wants or needs, DoE's adopted definition admonishes TLA teachers to consider both the social and environmental factors. Part of the reconnaissance study investigated the participants' conceptual understanding of both technology and Technology Education.

### 1.6.4 Technology Education (TE)

According to Mapotse (2001:1), Gumbo (2003:11), Potgieter (2004:3) and Pudi (2007:1, 2), technology education is concerned with the technological knowledge and skills, as well as technological processes. Technology education involves understanding the use of technology and its impact on the individual and society. It is ultimately designed to enable and equip learners to perform effectively in the technological environment in which they live and to stimulate them to contribute to its improvement. It is still a relatively new subject globally, without a large research base or well established culture of classroom practice (Mawson, 2007:253; ITEEA, 2011:15). For Kendall Starkweather, ITEEA Executive Director, (in Laufenberg, 2009:16) it is *"…applying mathematics, science, and Technology;*

*solving practical problems, using knowledge, tools and skills. It's action based, it's exploring careers, it's increasing one's potential and it's fun."*

On the other hand, the Ohio Department of Education (2007) defines Technology Education as "… a study of technology which provides an opportunity for students to learn about the processes and knowledge related to technology that is needed to solve problems and extend human capabilities". Traditionally, technology was practiced mainly in industry, but the establishment of technikons and technical colleges in South Africa added an element of technology to hands-on curricula. Before 1994 it was taught in both GET and FET school bands, so in this study the action words in the definitions of Technology Education were assessed against teachers' classroom practice.
The next section outlines the programme of the study by chapter.

## 1.7 PROGRAMME OF THE STUDY

**Chapter One** has introduced the study, stating the research problem, aim and purpose. It elucidated the motivation and described the research methods and procedures undertaken during the reconnaissance study.

**Chapter Two** gives an account of the analyses and interpretation of findings from the reconnaissance study. It accounts for the justification and validation of the problem statement with the involvement of TLA teachers during the fact-finding phase (reconnaissance). It is the closing chapter of AR's preliminary (reconnaissance) study. The chapter concludes by outlining challenges raised by the co-researchers.

**Chapter Three** introduces the etymology of technology, discussing the theory that anchors it within the context as a way of engaging the participants collaboratively. The chapter gives a plan of action to address the challenges as highlighted by teachers of Technology in Chapter Two from a theoretical perspective. Sources were consulted as part of literature study to engage scholarship based on the aspects spanning teachers' challenges.

The chapter marks the beginning of the main part of the AR. It concludes with plans to meet these.

**Chapter Four** details how sampling, capturing, analysis and interpretation of data collected were conducted, focusing on the main AR fieldwork activities undertaken during the intervention strategies and reflective practices of the cyclic processes. The chapter presents methods of data analysis and strategies to ensure trustworthiness.

**Chapter Five** processes the evidence and results of both data interpretation and findings. The results of the preliminary research will be compared to the results at the end of the main AR cycles so as to gauge the extent of emancipation with the participants. The chapter's focus is empirical research, based on fieldwork activities of the AR cycles in each contact session with the participants.

**Chapter Six** provides an outline summary and recommendations of the study based on the findings. It is here that the outcomes of AR in Limpopo Province are presented. The chapter will assess the data[3] collected, indicating its gaps, shortcomings, flaws and limitations. Finally, the chapter will present guidelines to teacher empowerment, regarding the teaching of Technology based on the AR experiences and findings.

[3] Although 'data' is the Latin plural of datum it is generally treated as an uncountable 'mass' noun and so takes a singular verb (*Concise Oxford English Dictionary*, 2011, Eds. Stevenson & Waite).

# CHAPTER TWO

# CONFIRMATION OF RESEARCH PROBLEM THROUGH RECONNAISANCE STUDY

*To look is one thing. To see what you look at is another. To understand what you see is a third. To learn from what you understand is still something else. But to act on what you learn is all that really matters,* Wilkinson (1988:9).

## 2.1 INTRODUCTION

This chapter presents the findings from the reconnaissance study for purposes of confirming the problem statement. According to Elliot (1991:73) and Ndlovu (2004: 65), reconnaissance is about describing and explaining viewpoints of the situation being investigated, and gives a clear setting or milieu in which the study will be conducted. The preliminary fact-finding investigation shaped the main study, confirming whether the research question was feasible and laying a foundation for further inquiry. According to Dick (2001:9) it is during the reconnaissance study that a researcher can adopt action research as a meta-methodology, i.e., a methodology one can use until one knows enough about the situation to choose the most appropriate one.

## 2.2 THE PRELIMINARY STUDY

On the day of my school visits I completed an observation grid during the Technology teaching, to be followed up by interviews of the teachers and the teachers filling in the interview questionnaire. This preliminary study was undertaken to identify the actual problem(s) that the senior phase TLA teachers experienced in their teaching. Preliminary research ensures that one does not find waste effort on a study that turns out to be unjustified (Hofstee, 2006:52). The Centre for Technology Education – Action Research (2010:02) asserts that before one begins with intervention one needs to gather baseline data and that knowing how participants perform before the study gives a starting point for comparing the results. The comparison of the preliminary and main findings will be reported in Chapter Five.

The cycle began with a series of planning actions initiated by myself as a researcher, during which I worked with TLA teachers as AR co-researchers. The benefit of this exercise was to establish a relationship and to have common ground about working together with the participants. Based on Figure 2.1 (below), one of the reasons for a preliminary study was to 'unfreeze' the participants from their challenges about teaching Technology and becomes aware of a need to change. After unfreezing process, the participants were led to the changing stage, that is, the situation was diagnosed and new models of emancipation explored and tested. The last stage of this process culminated in a 'refreezing stage', in which the application of new behaviour is evaluated, and if reinforced then adopted. AR is depicted as a cyclical process of changes, as illustrated in Figure 2.1, which summarizes the steps and processes that were planned and implemented during the preliminary study.

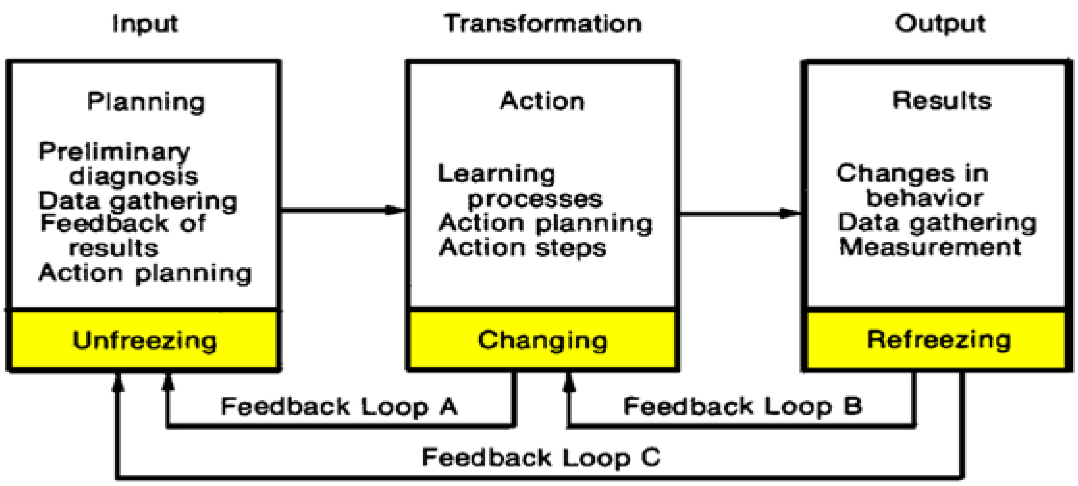



**Figure 2.1: A system model used for AR process during preliminary study** (Prokopenya, 2008:201),

In accordance with Figure 2.1, the reconnaissance study was conducted between the input and transformation of the results, which informed planning for action. Thus, feedback Loop A was completed during the preliminary study for action planning purposes after data gathering. This unfreezing, which is an input on planning, would lead to the transformation of action.

A variety of data gathering techniques were used. Eighteen participants were observed, interviewed and responded to the questionnaires. Schools' names were given pseudonyms for ethical reasons. My aim was to build a relationship of mutual trust with the participants during my first AR cycle. I explained the main aim of my study and informed the participants as to how we could benefit from the AR and its possibility of enhancing the teaching of Technology. Consensus and consent with the participants at each school was reached and forms signed to permit me to collect data using the three identified instruments. Collaboration on both action planning and action steps was sought jointly with the teachers, thus creating a desire within TLA teachers to do things differently with their learners. These were confirmed as teachers willingly signed the consent forms. I gave learners theirs to let their parents or guardian sign.

The sections that follow present the findings of the reconnaissance study. Data was collected in the natural settings of the participants by observing periods as they were set in their timetable. Interviews were conducted during their free time, and questionnaires filled in out of official school hours in order not to interfere with the normal running of the school activities. The findings are presented collectively from observations, interviews and questionnaires. These findings of the preliminary study have been divided into themes and are presented as such.

## 2.3 DATA PRESENTATION OF THE PRELIMINARY STUDY

Data from the preliminary study is broken down into a number of themes. The indentified themes are teachers' Technology teaching experience; Technology planning for teaching; assessment in Technology; support in Technology; resources in Technology; curriculum policy interpretation, implementation and learning outcomes; teacher-learner ratio. The themes are outlined as follows.

### 2.3.1 Participants' biographical information and teaching experience

Triangulation was used after data collection that is to strengthen the study by combining various methods (Patton, 2002). As Mokhele (2011:99) writes, it entails using multiple methods, in this phase observation, interviews and recordings, to find a valid, reliable and diverse construction of reality. Data analysis of the preliminary study, which is Phase 1, for each technique, is presented in a narrative form. Tables, Figures and pictures are used to supplement the analysis. This process of data analysis focuses on understanding the teaching and learning actions and events within the participants' settings and contexts.

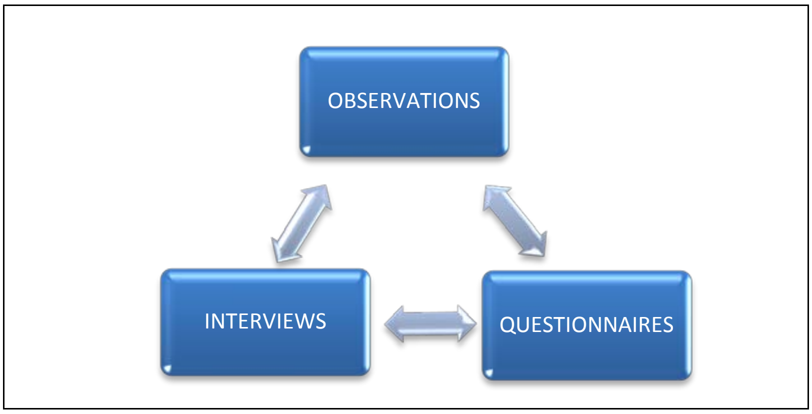



**Figure 2.2: Triangulation of findings from the reconnaissance study**

It should be noted that triangulation is a contested idea as opposed to crystallisation (Richardson, 2000:934), the former enabling one to shift from seeing something as a fixed, rigid, limited dimensional object (that is triangulation) than seeing a crystal, which allows for an infinite variety of shapes, substances, transmutations, dimensions and angles of approach. This phenomenon will be used in Phase 2, particularly in Chapter Five under the findings. At this stage, only data will be presented based on the activities from the instruments used in Phase 1, as displayed in the Vignette of Cycle 1 activities.

### 2.3.2 Vignette of Cycle 1 activities:

This was a proposed schedule of the activities that took place each day in a selected secondary school during Cycle 1:

**Textbox 2.1: Cycle 1, the 08th to 12th March 2010, activities**

1. Once-off meeting with the Mankweng Circuit Manager (a follow-up) to collect the permission letter for schools visit in his area
2. Visit to school sequentially: VMV; BMB; RMR; KMK; WHW
2.1. Meet school's SMT and provide purpose of the visit
2.2. Signing of a consent form for the research by each participant
2.3. Class observations during Technology lessons
2.4. Interviews with Technology teachers
2.5. Collection of data from Technology teachers' files
2.6. Picture taking session (of classrooms and/or Technology laboratories)

Data was collected each day of the visit at each school from the participants, using only the three instruments during Cycle 1 contact session. Data from both interviews and observations was reviewed holistically and important themes noted. The questionnaires had preconceived themes which gave a direction to the analysis, which the themes in the questionnaire were used to guide, although additional ones emerged from the interviews. Pictures of what I observed within the Technology classrooms are displayed below and the interpretations of them highlighted. Consent forms were signed by both teachers and learners' parents and guardians. This will serve as observation findings in Cycle 1 during Phase 1.

### 2.3.3 Observations findings from Cycle 1

I took photographs of all the classes being taught Technology in all the selected schools, and observed that they did not have any Technology workshop or laboratory. I also found out that the teachers were using their classes for Technology tuition. Sample photographs (photos) of the Technology classes are displayed below:

**Photo 2.1 from WHW high school** **Photo 2.2 from BMB high school**

From photo number 2.1 to 2.3 one can witness the set-up in which Technology is being taught, while photo 2.4 displays the condition of the chalkboard. It was common in all selected high schools that learners were taught all their subjects in a common venue, with the teachers rotating between the periods. In all sampled schools, except BMB, I observed that the teacher-learner ratio was a course for concern, as can be seen on photo number 2.1 and 2.3.

Findings from what was observed served as an umbrella to the interviews and questionnaire. Findings from the interviews sought clarity of the observations and confirmed the themes from the questionnaire. The use of multiple methods in an investigation is to overcome the weakness or bias of a single method (Denzin, 1988:511). Triangulation allowed me to map out and explain more fully the richness and complexity of teaching Technology by studying it from more than one standpoint (Cohen and Manion, 1994:269; Cohen, Manion and Morrison, 2000:113).

**Photo 2.3 from VMV high school**

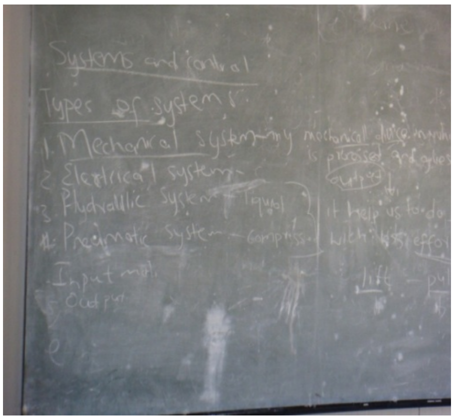



**Photo 2.4 from VMV high school**

However, before going further with the findings, I present the biographical information drawn from the first sections of both the interview script and questionnaire.

There were 18 participants in total from the five participating secondary schools, nine male and nine female. Eleven participants had less than six years of Technology teaching experience while seven had more than five years. Eleven out of the 18 had no form of Technology qualification and seven had some. Thirteen worked in rural areas whereas five worked in urban areas. Ten could plan the Technology lessons whereas eight still needed help. This account is displayed in Table 2.1.

**Table 2.1: Biographical information of participants and their teaching experience**

| Gender | | Technology teaching experience | | Technology qualification | | Context | | Can plan technology lesson | |
|---|---|---|---|---|---|---|---|---|---|
| M | F | Less than 6 years | More than 5 years | Yes | No | Rural | Urban | Yes | No |
| 9 | 9 | 11 | 7 | 7 | 11 | 13 | 5 | 10 | 8 |

Findings from all the three instruments were integrated since they addressed similar themes; hence they were triangulated (Anderson, 1993:175; Kerlinger, 1986:479).

### 2.3.4 Integrated thematic findings

The themes were selected to cover aspects of Technology teaching from policy interpretation to the classroom practice. These themes include Technology teaching experience, Technology didactic planning, assessment in Technology, and support in Technology, resources, policy and teacher-learner ratio. The subsequent section exposes how the developed themes affect the classroom teaching practice of TLA among the selected secondary schools.

#### 2.3.4.1 Theme 1: Technology teaching experience

The reasons for teaching Technology by teachers ranged from being coerced into teaching it to the passion for it. For instance, the interviews revealed: "it was just allocated to me"; "it's fun, interesting and compels one to be innovative". Most of Technology teachers were generally uncomfortable with the pedagogy of Technology as evidenced during both the observations of their teaching and interviews. Some teachers did not have any interest in teaching TLA as one contended: "It just came along while I am already teaching and I didn`t develops any interest in the subject". The teachers' biographical information confirmed their lack of content knowledge, qualification or experience to a greater extent.

#### 2.3.4.2 Theme 2: Technology planning for teaching

Only seven out of 18 teachers from the questionnaire indicated that they preferred to use both the textbook and a policy document for their lesson planning. During the interviews it seemed that this preference would not materialise as they emphasised: "… if educators were provided with at least a textbook so that we are able to prepare our learning programme"; "I don't think the challenges I meet as stated would have happened if I had relevant and enough textbooks for learners"; "… we need enough textbooks and learner support material".

The Technology content matter that the teacher delivers should be obtained from the framework, work schedule, textbooks and the pedagogic content knowledge. This was found not to be the case with the participants as one responded: "We want to be supplied with pacesetters, scheme of work and draft lesson plans". This was confirmed as I requested to view their lesson plans before they presented, but many could not provide it. Only two out of five schools engaged collectively in the development of the Technology learning programme.

#### 2.3.4.3 Theme 3: Assessment in Technology

An interview question under this theme sought to establish whether teachers really knew the difference between assessment and evaluation in Technology. The question further wanted to establish which assessment methods Technology teachers were acquainted with and applied during their instruction. "We are assessing skills, knowledge, attitude and values. We evaluate learners' performance", one teacher said. Many confined themselves to assignments, class work, homework, tests and examinations, which seemed to confirm my observation that teachers did not do any projects or tasks with their learners as these options were not ticked off in the questionnaire. "Technology at our school is not taken into consideration because learners are not doing any practical work", one interviewee declared. When asked as to whether they had a copy of provincial or national assessment manuals only three said they had.

#### 2.3.4.4 Theme 4: Support in Technology

Teachers would like to see technological support flowing from within and outside their schools so as to develop in TLA: "The principal should develop interest in Technology education so that he cannot have a problem in allocating a budget for Technology education"; "… mentors will be highly appreciated to visit the school regularly"; "… parents should take part also". During the years 2010 and 2011, I took on the role of the mentor and a subject advisor at those selected schools with the Technology teachers when I visited the schools. The teachers urged their SMTs to take Technology seriously and to allocate both its budget and teachers accordingly. The responses from the questionnaire indicated that support from the district office was rated the least compared to their colleagues and their SMTs. The response of district support did not surprise me since the teachers said in the interview that they did not have any district-based subject advisor for Technology Education.

#### 2.3.4.5 Theme 5: Resources in Technology

Observation confirmed lack of textbooks for both teachers and learners as none could be seen from the learners and the teachers were sharing a textbook at some schools. From the interviews it was evident that resources were a pressing need for the effective teaching of Technology. Respondents from different schools shared the same sentiments, as they argued: "… we don't have enough resources"; "I guess it's a hands-on subject and no resources are available"; "… learners should be encouraged to buy necessary resources if needed". Teachers called for the DoE of Limpopo Province and their schools to intervene in terms of providing resources: "The department must also provide resources so that learners can work in groups to complete projects"; "We need to have a workshop centre where learners can be taught some practicals. The school must have its own resources to help learners familiarize themselves with those Technology materials"; "I recommend that the school provide Technology resource centre". In all the selected schools I observed that none had set aside any room(s) for Technology practicals.

#### 2.3.4.6 Theme 6: Curriculum policy interpretation, implementation and learning outcomes

"I don't think the challenges I meet as stated would have happened should I had Technology policy document as a guide", remarked one Technology teacher during an interview. I requested participants to show me their Technology curriculum policy documents but none one had, even though a few gave an excuse that they had but could not locate them then. When they were asked in the interviews or questionnaire about the interpretation and implementation of the curriculum policy their responses pointed in one direction, that is, they did not have them but if they had did they could not interpret or implement them: "I don't know the learning outcomes"; "we don't have the policy documents at our school"; "I don't know LOs by heart, I have to refer".

#### 2.3.4.7 Theme 7: Teacher-learner ratio

Large numbers of learners within a class deprive them of active participation and limit their thinking process, and classroom management becomes a challenge. I observed that teachers' movement within a class and their interaction with the learners was also restricted due to over-crowdedness. It was difficult for me to have a chair or even a space to sit down. The teacher-learner ratio ranged from 1:60 to 1:90, which proved to impact on a few factors, for example, although the schools had monthly schedule for tests the interview findings indicated that the turnaround time for marking learners' submitted tests took a minimum of two to a maximum of three weeks. Marking overlapped into the next test dates. "The department needs to improve the teacher-learner ratio so that an educator is faced with a manageable class" said one teacher.

The next section revisits the research question to confirm or disconfirm the problem statement.

## 2.4 DECISION ON THE MAIN RESEARCH PROBLEM CONSIDERING FINDINGS OF THE RECONNAISSANCE STUDY

After the analysis of the findings drawn from the reconnaissance study the research question was stated in accordance with the challenges raised by the teachers. It would appear that the findings from the themes as discussed confirm challenges they faced. The challenges still centre on teachers' lack of knowledge as cited in 1.2 and are confirmed by the findings. It is assumed that poor or lack of Technology Education capacity in Limpopo Province has left the teachers with the frustrations related to the implementation of TLA in the senior phase. It became apparent that TLA is a discipline with its own content and cultural phenomenon, thus posing these challenges to its teachers. TLA teachers still have to establish the academic basis of this new subject (de Vries and Tamir, 1997:04), a situation compounded by the majority of Technology teachers in the country having to make a transition from what they specialise in from their teacher training so as to teach this relatively new learning area of Technology Learning.

The challenge that Technology teachers faced as reported in the findings seem to address to a greater extent my stated research question in 1.4. Based on the above findings from the preliminary AR investigation, I decided to rephrase only this research question as the one that been explored and stated in 1.4 was confirmed and attested to by the findings. Thus, the main research question is stated as:

> **How could action research intervention be used to improve the teaching of senior phase Technology teachers who are un- and/or under-qualified?**

This research question was my final main research question that the entirety of this study addressed. In accordance with the main research question the research sub–questions are also maintained. These sub-questions sought to find out more about the participants' Technology teaching:

- What is the nature of teaching Technology?
- How do senior phase Technology teachers at selected schools of Limpopo Province teach Technology?
- What are the AR-based intervention strategies that can be employed to improve teachers' Technology teaching?
- How can senior phase teachers be emancipated to teach TLA with confidence and every chance o success?
- Based on the intervention strategies and findings of the study, what teacher-centred guides for Technology teaching can be proposed?

These challenges suggested an intervention to a greater extent in order to emancipate teachers from their incapacity stage. The first AR intervention prioritised the identified meaningful topics (themes) from the findings to be looked into during the main AR activities, namely Technology curriculum policy, Technology content knowledge, Technology material resources, Technology lesson planning, methods of teaching Technology and skills, teacher support, and assessment in Technology.

While these TLA teachers are in transition, an intervention in the form of AR is envisaged to bridge the Technology knowledge and teaching gap. Thus, their challenges in regard to the teaching of Technology are addressed through the main AR activities detailed in Chapter Four, a literature study on the above listed topics to be conducted in Chapter Three.

## 2.5 DEVELOPMENT OF THE MAIN ACTION RESEARCH STUDY

Hoban (2005:1) stated that:

> *"teaching is more complex than it has ever been before. We need teachers who are reflective, flexible, Technology literate, knowledgeable, imaginative, resourceful, enthusiastic, team players and who are conscious of student differences and ways of learning."*

It can be possible to produce such a teacher through AR, and as Cohen and Manion (1994:217) state in this regard, *"action research is a small-scale intervention in the functioning of a real world and a close examination of the effects of such intervention"*. With a sample of Technology teachers from selected schools in Limpopo Province, I made some interventions and monitored their efficacy through the AR cycles.

Action research phase 1, as depicted in Figure 2.3 (below), is the reconnaissance phase in AR. This is a minor phase of the study for fact-finding purposes. AR Phase 1was implemented to check my assumptions and claims. It was a minor phase which served as a catalyst to shape the study further. The phase confirmed that the main research question was viable with minor rephrasing. This phase laid a solid foundation for further inquiry to unfold in the main AR Phase 2.

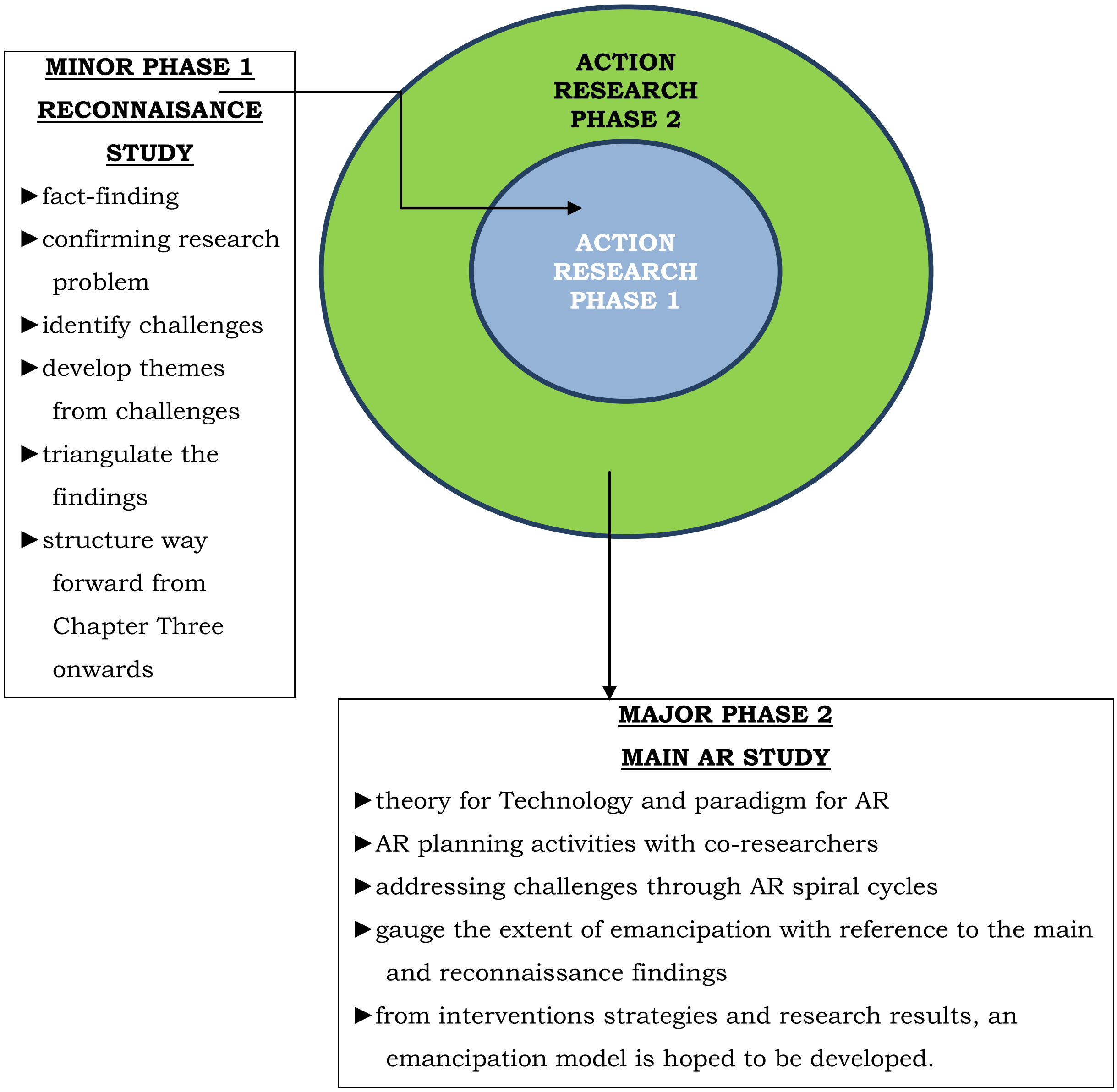



**Figure 2.3: Minor and major phases of the AR study**

Research is an important way in which the field of Technology Education can become further established and teachers empowered. If one agrees that schools constitute the primary site of inquiry in Technology Education then the ethos of classrooms and laboratories in which the subject is taught must be a prime area of research need (Lewis, 1999). As schools can be used as a chief research base, the theories, methods and procedures chosen for the purpose of this study were found to be more applicable at schools around the Capricorn District. These are described in Chapters Three and Four respectively as part of the study Phase 2. Phase 2 attempted to respond to the concerns and challenges raised by Technology teachers during the empirical reconnaissance investigation, and are the major phase of the AR study. This phase was implemented later as the main methodology of the study, in which I met with participants on a regular basis for AR cycles. The contact session programme with the co-researchers is attached in Appendix 2.1. I trusted that both the main research question and sub-questions would be addressed subsequently during Phase 2 within Limpopo Province.

The province and region, district, circuit and schools used during the reconnaissance study were unchanged during the main empirical inquiry, to make data valid and legitimate, as pointed out in Section 2. The techniques integrated in the main study are explained in the research methodology Chapter Four. During the reconnaissance study three techniques were used to collect data. In this main study I included additional techniques that I perceived relevant to respond to the main research question, guided by the findings of the preliminary study. The incorporated techniques from observations, interviews and questionnaires are photographs, video-recordings, document analysis, field notes, rating scales and workshops. I planned that the participants and I would test the intervention, thus leading to a redesign based on reflection and re-implementation of the plan.

I involved co-researchers with the emancipation paradigm, also known as critical theory (CT), during the cause of the Technology enquiry. I thus engaged the participants with major AR theories, namely: action science theory, cooperative inquiry theory, developmental action inquiry theory, living theory, and participation action research (PAR) theory, which I regard as intervention paradigms. Ontologically, as a critical realist, I was in search of the truth or reality which took place during Technology teaching. Epistemologically, I ascertained if I could make any positive change with this study after being exposed to Technology teaching reality as an interventionist. My knowledge interest regarding improvement was to bring about change in the way which teachers thought about their teaching of the TLA. Methodologically, I strived for trustworthiness. Miles and Huberman (in Robson, 1993:402) averred that: *"each action researcher is a one-person research machine who defines the problem, does the sampling, designs the instrument, collects the information, reduces the information, analyses it, interprets it and writes it up"*.

## 2.6 CONCLUSION

This chapter has presented the findings of the minor empirical research, reconnaissance study (Phase 1) in terms of themes. Technology teachers' challenges were spelled out from the findings. Most importantly, the chapter drew me to making a decision about the main research problem, which was to maintain it as confirmed by the findings, with minor rephrasing.

I briefly explained how the study developed from this point onwards (Phase 2). It was assumed from the findings that the Technology gaps which existed in the teachers could be bridged through AR interventions. I saw and heard participants' challenges; therefore in the chapter that follows I act on what I learned from the findings. It presents the preamble challenges raised by participants as central topics from a theoretical point of view.

# CHAPTER THREE

# THE NATURE AND ASPECTS UNDERGIRDING TECHNOLOGY EDUCATION

*Trying to define the variable Technology is like the mathematician's endeavour to contrive integration formula to calculate one's number of hair* (Mapotse, 2001:7) – *ipisissimaverba.*

## 3.1 INTRODUCTION

Teachers are generally faced with challenges in their teaching of Technology, as was made explicit in Chapters One and Two. The introduction of the new learning areas in the General Education and Training (GET) band, of which Technology is one, compounded the problem even further (Chisholm, Volmink, Ndlovu, Potenza, Mahomed, Muller, Lubisi, Vejevold, Ngozi, Malan, and Mphahlele, 2000:7). These challenges can also be understood in reference to the political transformation from the apartheid education system to the current one, which has shaped the training and development of teachers in general. It is against this backdrop that Gittings (1988:6,16), Ankiewicz (1995:1), and Van Rensburg, Myburgh and Ankiewicz (1996:1) postulated that no educational discussion in South Africa can be entered into without taking into cognizance of the country's historical and political background. Guided by these challenges, which were confirmed through the preliminary study as reported in Chapters One and Two, this chapter discusses aspects undergirding Technology Education as can be extrapolated from the existing scholarship. These challenges are discussed as themes in this chapter to provide their theoretical perspective, and include curriculum, Technology teachers, policy and support, resources and assessment, content knowledge and planning as part of preparation for Technology teaching and its contextualization. These themes will address the first objective in Chapter One (1.3), which aims to discuss the nature of teaching Technology. However, it was deemed necessary first to ground the study theoretically and outline developments in Technology Education.

## 3.2 THE THEORETICAL FRAMEWORK GUIDING THE STUDY

The importance of a theoretical framework or a thorough literature study at the beginning of scale development was identified in 1952 by Goode and Hatt (in de Vos, Strydom, Fouche and Delport, 2002:192), who suggested that the researcher first have a thorough knowledge of the subject regardless of the technique employed, and systematically exploit that technique and that of others through a careful study of literature. For the purpose of this study, critical theory was used in the Technology literature study, as outlined in the theory script in textbox 3.1 (lead sentence from Creswell, 1994:90). This script displays how action research was integrated with Technology in the context of teachers' knowledge and pedagogy of TLA by using critical theory. Teachers' emancipation could be predicted as a result of this intervention.

**Textbox 3.1: Technology theory script**

| |
|---|
| The theory that I used is critical theory. It was developed by Frankfurt School using the writings of Karl Marx, and it was used for emancipation and self-determination. This theory indicates that there is fundamental dialectical relationship that theory and practice are indivisible especially in technology. As applied to my study, this theory holds that I expected the intervention through action research to influence the teaching practice of senior phase Technology teachers in selected schools of Limpopo Province. Hence, my assumption was that engaging teachers in critical theory had the potential to improve their understanding of delivering Technology within their context. |

Information transcription adopted from Tooley (2000: 94-95).

Critical theory, as first defined by Max Horkheimer of the Frankfurt School of sociology in his 1937 essay, *Traditional and critical theory*, is a social theory. In this study it is oriented toward critiquing and changing Technology teachers, in contrast to traditional theory, which is oriented only to understanding or explanation. Critical theory has two meanings, criticism and critique, derived from the Greek word *kritikos* meaning judgment or discernment (Critical Theory, 2010:02). The study will develop awareness of the Technology teachers so as to pass judgment on their teaching of Technology and evaluate their knowledge base of Technology with the sole reason of emancipation. Theory informs thinking which in turn assists in making research decisions and sense of the world (May, 1993:20). Theory is also an explanation of how and why a phenomenon operates as it does, and it serves the purpose of making sense out of current knowledge by integrating and summarizing it, and thus it can be used to guide research by making predictions (Johnson and Christensen, 2004:58). Critical theory has an emancipatory intent. It engages in the real world challenges, in the context of this study, conventional Technology teaching practices and ideas, including ideals of developing understanding of how the research collaboration justifies Technology action (Gibson, 1983:44). It explains, theorizes and enables more control over participants, emancipatory endeavour being its prime characteristic (ibid.). It follows that the most important aspect of critical theory is emancipation, as with the absence of this praxis its positioning cannot be validated within the paradigm of critical theory. In examining critical theory further, Tooley (2000:95) states that, *"in a fundamental dialectical relationship, theory and practice are indivisible"* (as mentioned in the theory script). This makes sense since Technology Education is a 'hands-on' subject. Its core content and themes, based on definition, stress that the outcome should be a product, artefact, model, ornament, or new systems and processes.

The emancipation of the Technology teachers through critical theory is a viable option, given the need for them to develop a sense of their current knowledge and teaching of TLA and how it could be critically transformed with the mission to empower them. Freire (Pihama, 1993:40) wrote that, *"Cut off from practice, theory becomes simple verbalism. Separated from theory, practice is nothing but blind activism"*. The participants were engaged in both the theory and practice in their teaching contexts. Theory was extrapolated from both the Technology policy and circuit work schedule on themes to be taught each term. Experiential learning is considered a powerful tool in ensuring meaningful learning in Technology in terms of combining theory and practice. 'Hands-on' in Technology must be taken to refer to learning-through-experiences, that is, through practical engagement in investigating, designing, making, evaluating and communicating ideas and plans (DoE, 2003a:26). The participants' practice was from both the prescribed projects per work schedule with their learners and lesson presentation following core themes. However, as Habermas (1974:59) commented on the approach to applying a conscientisation process to formulate emancipation, this is uncertain as engagement of emancipation outside the praxis can perpetuate existing discourses and relationships, because there is no measure, model of comparison or direction. Chapter Four will reveal and reflect on both the discourse and the praxis that the study has taken. It is expected that it cannot be measured or lead to the Technology teaching's emancipation model.

The upcoming section gives a brief overview of how the global communities have taken the initiative of developing a Technology Education curriculum within their schools' curricula. It is not since that South Africa also introduced Technology Education in its curriculum, so the trend of development globally impacts on local imperatives.

## 3.3 INTERNATIONAL DEVELOPMENTS OF TECHNOLOGY EDUCATION

Guided by the parameters of the current study I provide sketches and descriptions of the developments of Technology Education in selected contexts. According to Madaus and Kelleghan (in Rasinen, 2003: 31), a curriculum consists of six components, namely content, general objectives, specific objectives, curriculum materials, transaction and results. These served as one dimension of comparison for the study conducted by Rasinen in 2003. A second dimension that Rasinen used included three elements, rationale and content, implementation goals and other observations. In the past decennium there has been an increase in attention paid to Technology Education worldwide. Many countries have either made dramatic changes in an existing school subject or created a new subject in the curriculum. Much rhetoric was used to defend these changes and/or introductions. Technology Education, according to some, was to be the core subject of a curriculum that would integrate knowledge and skills from various other school subjects, such as Crafts, Science, History, and Economics (de Vries, 1999b). The primary sources for curriculum information are displayed in Table 3.2 from Rasinen's (2003:31) study.

**Table 3.1: Technology Education developments in six countries**

| | |
|---|---|
| Australia | *A statement on technology for Australian schools, A joint project of the States, Territories and the Common wealth of Australia* (Australian Education Council, 1994). |
| England | *Design and technology in the National Curriculum 2000* (Qualifications and Curriculum Authority, 2000). |
| France | *Nouveaux programmes de 6e* (Ministère de l'Éducation, 1995).<br><br>*Nouveaux programmes du cycle central* (Ministère de l'Éducation, 1997). |
| The Netherlands | *The new core objectives for the subject Technology in the Netherlands* (Huijs, 1997).<br><br>*Development of technology education* (de Vries, 1999). |
| Sweden | *Kursplaner för grundskolan* (Utbildningsdepartement, 1994). |
| United States | *Technology for all Americans: A rationale and structure for the study of Technology* (International Technology Education Association, 1996).<br><br>*Standards for technological literacy: Content for the study of Technology* (International Technology Education Association, 2000). |

All of these documents were regarded as nationally accepted guidelines for Technology Education within the countries concerned at the time the study was conducted. The earlier major developments in Technology Education in England (DFE, 1995), Scotland (Scottish Executive, 2000), New South Wales, Australia, Board of Studies (1993), and the USA (ITEA, 2000) suggested a variety of concepts necessary for the understanding of

Technology Education at the elementary stages of learning (Thompson, 2001:5). The last two to three decades have seen Technology Education emerge as a subject in its own right in many countries (Jones, Buntting and de Vries, 2011:05), of which South Africa is one. To demonstrate this, *The International Handbook* describes the historical developments of the subject within ten countries, namely England (Benson, 2009), France (Ginestié, 2009a), Finland (Kananoja 2009), the USA (Dugger, 2009), Canada (Hill, 2009), Australia (Middleton, 2009), New Zealand (Jones and Compton, 2009), India (Natarajan and Chunawala, 2009), Mainland China (Ding, 2009) and South Africa (Stevens, 2009). These global developments triggered a need to introduce Technology Education as a school subject to prepare learners for the new industrial demands (Gumbo, 2010:5-7). As Technology is in a continuous state of development and growing demand this calls for teacher emancipation to cope.

It is in this context that the teaching of Technology in South African schools can be examined, and the approaches are also important to understand how it was approached in the current study.

## 3.4 TEACHING APPROACHES BASED ON TECHNOLOGY DEVELOPMENT

Different states and their schools considered diverse models of curriculum approaches from which to choose based on the global trend in the development of Technology. These approaches are explored in this section because they played a role in curriculum reviews of different countries, including South Africa (Black, Raizen, Sellwood, Todd and Vickers, in Gumbo and Makgato, 2008:48-54).

### 3.4.1 Craft approach

This approach is characterized by knowledge and skills about materials to transform them into fabricated objects; cultural and personal value; traditional design; learning activities that involve making things based on prescribed designs; and classrooms that are equipped with machines and tools from wood working, metal working, electrical, catering and textile trades. The emphasis is more on psychomotor skills and less on design.

### 3.4.2 Occupational/vocational approach

This is characterized by hands-on transformation of materials into products; current industrial practice skills; and classrooms that are equipped with machinery from industry.

### 3.4.3 High-tech approach

This approach is characterized by modern technological industry and desire to shape the skill base of future workforces.

### 3.4.4 Applied science approach

This approach is defined by the scientific approach; use of science to explore new applications of technology; and the study of science and technology in close association with each other.

### 3.4.5 Technology concepts approach

At the core of this approach lies learning processes that cause technological developments; theoretical understanding rather than practical action; and systems concept.

### 3.4.6 Design approach

This approach is characterized by practical capability; active learner involvement in tackling realistic problems; and design-make-evaluate activities. Its emphasis is on learners' own decisions about what kind of product is needed and what the product would look like, how it will work and how it should be made.

### 3.4.7 Science-Technology-Society (STS) approach

This is characterized by curricula organized around societal issues; connections between classrooms and the outside world; the study of technological innovation as a driving force for social change; and problem-solving.

### 3.4.8 Integrated subject approach

This approach integrates several subjects into a framework that provides understanding of the discipline of Technology and its interrelatedness with others, e.g., Science, Mathematics and Technology.

### 3.4.9 Approach adopted by South Africa

The situation has changed in many ways in South Africa since the collapse of apartheid policies and a new democratically elected government. The educational system had previously reflected a system of government with separate departments for each racial group overseen by a Department of National Education (Williams and Williams, 1996:278). Williams and Williams (1996:279) further point out the reason for including Technology Education in the curriculum is to enhance: a) an opportunities for the disadvantaged; b) the technological nature of society; c) international recognition as a significant aspect of the curriculum; d) national economic problems; e) possibilities of personal development in cognitive skills; and f) creative thinking and problem solving. Hence, South Africa has to come up with her own approach to addressing these core reasons for introducing Technology Education.

The background to approaches presented in this section, which casts light on the motive behind the Technology Education curriculum reform, coupled with contextual specifications, informs the manner of addressing the themes raised by participants in the case of South Africa. Technology teachers can contextualize their teaching only if they are aware of what their education ministry's has adopted and adapted as their technology approach. In C2005, South Africa adopted the design approach, in accordance with 3.4.6 above, of design-make-evaluate (DME). The DME approach was adapted in the NCS and modified to investigate – design – make – evaluate - communicate (IDMEC), termed the technological process. Some Technology scholars use both the design and technological processes as synonymous (Pudi, 2007:70), which in the case of South Africa I regard as the method of teaching Technology as displayed in textboxes 3.1 and 3.2.

The Technology discussion document of the DoE (April 1997:86) typifies the technological process as *"the cycle of investigating problems, needs and wants by designing, developing and evaluating the solutions in the form of products and systems".* While Johnsey (cited in Gumbo and Makgato, 2008:23) gives a clear and precise definition of a process as a way of going about achieving an end and the separate parts of a process as skills, Mapotse (2001:59) writes that the technological process is the basis of all technology endeavours. An understanding of the process is fundamental to the acquisition of Technology literacy. The technological process is integrated and indivisible and therefore assessment should apply to the whole process. In many Technology sources the term 'technological process' is interchangeable with 'design process', the components of which Mapotse (2001:60) Garratt (2004:9), Gumbo and Makgato (2008:25), and Technomoodle (2010:2) describe as follows:

- Define the problem clearly and fully. Ask yourself, what is the problem that I am trying to solve? That is a brief.
- Brainstorm the ideas, individually or in small groups to propose possible solutions. At this point, all possible solutions should be considered, no matter how extreme they may seem.
- Research the idea and problem. Start by searching for existing solutions to similar problems. Analyze both the good and bad solutions.
- Identify criteria on what the product or system must do, for example, the boat hull must carry 2 kg of weight and be 800 cm long without tipping or sinking.
- Specify constraints, i.e., the limits imposed on a design solution. This is often related to resources. Write a specification, for example, the boat hull must be more than 50 cm and less than 100 cm long.

- Select an approach, decide on a design that meets the specifications, fits within the criteria and constraints, and has little negative effects. Select a preferred solution.
- Lay out the design using technical sketches, and then create detailed orthographic multi-view drawings. Prepare the working drawing and plan ahead.
- Create a model or prototype, a model being a scaled version of the final product with all parts in correct proportion to the object and a prototype being a full scale fully operational version of the solution.
- Test and evaluate the design, seeing how well the design satisfies the original criteria and constraints. Examine the solution's strengths and weaknesses. Change variables that affect the performance of the design.
- Create the artefact and the final design with all the changes, improvements, and modifications. That is constructing a prototype.
- Communicate results, sharing solutions and how you obtain it with others. Write a report.

The next section draws attention to all the challenges as one conceptual entity, namely curriculum transformation in South Africa since 1994.

## 3.5 SOUTH AFRICAN CURRICULUM TRANSFORMATION

In 1995 the Ministry of Education commissioned the first ever National Education Audit, which highlighted the fragmented provision of teacher education, a mismatch between teacher supply and demand, and high number of unqualified and under-qualified teachers (Department of Education, 2006a:6). The report revealed that teachers then in the system mirrored apartheid, since a high number did not possess any form of teaching qualification. The audit occurred before the introduction of Technology as a compulsory subject in the GET band and prompted a reform, transformation and review of its curriculum. Curriculum represents a selection of ideas, skills, values, norms and practices available within a society. It is concerned with the nature of knowledge, how we know and how can we prove what we know. It is concerned with questions about the nature of reality, known as *ontology*, and the question that influences students, that is *axiology* (Smith and Lovat, 2003:12-13).

Kimbell (1996:99) cautions that, *"the centralizing influence of a national curriculum runs the risk of placing a dead weight on innovation, discouraging imaginative teachers and schools from developing their curricula"*. In South Africa, the Technology curriculum is centralized nationally, the difference of which is the nature of knowledge that the teacher has to show in delivering it. I differ with Kimbell's assessment based on the South African context, in that even though the curriculum is centralized, what is important in the case of Technology is the teachers' ability to contextualize their teaching. Following the advent of universal suffrage in South Africa there has been a need to transform the curriculum, as expressed in Chapter1 (1.1), to address both the ontology and axiology (Smith and Lovat, 2003:12-13). Of importance to the study, the transformation aims to represent the aspirations of all structures of society, and this fits well in addressing learning outcome three of Technology, which has to do with the contextual knowledge.

The majority of South African teachers have grappled with an education system that has been in the throes of rapid transformation sparked by the student cohort of 1976 (SA Soweto students upraising). Technology teachers are now challenged to exert their professional judgment, curriculum expertise, teaching prowess and management skills in the interest of learners, school communities and the nation (DoE, 2003b). This is informed by the nation's national curriculum being at the heart of its education system. The curriculum is a primary source of support and direction for learning and teaching in the education system (Motshekga, 2009a:11). The education transformation journey travelled thus far in South Africa is displayed in Figure 3.1, which represents the South African educational changes since 1994. The Figure displays curricula reforms from the Report 550 to Curriculum and Assessment Policy Statement (CAPS).

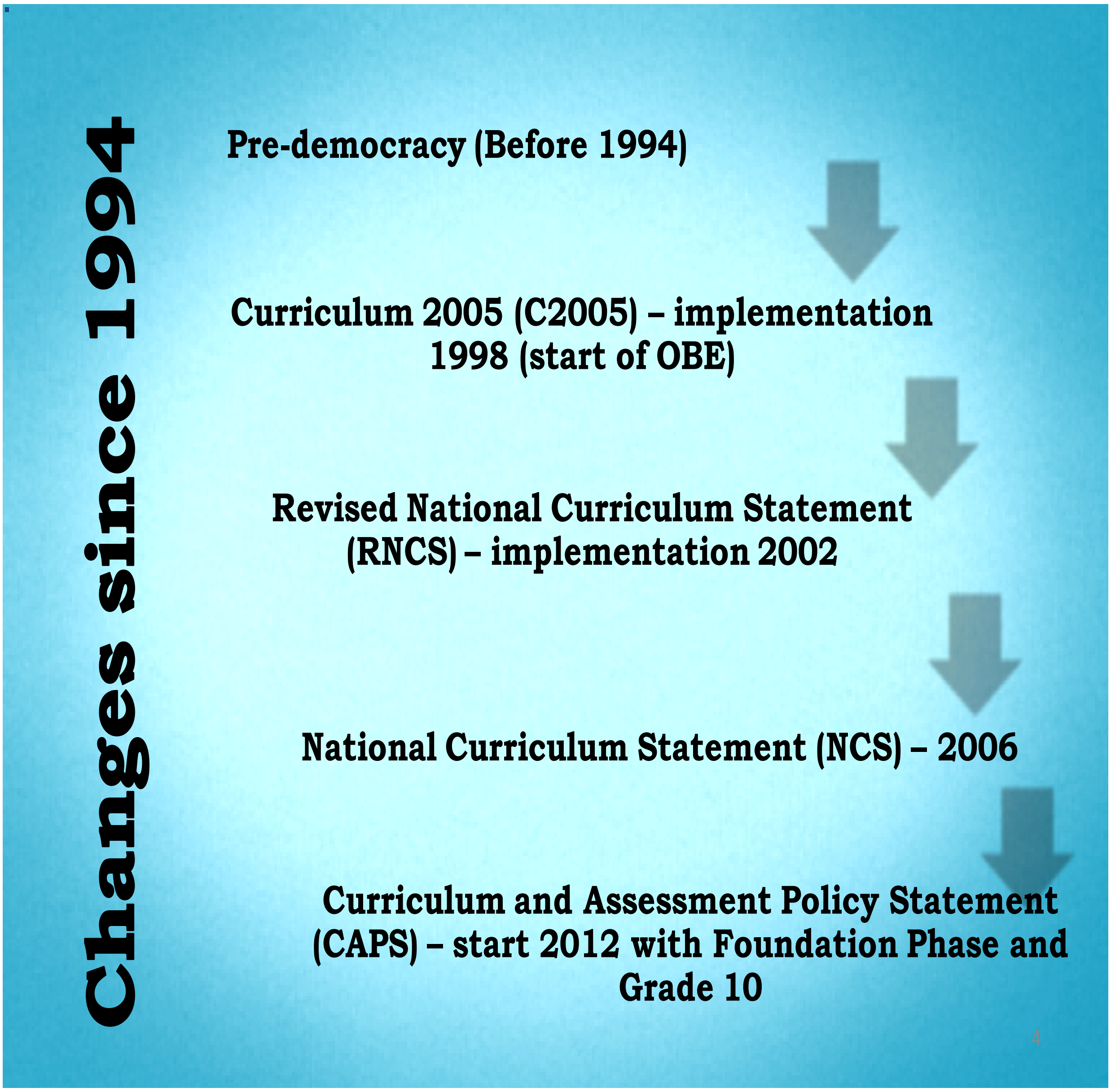



**Figure 3.1: Education transformation in South Africa** (adapted from de Jager (2011:1).

Curriculum transformation therefore has a profound influence on the other challenges raised by Technology teachers. Although 1994 brought many changes, some felt that the government should not interfere with education, while others argued that democratization of the government should result in the democratization of education (Pudi, 2002:19; Chisholm, 2004:13; Mahomed, 2004; Carl, 2005:223). In either case, the education system in South Africa has gone through a democratization process, which paved the way for a new curriculum that put both TLA and its teachers in the limelight. This process has left both teachers and parents feeling that the curriculum has many challenges, as cited in Chapter 1(1.1). Teachers generally feel disempowered by this transformation; hence I opted to engage them as co-researchers in this study for emancipation purposes.

The Minister of Basic Education, Angie Motshekga (2010:2) has stated that, *"curriculum reform is not something that the system takes lightly. We need to work against change fatigue in order to restore confidence and enthusiasm amongst all stakeholders"*. The transformation processes since 1995 have involved not only a new curriculum but also a new approach to teaching and learning (de Jager, 2011:144). Van Wyk (2007:23) contends that, "in the new curriculum the issue is not *what* is taught but *how* it is taught". Senior phase Technology teachers in Limpopo and elsewhere are expected to acquaint themselves with the new approach of teaching and learning Technology, as highlighted in 3.4.9. The *how* of teaching Technology is what this study seeks to address.

The DoE introduced the Technology 2005 (T2005) project as part of the outcomes-based education (OBE) approach into public schools in three of the nine provinces during 1995 (Potgieter, 2006:515; Gauteng Department of Education, 2010:17). The OBE approach was criticized for the confusion it brought in the education ministry (Department of Education, 2000; 2002; Chisholm, 2003; Chisholm, 2004). As stated in Chapter One, OBE was withdrawn from the education system in 2009. Patience's (1995:381) argument is still relevant, namely that:

> *"… the education system is very much in the state of flux and experimentation with many pilot studies being conducted. Guidance is sought from international models and successes to see what can be applied in South African context. The state is treading very carefully*

*because there is a lot at stake both financially and in terms of human resource".*

The successful implementation of the Technology curriculum is dependent on teachers having a solidly established personal construct of technology, equivalent to that of the curriculum (Tholo, Monobe & Lumadi, 2011). This was true for T2005 as teachers were not accorded an opportunity to establish personal construct of technology.

The DoE abandoned the T2005 project due to financial constrain (T2005, 1996), a decision that added to the constraints of growing teachers in the subject (Stevens, 2006:511). The project, initiated before 2005, had the potential and capability to empower Technology teachers from 1997 to 2005. Some interventions with them were sort and it was hoped to alleviate the incompetency constraints suffered by them as a result.

Patience (1995:381), Perry and Arend (2003:312) and the DBE (2010a:17) have offered a more concise and concluding summary of the effect of curriculum transformation in South Africa. The most significant changes since 1994 in terms of the employment and quality of teachers have been the increase in the number of un- and under-qualified teachers (Perry and Arend, 2003:312). This is attributed to the number of teachers hired within a school and being remunerated by the School Governing Body (SGB). The Department of Education on National Policy Framework for Teacher Education and Development in South Africa (2006:6) declared that since 1994 teachers have had to cope with the rationalization of the teaching community into a single national system, the introduction of new curricula which emphasized greater professional autonomy, and new knowledge and applied competences. Teachers require new content knowledge and the didactic on how to teach Technology and should be competent in the delivery of it. According to Patience (1995:379), curricula have to be made more relevant to the South African learners, and teachers need to be involved in this process of curriculum development to make them more receptive to these curriculum changes.

Findings from the reconnaissance study in Chapter Two have shed some light on how teachers in the field teach Technology without a textbook, a policy manual, support or resources. Having discussed the way in which South Africa curriculum transformation has affected teachers, the challenges raised in Chapter Two are now theoretically explored.

## 3.6 TECHNOLOGY TEACHERS' CHALLENGES

Challenges affecting Technology teachers can be divided into two areas. The first are those created by external factors, e.g., time allocation of 8% per week; resources; movement of teachers in and out of TLA; and planning by district and other stakeholders. The second are those created by internal factors, that is by teachers themselves, e.g., qualification; creativity to cope with limited resources; system and control; and teaching, assessment and reporting practices, especially through learning outcome 1 (LO1), integrating learning outcome 3 (LO3) into a task and planning (Moeng, 2009:18). Teachers' conceptualization of technology is complex and is influenced by a range of factors including how willing they are to change their own concept of Technology and Technology Education, their background experiences, the subject's sub-culture, and the level of support given to teachers during any change process (Jones, Buntting and de Vries, 2011:5). To a large extent, Technology teachers have adopted a 'wait-and-see' approach and are expecting a systemic curriculum direction, professional development, and provision of resources (INTAD and Warner, in Barnes, 2005:1). If Technology teachers in Limpopo were trained in the Technology teaching methods, content delivery procedures and value-laden process, they would move away from the wait-and-see approach to IDMEC. The majority of schools in the province are generally not taking Technology seriously, with most offering it to the senior phase only, as revealed during reconnaissance study and attested to by a yearly relocation of Technology teachers. The sporadic changes that have seen teachers poorly grounded in Technology, led to the following response by Western Cape Department of Education (2011:1):

> *"An understanding of the components of technological systems, such as input, process, output, feedback, sequence, interconnectivity and how a range of factors affect them are all part of developing technological knowledge and understanding".*

Technology teachers need teaching models that can help them to approach Technology meaningfully and teach it effectively, as argued in the next section.

### 3.6.1 Methods of teaching Technology

There is a need for teacher education that is based on the technological understanding beyond specialized expertise (Hansen and Olson, 1993:7), in turn helping Technology teachers manipulate strategies of engaging their learners in complex technological problem-solving strategies. The problem-solving activities will demand the application of technological processes from the learners' side, but Technology teachers should take the lead in directing them on how the relevant processes can be manipulated. At times these require analysis of existing products and systems, while principles underlying technological development, such as reliability, ergonomics, aesthetics, adaptation, modification, fitness of purpose, are examined and explored (Western Cape Department of Education, 2011:1). There are many reasons for learners to utilize a range of processes when developing their technological literacy and capability, as listed in 3.4.9.

Technology is a broad area that focuses on many core topics, such as structures, system and control, and processing. To present such topics to learners requires teachers to know and apply diverse technological methods. Mapotse (2001:61-62) succinctly discuses three methods of teaching Technology, namely, i) the IDMEC method – investigate, design, make, evaluate and communicate; ii) the Focus Task method – when a Technology teacher focuses his/her lesson on a specific task, e.g., measuring, soldering, or interpretation of a recipe, in preparation for the an upcoming project; and iii) the IDEA method – identify, disassemble, evaluate and assemble. This third method is used by large corporations and industries which want to improve their latest products in relation to their previous model and that of their competitors. However, whilst, the Technology curriculum policy of South Africa stresses the first, the IDMEC, the participants indicated during the interview and questionnaire that they knew nothing of it.

The Technology teachers therefore should be exposed to all these methods during intervention and interactions. These methods would provide learners with a broad concept of the nature of Technology, and awareness that technology is ubiquitous. Participants should be able to link the methods with learners' preferred learning styles and the range of processes they employ in learning Technology. It is incumbent on a Technology teacher to incorporate more than one method in teaching as this will make it more interesting to both learners and teachers (Williams, 2000:2). Knowing about how children learn, their knowledge construction, their use of multiple forms of intelligence, and their use of a variety of learning strategies enables teachers to plan for appropriate and relevant learning. It can inform the development of teaching strategies, programmes and curricula that best fit the needs of their children, whatever their age, aptitude, ability, or experience (Thompson, 2001:5). Ritchie (Wilson and Harris, 2003:233) identifies three critical features of teaching and learning Technology, which are significant for nurturing technological capability:

- Learning through practical experience
- An effective learning process that lets children construct their understanding of the world
- Learning within a social context.

The more Technology teachers and their learners engage in technological activities the more their confidence in their technological abilities is likely to be enhanced (Stables, 1997:51), but only if the merging of Science and Technology in the intermediate phase were to be accorded equal instructional percentage as part of preparing learners for studies in senior phase Technology. Johnsey (1997:201-207) proposes that, *"procedural skills be used strategically and concludes that greater recognition of the value of research activity in the primary school curriculum would enhance learning and provide a basis for design".* If learners can touch base with IDMEC especially the Grade 7 as the primary exiting grade of senior phase as Johnsey proposes, then learners will be ready for Grade 8 and 9 technologies which are housed in secondary schools.

The research activities advocated by Johnsey can be executed by learners in their technological tasks provided teachers have been exposed to such, for example:

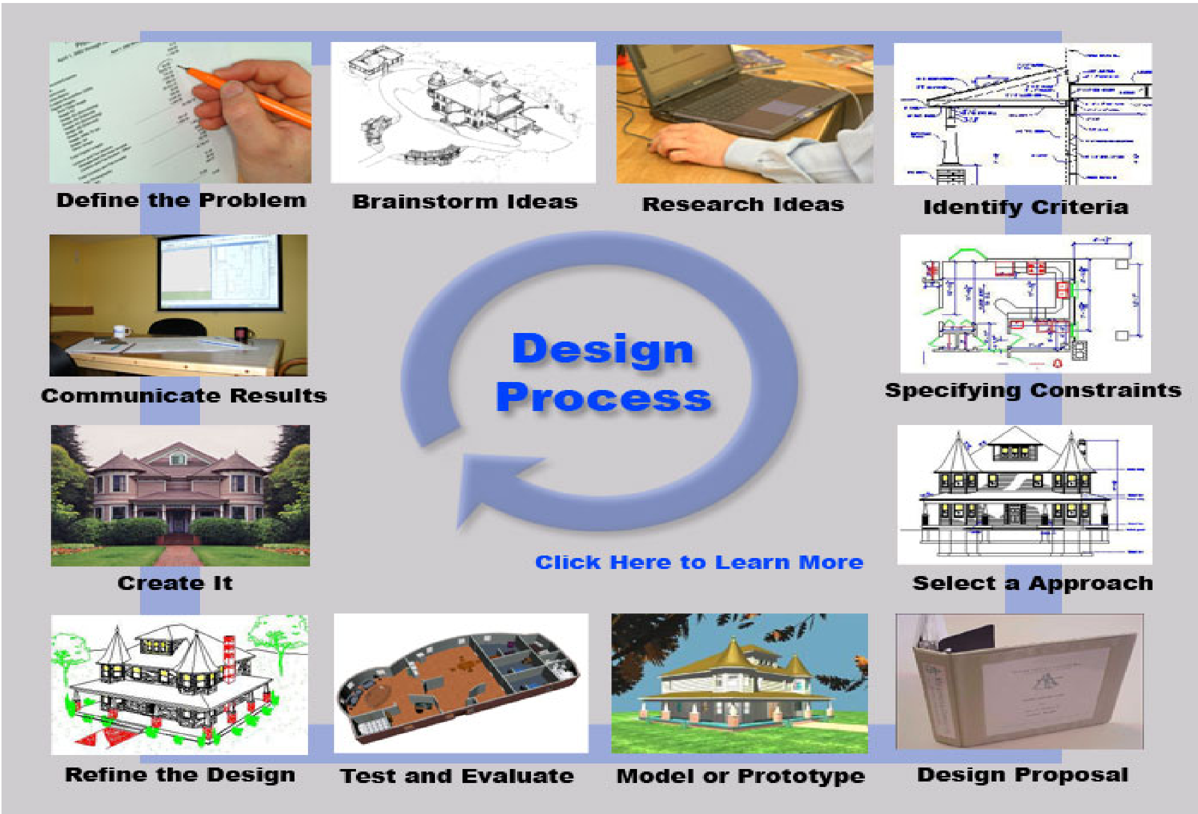
- *Case study tasks*: true stories about design and technology in the world outside the school, that is, investigations which aim to link learning at school with technological experiences in the wider community.
- *Resource tasks*: short, practical activities designed to engage with the capability task. Their purpose is to train learners in the skills of making and/or handling certain materials and knowledge gained.
- *Capability tasks*: longer, more open-ended tasks requiring designing, making and evaluating. They build on learning experiences derived from case studies and resource tasks and are based on design projects.

(Givens and Barlex, 2001; HEDCOM, 1997; Henak, 1992; McCormick, Murphy and Hennessy, 1994)

The operational approach to Technology is project-based, i.e., coherent units of work spread over an extended time. In teaching Technology the shift should be towards learner-centeredness because the nature of the technological design projects is that learners are to a great extent practically involved. The teacher should introduce new ideas and provide support for the learners to make sense of these for themselves (Department of Education, 2003: 26). Both the technological methods and learning styles could be incorporated better during teachers' teaching and planning.

### 3.6.2 Design Process models of teaching Technology

The design process can have many steps to follow in addressing a need. Picture 3.1 (below) displays 12 generic steps within the design process.




**Picture 3.1: The pictured model of the design process**. Source: Technomoodle (2010:1).

Within the current debate on the nature of technology and the appropriate form and content of school curricula for Technology Education, there is recognition that values are a central component, and a sense in which technology, both its products and its processes, represent the embodiment of the culture. People create the things they value, the things they think beautiful or useful, and devise tools, machines and systems to accomplish the ends they value. Beliefs, values, philosophies, experiences, in short culture, is manifested in part in the artefacts and systems they create Conway (1994:109-119). Technology offers many opportunities for learners to develop their capability, in particular, to intervene in the human-made world by investigating, designing, making, evaluating and communicating products and systems to meet people's needs and wants by solving problems (Western Cape Department of Education, 2011:1). Figures 3.2, 3.3 and 3.4 below) adopted from Ter-Morshuizen, Thatcher and Thomson (1997:11-12) display three model types of the design process respectively.

**a) The design loop model**

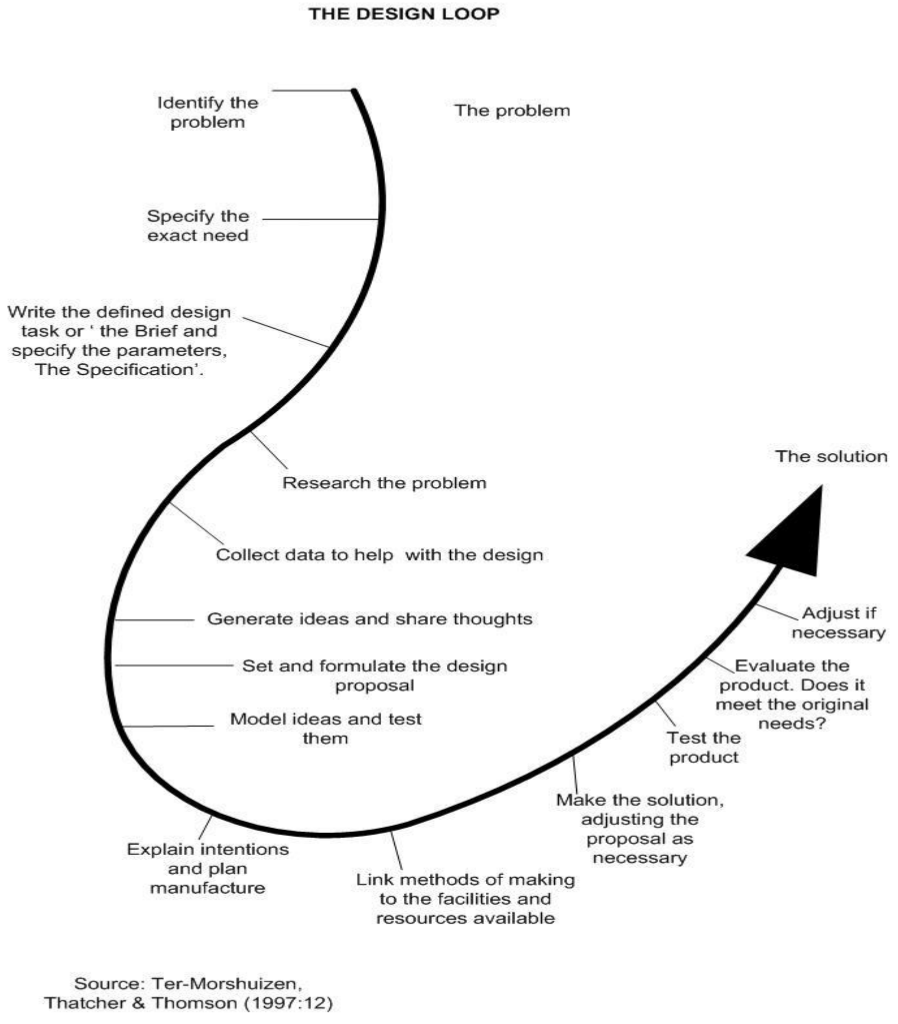



**Figure 3.2: Design loop teaching model of the technological process**

The design loop is the technological process that seeks to foster creative and critical thinking, effective group dynamics, management skills, research and information handling, communication and socio-environmental awareness on learners (Gauteng Department of Education, 2005:5). The design loop implies that the design process follows consecutive and progressive steps until the process has been completed. Figure 3.3, in particular, represents the linear model of the design process.

**b) The linear model**

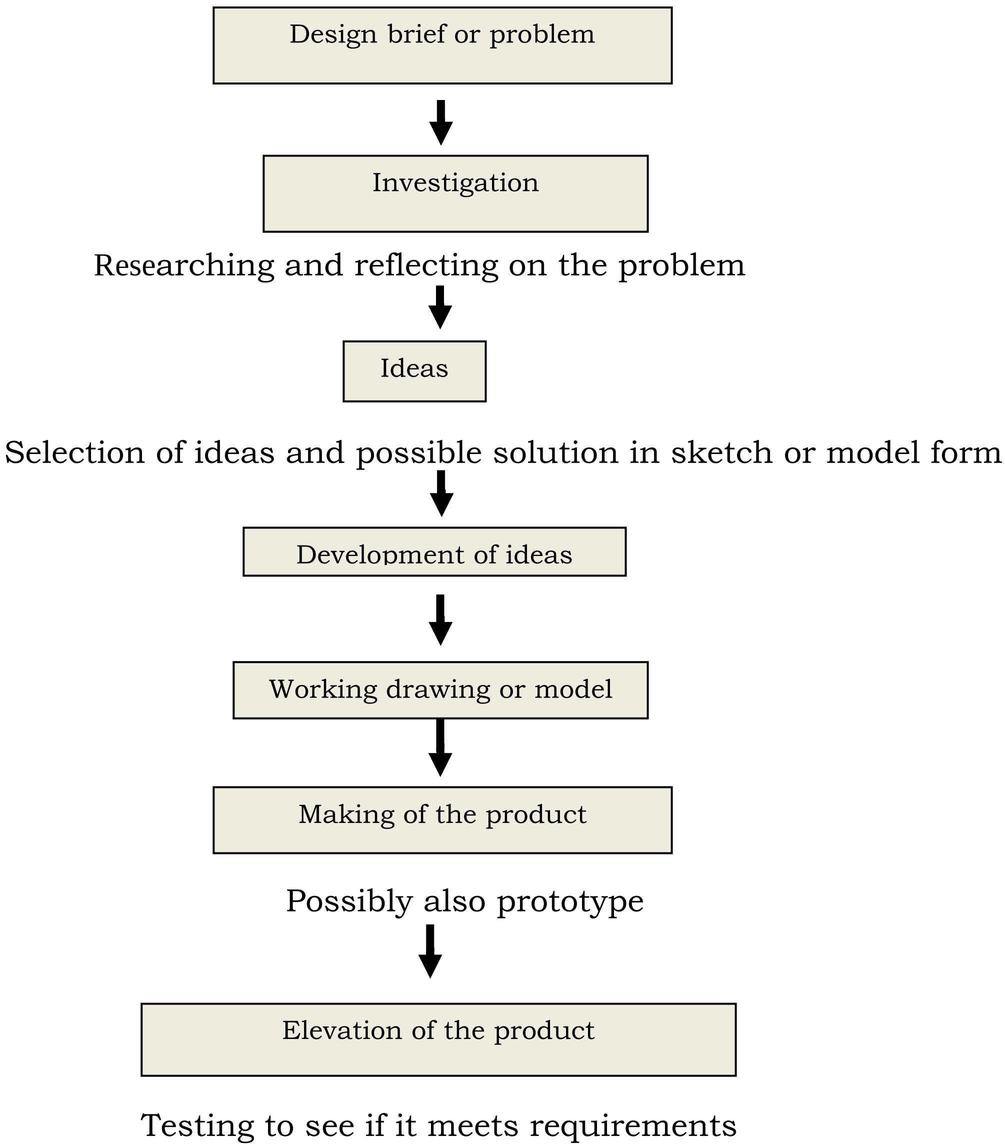



**Figure 3.3: Technological process: linear teaching model**

The model gives the appearance of logical, sequential flow of action. To integrate experiences or activities that involve tacit doing as a means of acquiring, or a complement to acquiring knowledge and abilities, the participants need to know how to incorporate the design process in their lesson presentation. The linear model of design process integrates the theory and practice, an approach that contributes to the development of individuals as informed participants in a technological society. The linear design process is sequential, beginning with the perception of a need, continuing with the formulation of a specification and generation of ideas and a solution, and ending with an evaluation of the solution (Ter-Morshuizen, Thatcher and Thomson, 1997:11-12). Technological capability is assisted by the steps of the linear model in the design process.

The circular model also implies that the design process follows consecutive, circular and progressive steps until it has been completed.

**c) The circular model**

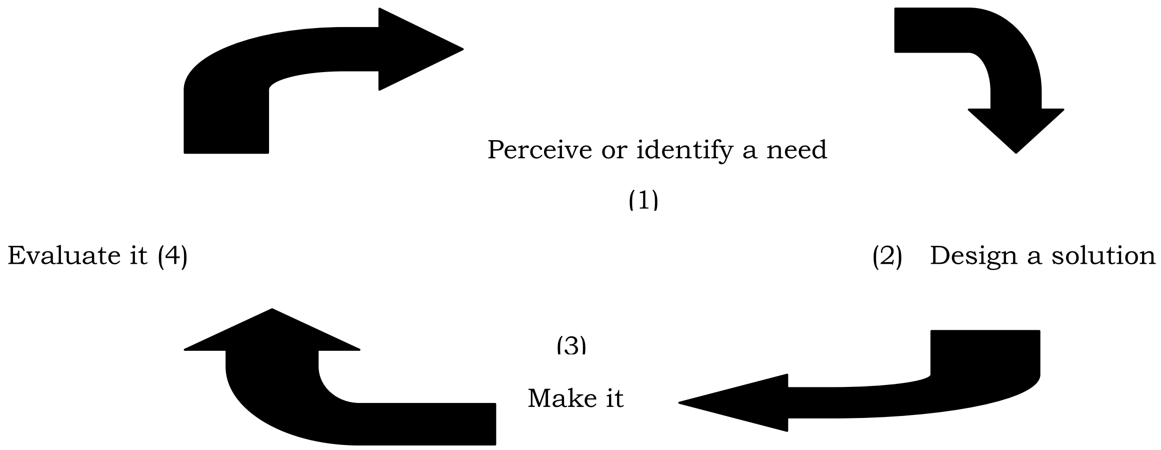



**Figure 3.4: Technological process circular teaching model**

Participants must have a clear idea of these steps in all the models displayed in order to implement technology effectively in their classrooms. The last model takes the formats of *lekgotla,* in which learners takes turn to act or reflect on an activity's progress while others listen and critically observe.

**d) The interactive model**

With the interactive model, learners demonstrate both reflective and active capabilities alternating. There is a constant interplay between thinking and doing; however, the design process is more than a series of progressive steps from problem to solution. There is also constant interplay between active steps and a range of thinking activities. Participants in Limpopo were introduced to different models of the design process illustrated in this section (Figures 3.2, 3.3 and 3.4.) In their condensed glossary, ITEA (2011:1) define 'design' as an iterative decision-making process that produces plans by which resources are converted into products or systems that meet human needs and wants or solve problems.

The participants were advised to apply any of the design process models during their containerization projects for Grades 8 and 9. The targeted individuals to be developed on how to use the design process in their project making were senior phase Technology teachers. We (the participants and I) had a session to discuss the planning of how to present containerization lessons to their learners, but left the choice of the design model to an individual teacher.

### 3.6.3 Technology teaching and planning

According to Nicholas and Lockley (in Williams and Gumbo, 2011:419), curricular changes have implications for classroom practice and teachers' concepts of what being a successful teacher of Technology means. This paradox is influenced by the fact that, unlike the other learning areas, which were repackaged from the Nated/Report 550 (pre-democratic dispensation curriculum) subjects, TLA appeared for the first time as a new subject in both GET and FET bands in the democratic era (Mapotse and Gumbo, 2012:139). To date, some teachers are still grappling with the pedagogy of Technology with regard to classroom practice and planning.

#### 3.6.3.1 Teaching in Technology class

The new curriculum raised demands for the training and re-training of teachers. This included pre-service training at different tertiary institutions and traditional approaches to emancipation such as in-service training in the form of workshops, seminars, conferences and crash courses (Steyn, 2010:160). An adopted technical and simplistic view of teaching is based on the belief that teachers' knowledge and skills could be improved by using experts from outside the school system (Boyle, Lamprianou and Boyle, 2005:4; Lee, 2005:40). This phenomenon proved largely ineffective as outside experts did not sufficiently change teachers' Technology subject knowledge or pedagogical skills (Mewborn and Huberty, 2004: 4), leading Mundry (2005:14) and Desimone, Smith and Ueno (2006:209) to suggest that, *"the provision and sponsoring of ineffective emancipation programmes be discontinued"*. This AR-based intervention study provides an idea of an alternative which can be extended to a sustained post-study project. The teaching and learning principles central to Technology teaching, namely facilitation of learning, learner-centeredness, active and participative learning, creative and critical thinking and problem solving, all appear to be consonant with the approaches considered appropriate for effective learning and instruction in Technology Education (Reddy, Ankiewicz, Swart and Gross, 2003: 27-28).

#### 3.6.3.2 Planning in Technology

While there was considerable simplification of the curriculum in the process of review of C2005 and the development of the NCS, one aspect which remained problematic, according to the Review Committee Report, was planning (Motshekga, October 2009:25). During the reconnaissance study, Technology teachers seemed to be in favour of empowerment on how to develop a lesson plan contrary to the one in Chisholm's report. They requested the provincial DoE to provide them with the work schedules and pacesetters in order to teach learners common technology themes. A research report by Chisholm et al. (2005) found that Limpopo teachers were uncomfortable with planning and blamed it on a high administrative workload.

Table 3.2 (below) summarizes the types of planning the DoE expects from the schools.

**Table 3.2: Summary of types of planning expected from a school**

| | PLAN TYPE | APPLICATION | THOSE RESPONSIBLE | SCOPE |
|---|---|---|---|---|
| 1 | Whole-school plan | One per school | School management teams and all other stakeholders | Minimum of a year to execute the plan |
| 2 | Learning programme | One per learning area per phase | Phase teachers | LOs sequence; core knowledge, concepts and content to be covered per year |
| 3 | Work schedule | One per grade per learning area | Technology teachers teaching the same grade | LOs per learning area sequence; core knowledge, concepts and more detail content done per term. |
| 4 | Lesson plan | One plan per lesson block. In technology a lesson block is usually one project | Technology teacher in consultation with the *MST **HOD | Teaching and learning activities and content based on the context; executed weekly or daily during technology periods |

*MST: Mathematics, Science and Technology; **HOD: Head of Department

The DoE (2006: 87) stresses that, *“the planning process should be seen as an ongoing cycle, that it is a critical part of managing the curriculum and is very important task for a Technology teacher”*. There are four levels of planning that should be adhered to by each school in South Africa, in accordance with the expectations of the DoE. Teacher activities in a classroom should cover the aspects that undergird the Technology lesson plan presentation, and include learning styles; school policies; teaching methods; expanded opportunities; and conceptual links with previous plans.

The Technology department at school needs to discuss factors as highlighted by the DoE (2006:88) during their annual strategy plan and official curriculum documents, in line with available human resources and materials, with possible excursions to technology sites. The culmination of planning activity in the Technology class, workshop or laboratory is assessment. The teacher-learner ratio plays a vital role in executing technological tasks and affects the core business of Technology classroom management, i.e., assessment.

### 3.6.4 Assessment and constraints posed by overcrowded classrooms

The Review Committee Report (Motshekga, October 2009: 8-9) found that, *"overcrowding in class makes informal assessment difficult and formal assessment extremely onerous for teachers".* It was apparent in the selected schools I visited during Phase 1 (Reconnaissance study, Section 2.5) that those Technology teachers had a large number of learners within a class and were teaching different learning areas. Most Technology teachers teach across the phases and the bands, e.g., teacher X teaches Grade 8 Technology in GET band and Grade 10 Mathematics in FET band. It should be noted that the workload burden when teaching multiple learning areas increases substantially and renders assessment in each learning area a daunting task.

Naidoo and Savage (1998: 124-127) point out that, *"large classes are the legacy of apartheid and their management and coping is left to individual teachers".* They urge both policymakers and curriculum developers to seek ways of helping teachers to effectively teach large classes. Reddy et al. (2003:41) found that large group size in a packed class deprives members of every group active participation and hence limits exposure to their thinking skills. The Review Committee Report recorded many comments regarding overcrowding and the difficulty of implementing the curriculum in large classes (Motshekga, October 2009:59), and went on to emphasize that even though there is a policy regarding teacher: learner ratio for all the schools in South Africa, certain school level factors were impacting on the size of the classes. These included:

- Shortage of classrooms
- Management responsibilities of staff reducing their teaching load and increasing that of other teachers
- Positive incentive for principals to take additional learners
- Shortage of subject specialists.

Apart from the necessary plan to relieve overcrowding in schools over time, based on national resources, there are specific methods and approaches to teaching large classes effectively, particularly in the area of classroom management. Teachers need to revisit and revise that section. Technology projects can also be carried out in groups outside the class as there is insufficient space to arrange learners in groups within the class.

Assessment is a process that uses information gathered through measurement to analyze or judge a learner's performance on some relevant work task (Sarkees-Wircenski and Scott, 1995). Hill (1997:32) concludes that, *"the assessment process can be applied to a systemic examination of materials, programmes or activities for the purpose of formulating a value judgment about their suitability within a particular application"*. Assessment provides the feedback needed by the technology teacher to successfully guide student learning activities. If it is not manageable, feedback to students and other stakeholders will be delayed or quality compromised. De Dakar (n.d:29) summarizes teacher-learner ratio as:

> *"The number of learners per teacher is an essential factor to be taken into account when defining the need for teachers. The Education For All Fast Track Initiative (EFA-FTI) framework recommends value of 40 learners per teacher in primary school".*

### 3.6.5 Support within Technology

The Review Committee Report (Motshekga, October 2009:8) stated that, *"there were too few subject advisors nationwide to do justice to thorough and qualitative in-class support for teachers, and many of those there were had insufficient knowledge or skill to offer teachers the support required to improve learner performance"*. The report gave a true reflection of the participants' complaints at having no subject advisor for TLA. Subject advisors are seen as resourceful in terms of sharing the technological content knowledge and pedagogical knowledge to the teachers and teachers expressed the need for a greater support, given the demands placed on them by the curriculum reviews (Mahomed, 2004:4). If Technology teachers cannot get the support they expect in this era of rapid curriculum reform they will be left behind so some intervention in the form of constant AR cycles should be incorporated, as confirmed by Malada's (2004:88) study of Limpopo. The challenge to curriculum transformation therefore is teacher development and support and the provision of learning support materials (Mahomed, 2004:11).

### 3.6.6 Contextualizing resources

Teachers require adequate, accessible and relevant resources in order to implement their schemes of work successfully. The type of equipment has changed over the last few years (Eggleston, 2000:9) so schools need to ensure that the relevant resources are available, for the appropriate language and age level. Where specific practical work is required the lack of appropriate resources can contribute to lack of learning (DoE, 2003b:32).

The ability to use relevant resources such as hand tools and materials is reportedly linked to good Technology subject knowledge, teaching skills and classroom management, relationships with learners, dedication, accessibility and hard work (Department of Education, 2000). The reconnaissance study also found that lack of adequate physical resources both for teachers and learners continue to be a challenge for effective teaching and learning of Technology. However, as in other studies (Khumalo, Makgato and Mafisa, 2006; Makgato and Mji, 2006), it has been found that the availability of physical resources is not a guarantee of effective teaching and learning, particularly if teachers do not know how to use them in class. Gumbo and Makgato (2008:139) found that resources depend largely on the school, localities and/or the province. This is in line with what teachers urged, that is that their SMTs should set aside a budget for Technology, the community should be engaged in supporting learners, and the provincial ministry should provide the necessary capital, human and material resources. Sessions in the Technology class may incorporate tools, time, people, money, information, energy and machines (Department of Education, 2003:19).

The importance of resources has been confirmed by observing some few lesson presentations of Technology teachers in senior phase classes, with their shortage leading to lessons not being completed by some learners (February, Ogunniyi, Langenhoven and Olufunmilayo, 2012:555). The teachers resorted to giving class work to their learners, claiming the resources had not been purchased by the school. On the other hand, resources available in the localities could be utilized to contextualize Technology learning, such as plastic bags, bottle containers, loose wires and cardboard.

The next section discusses Technology policy interpretation and implementation.

### 3.6.7 Technology curriculum policy interpretation and implementation

This section addresses two issues; those are rationale for Technology learning area and integrated approach to the learning outcomes and assessment standards.

#### 3.6.7.1 Rationale for Technology learning area

South Africa's DBE adopted the design approach initially called DME, and through curriculum transformation renamed IDMEC (see Sections 3.4.6, 3.4.9). This could be realized if teachers were to acquaint themselves with the Technology curriculum policy as summarized in textbox 3.1. Textbox 3.2 shows the three LOs for Grades R-9 and their assessment standards (ASs). LO1 is more of the method to teach Technology in the sense that for senior phase Technology teachers to deliver the LO2 content laid down on both the provincial work schedule and Technology policy document, they must use IDMEC. LO2 serves as the content of Technology, which every time the Technology teacher delivers a Technology lesson should select content from. LO3 is regarded as the values outcome since it advocates inclusion of and respect for other cultures and the environment

**Textbox 3.2: Unpacking GET Technology curriculum and policy**

| | | | |
|---|---|---|---|
| *LO1: | Investigate | *AS 1 | |
| | Design | AS 2 | |
| | Make | AS 3 | Method (AS1-AS5) of |
| | Evaluate | AS 4 | teaching technology. |
| | Communicate | AS 5 | |
| LO2: | Structures | AS 1 | |
| | Systems and control | AS 2 | Content (AS1 – AS3.3) |
| | Electronics and electricity | AS 2.1 | (core & themes) of |
| | Pneumatics and hydraulics | AS 2.2 | teaching Technology. |
| | Mechanical systems | AS 2.3 | |
| | Processing | AS 3 | |
| | Textile | AS 3.1 | |
| | Materials | AS 3.2 | |
| | Food | AS 3.3 | |
| LO3: | Bias | AS 1 | Values (AS1 – AS3) to be |
| | Impact | AS 2 | observed in Technology class |
| | Environment | AS 3 | |

*LO: Learning Outcome; *AS: Assessment Standard

The goals of Technology are organized into three related LOs (Western Cape Department of Education, 2011:24), which cannot be separated from each other during Technology teaching. It is therefore incumbent on the Technology teachers to integrate these LOs within their instruction. For example:

> LO2 - technological knowledge and understanding; AS1- Structures; Theme – Housing; Topic – Roofing; *Integration:* LO1 and LO3 can be in a statement or question or specifications, e.g. Design, Make and Evaluate a house roofing that would meet the needs of your ancient community before civilization. Use reinforced cardboard for the roof and walls, and other materials of your choice. Your prototype should not be more than $15cm^2$.

This example can be used in all senior phase grades. The difference is the application of the scope's depth and width as mentioned in each grade's ASs.

South Africa has a unique Technology curriculum structure, and as Kitahara (2008:1) writes: "The true nature of Technology is to be of assistance to daily life, and it is relevant to find the means of acquiring the skill to use in a meaningful way". Similarly, the Department of Education (2003:19) postulates that technology is concerned with the meaningful acquisition and integration of skills, knowledge and values and the application of various processes needed to solve problems in order to extend human capabilities.

Different countries use different terms to refer to Technology Education, such as Technics, Design and Technology, Technology Education, and Technological Education (Rasinen, 2003:1). In this study, the concepts Technology Learning Area (TLA), Technology subject, and Technology are considered synonymous, whereas Technology Education and Technological Education are regarded as identical. Regardless of the term used in South Africa, the ultimate goal of this AR project is to emancipate Technology teachers to teach this subject successfully and with confidence. This will be possible only if they understand the application of LOs with their ASs during lesson presentation.

#### 3.6.7.2 Integrated approach to the learning outcomes and assessment standards.

Table 3.3 (below) serves as flesh to the skeletal outline of textbox 3.1. I chose to illustrate the AS1 of LO1 only and let the participants complete the rest as an activity within the AR cycle. Table 3.3 shows how the LO and the AS can be straightened out in the senior phase with the progression from Grade 7 to Grade 9.

**Table 3.3: Senior phase Technology's LO1 and AS1**

| | | | |
|---|---|---|---|
| **LO1: Technological processes and skills** | | | |
| **AS1: Investigate** | | | |
| | **Gr 7** | **Gr 8** | **Gr 9** |
| **Methods** | | | |

| | | | |
|---|---|---|---|
| Investigate AS 1<br>AS 1.1 | Background context locally | Background content nationally | Real life context globally |
| AS 1.2 | Examine existing products | Compare existing products | Analyze existing products |
| AS 1.3 | Performing simple practical test | Develop and perform practical test | Develop and perform practical tests procedures |
| AS 1.4 | Plan a strategy for collecting data | Use of appropriate technologies and methods | Use of a variety of available technologies and methods |

The AS gives the Technology teacher the scope of the content to be covered by grade and by phase. The teachers and I jointly developed Table 3.3 as a way of empowering them on how to unpack any curriculum-related policy document. I took the lead in working on this table with them since this was an intervention study and this a contact session activity. I grouped teachers from different schools to undertake the exercise, asking them to complete the remaining ASs of LO1 as well as LO2 and LO3 and their Ass, with the help of their curriculum policy documents. This had to be completed with a particular social and environmental context in mind, because no technological developments within society are 'value-free'. The environment and beliefs, culture, values and biases of society impact upon the development of Technology (Western Cape Department of Education, 2011:2).

To be effective in Technology Education teachers should have a good sense of the three dimensions of technological content knowledge. This is knowledge about technology content, knowledge in content of technology and general pedagogical content knowledge (Moreland and Jones, 2000:288). Teaching begins with an understanding of what is to be learned and what is to be taught, and includes knowledge of content, general pedagogy, educational contexts and educational ends (Moreland and Jones, 2000:229). Curriculum knowledge consists of the knowledge of the scope and sequence of the learning programme and the materials used. Subject knowledge is important to achieve the outcomes and if teachers do not possess it they will be unable to teach and facilitate effectively. If a teacher lacks the knowledge or skills for the learning area it will impact negatively on the learners' achievements (February et al., 2012:555). Technology teachers have limited content knowledge, as revealed by the findings of the preliminary study in Chapter Two.

### 3.6.8 Hints on classroom management during Technology teaching

Nelson (2008:5) offers useful tips for teachers which I cite in concluding this section. He urges Technology teachers to, *"define clearly and teach the classroom procedures and routines, handle inappropriate behaviour promptly and consistently, and plan ahead".* If the teacher's classroom is well managed then he or she will be able to teach the subject matter effectively. Concepts helpful to Technology teachers from Nelson (2008:5) include the following:

- Stop asking, "What am I supposed to do?" Start stating, "What must I know that will help me to accomplish what I need to do"?
- Have the room environment ready for instruction.
- Ordered environment + strong learner demands = effective classroom.
- The disciplined learner is taught by a teacher with a high control of the class and high support for learners.
- Give each learner a seating chart. They need to know each other.
- The greater the time learners work together and the greater the responsibility they take for their work, the greater the learning.
- Successful teaching includes scare, discipline and responsibility.
- The shorter the assignment, the higher the achievement.
- The more frequent the tests, the higher the achievement.
- Teaching is the process of arranging learning experiences to facilitate student achievement.
- Organize content into related sequential concepts.
- The teacher must be a decision maker who is able to translate the body of knowledge about teaching into increased learning.
- Most learners learn best in a spatial, tactile, kinaesthetic mode.

- Learners score higher on a test measuring attitude towards school and attitude towards a subject when they learn from an activity-question approach versus a textbook-lecture approach.
- The successful teacher engineers activities for learner success.
- A learner with good self-esteem will achieve in school. A teacher with good self-esteem will succeed in the classroom.
- Self-esteem is boosted by self-achievement.
- The successful teacher practices enhancement activities, not survival or protective activities.
- Each person has unlimited potential. Humans are the only living things able to improve the quality of their lives.
- Use each new day to transform and nourish your life.
- Just do it!

## 3.7 CONCLUSIONS

"What is the nature of teaching Technology?" is the research sub-question tabled in Chapter Two (2.4), and responded to in this chapter. New thinking and new ways of doing things are the prerequisite for curriculum change and it should be noted that the responsibility of the teacher within this process of change will be altered for the learners. Curriculum and teacher development theories and practices in recent times have focused on the role of teachers as specialists in the development and implementation of effective teaching, learning and assessment practices (Department of Education, 2003:1). Zuga (1989) concluded that, *"a Technology curriculum should develop learners' skills and help them to become wise consumers and problem-solvers in responding to their communities' needs and wants"*. South Africa has attempted to move away from her problematic past, based on racial lines within a segregated curriculum, but the curriculum review, transformation, transmutation and reform have posed great challenges and difficulties. Inherited from the past education dispensation, they confront all education stakeholders with the demands of shaping the present and future teaching and learning, including in Technology. This process has been by far a 'bitter-sweet' one, 'bitter' in the sense that it introduced Technology as a new subject for which teachers are not yet fully prepared to teach, 'sweet' in that contact sessions for the AR cycles can hopefully change the teachers' state of affairs during their emancipation process.

The impact of incapacitated teachers on learning raised issues that called for intervention with the Technology teachers. The next chapter presents the methodological plan of how these issues could be addressed, as well as the activities of the emancipation process.

# CHAPTER FOUR

# THE MAIN ACTION RESEARCH METHODOLOGY FOR THE STUDY

*The basic problem most people have is that they're doing nothing to solve their basic problem,* Richardson (in Wilkinson, 1988:52).

## 4.1 INTRODUCTION

The research problem, *"How could action research intervention be used to improve the teaching of senior phase Technology teachers who are un- and under-qualified?"* was identified in Chapter One, confirmed in Chapter Two and the subject of a literature review in Chapter Three. Chapter Four details the methodology of tackling the problem empirically. Action research (AR) can take on many forms and is not a static methodology, but rather a philosophy, orientation or flexible approach to research in which various data collection strategies might be employed to uncover people's knowledge and skills. Among other things it is used to learn about local conditions, identify challenges and plan how to address them (Ferreira, 2009:2), and in this chapter the challenges indentified in Chapter One are acted upon. This chapter also begins to address the research sub-question stated in Chapter Two (2.4): *"What are the AR-based intervention strategies that can be employed to improve teachers' Technology teaching?"* Emancipation activities, techniques, strategies, procedures and methods used in responding to this sub-question are outlined. In so doing I was influenced by the transition experienced by teachers from Report/NATED 550 curriculum through C2005 to NCS, which created an unstable environment in curriculum delivery and thus affected learners' performance, particularly in Limpopo Province (Limpopo Department of Education, 2011:16).

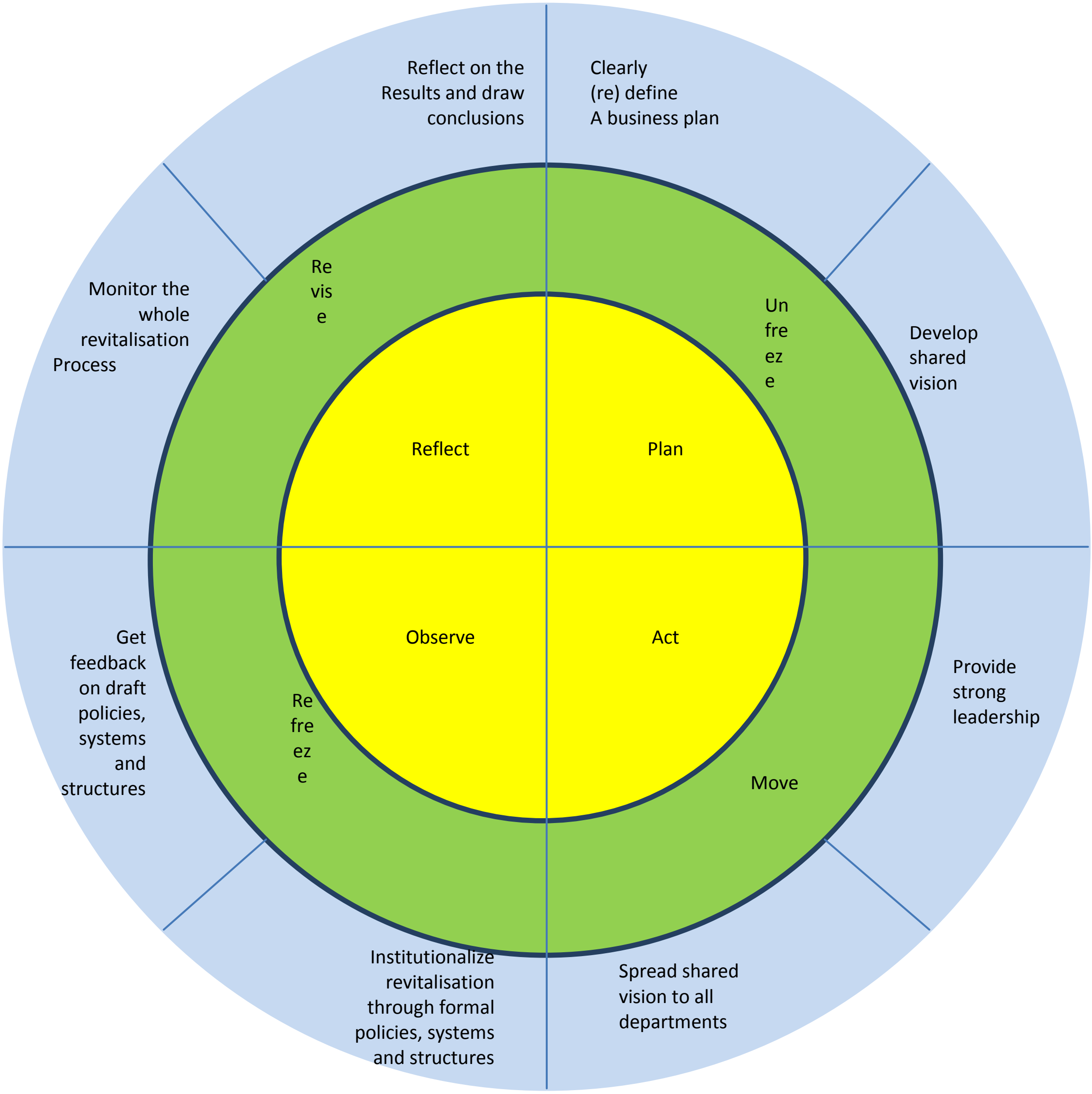
Chalmers (2006:15) claims that it is a process of being set free from constraints, i.e., deliverance from physical, intellectual, moral or spiritual fetters. According to Limpopo Province's MEC for Education, Namane Dickson:

> *"Teachers are important pillars of our education system and therefore our education can stand and fall on them. Soldiers on colleagues, workers of the mind and continue to produce brain power and prowess to take our country forward"* (Masemola, 2011:22).

During the process of freeing the 'pillars of our education system' from the constraints of teaching Technology I engaged senior phase Technology teachers in the AR approach as conceptualized in Chapter One (1.6.1). This main methodology covers the following: the perception of conducting main AR in Limpopo Province; the methods used in the AR main study; AR paradigms; emancipation of Technology teachers through AR; AR activities per cycle; and data analysis methods and trustworthiness.

## 4.2 AN INTUITION OF CONDUCTING MAIN ACTION RESEARCH IN LIMPOPO PROVINCE

Action Research (AR) emphasizes teachers' involvement in problems within their own classrooms and has as its primary goal the in-service training and development of the teacher, rather than the acquisition of general knowledge in the field of education (Borg in Ferrance, 2000:8). AR is a way of learning from and through one's practice by working through a series of reflective stages that facilitate the development of an "adaptive" form of expertise (Riel, 2010:1), as displayed in Figure 4.1 (below), which reflects both force-field model and task-alignment model as a hunch for Technology teacher emancipation. Figure 4.1 is adopted from Zuber-Skerritt (1996:84), who sets critical or emancipatory action research (AR) into a cyclical process of: "(1) strategic planning, (2) implementing the plan (action), (3) observation, evaluation and self-evaluation, (4) critical and self-critical reflection on the results of (1), (2) and (3) stages making decisions for the next cycle of research".




Action research model
Force-field model
Task-alignment model

**Figure 4.1: Emancipatory AR model for educational transformation**

In support of this 3-in-1 emancipation model (Figure 4.1), Mutshekwane (2004:9) states that modern proposals to review, reform, restructure, re-engineer or transform schools emphasise the emancipation of teachers as a primary vehicle in an effort to bring about necessary change. In an imaginative application of AR with Limpopo Province senior phase teachers to their Technology teaching as a change theory, Zuber-Skerritt (in Cohen, Manion and Morrison, 2000:235) takes the work of Lewin (1952) on force-field analysis and change theory (unfreezing → moving → refreezing → revising) and the work of Beer, Eisenstadt and Spector (1990) on the task-alignment, which sets participants into an AR sequence that clarifies the strategic intervention steps of AR. I engaged the participants usefully in these steps for emancipation purposes.

The increased realization and recognition of teachers' incapacity to teach has prompted increased scrutiny and questions about the effectiveness of all forms of emancipation in education (Guskey, 1991:239), hence I had to prove that AR is a different approach. Programmes of emancipation and capacity building of teachers in South Africa, specifically in Limpopo Province, are important for improving the quality of education (Mutshekwane, 2004:10). They are necessary in the light of employing the AR with participants to meet the curriculum changes and coping demands placed upon Technology teachers. Some of the educational problems in Limpopo Province are due to the lack of responsibility and teacher empowerment, as well as dedication and commitment on the part of many teachers and learners (Mothiba, 2005:1) to interpret, analyse and implement the Technology policy. On this topic, Sun and de Jong (2001:398) comment that the development of a nation depends squarely upon education. More specifically, I argue that teachers' knowledge, skills, attitudes, morale, devotion, motivation and commitment play a decisive role in raising the quality of the education system.

### 4.2.1 Research focus during initial reflection

The research approach in Chapter One (1.5.1), population and sample (1.5.2) and ethical protocol (1.5.3), were used for the reconnaissance study and for the main Phase 2 of the AR investigation. The schedule for research activities in Limpopo Province at Mankweng Circuit with the five selected secondary schools from 08 March 2010 to 12 March 2010, served as the first AR cycle or AR Phase 1 and its activities, as follows:

- Meet school's SMT to explain the purpose of the visit
- Ask each participant to sign the consent forms for the research
- Observe classes during the giving of Technology lessons
- Interview Technology teachers in each school
- Collect data from teachers' Technology files
- Photograph and video-record sessions of the Technology milieu and lesson presentation.

Pseudonyms of schools, school location and Technology teachers were presented in Chapter One (Table 1.1) and participants' biographical information in Chapter Two (Table 2.1). The preliminary/reconnaissance study was conducted with 18 senior phase Technology teachers, referred to as 'participants' from five selected secondary schools. The same participants were maintained in AR Phase 2. I, using four strategies (Sagor, 2005:5–8) during the preliminary study in the first term of 2010, to identify high-priority and meaningful topics for the study, namely:

- Reflective writing – daily writing, experiences and targets (performance, process and programme targets)
- Reflective interview – researcher's and co-researchers' reflective interview meeting before and after AR contact session for reflection purposes
- Analytical discourse - with the whole team of Technology teachers by school, including their immediate senior
- Team reflection –with all participants from all selected schools at a common venue. WHW high school and UL were used as common venues for our discussion, workshop, seminars, reflection, planning and for way forward strategies.

The next section gives an overview of the AR genesis, based on the approach to the entire study.

### 4.2.2 Action Research Genesis

Although the origins of AR were in social and community settings it was the field of education which kept AR alive in much of the West during the years that quantitative research was most dominant (Dick, 2001:8). Amongst the many claims as to the origin of AR (Wicks and Reason, 2009:123), Herbert Altricher has argued that it was first conceived by Moreno while working with European prostitutes around 1913 (Altricher and Gstettner, 1993). Many scholars believe its origins are in the work of social psychologist Kurt Lewin in 1946 (1948), who supposedly coined the term, developed and applied it over a number of years in a series of community experiments in post-world-war issues in America. In 1953, Stephen Corey, a researcher from Columbia University's Teacher's College, published "AR to improve school practice" and more recently, Sirotnik (1987) and Joyce (1991) identified AR as a process that develops a problem-solving ethos.

However though the origins of AR are unclear (Masters, 1995), it is significant that it was associated with American pragmatism, principally John Dewey's theoretical musings on the concept of reflective thinking and problem-solving (cited in Wicks and Reason, 2009:123-124). Sagor (2005) has identified three purposes for AR: building the reflective practitioner; making progress on school-wide priorities; and building a professional culture in the educational arena. Critical theorists have used AR as a way to empower and emancipate participants, reinforcing the notion that teachers are in control of their own research and responsible for decisions that affect their students.

A distinctive feature of AR is that those affected by planned changes have the primary responsibility for deciding on courses of critically informed action which seem likely to lead to improvement, and for evaluating the results of strategies tried out of practice. Above all, AR is a group activity (CTE-AR, 2010:02; Dick, 2010:16; Huang, 2010:95; Johansson and Lindhult, 2008:97-98; Kemmis and McTaggart, 1988:6; Masters 1995).

### 4.2.3 Conceptualization of Action Research

In Chapter One (1.6.1), the operational definition of AR from Dick (2010:4), who explains AR as a methodology with the dual aims of action and research, was discussed extensively. Smith and Lovat (2003:136) stress the importance of the title of AR itself: "The only research *(theoria)* which is of any use is that which arises in action *(Praxis);* conversely, the only action which can be effective is that which results from research. The two are a unity". According to Somekh (2006:1), AR is a means whereby research can become a systematic intervention, going beyond describing, analysing and theorizing social practices to working in partnership with participants (senior phase Technology teachers) to reconstruct and transform them (Technology teaching). It implies joint research action within a relationship that promotes equality between partners, allowing for flexibility and openness – something often required when out in the research field, working with human participants.

Carr and Kemmis (1986), Kemmis and McTaggart (1988), Zuber-Skerritt (1996), Smith (2001), and Calhoun, (2002) claim that maximizing the effectiveness of regular classroom teaching involves the need for constant studying of one's own situation in order to understand better the teaching process. During the reconnaissance study, data gathering instruments were administered to the participants so that they could better reflect on their Technology teaching situation. This was a fact-finding mission prior to unfolding the AR process, in which participants could examine their own educational practice systematically and carefully apply the techniques of research to bring about change in it (Ferrance, 2000:7).

Within all the definitions of AR there are four basic themes, namely empowerment of participants, collaboration through participation, acquisition of knowledge and social change. In conducting AR, I structured routines for continuous confrontation with the data gathered on Technology teaching by senior phase teachers. These routines, which are Feedback Loops A, B and C in Figure 2.1 (Chapter Two), are loosely guided by movement through the five phases of inquiry as displayed in Figure 4.2 and listed below:

- Identification of problem area
- Collection and organization of data
- Interpretation of data
- Action based on data
- Reflection.

Figure 4.2 (below) shows that the AR activities are circular and if repeated are spiral in their nature and follow the same pattern for each cycle. Ebbutt (1985) and McNiff (1988) add that feedback within and between each cycle is important since it facilitates reflection. This is reinforced in the model of AR by Altricher and Gstettner (1993:343), though in four steps, (i) finding a starting point; (ii) clarifying the situation; (iii) developing action strategies and putting them into practice; and (iv) making teachers' knowledge public. They suggest that steps (ii) and (iii) need not be sequential, thereby avoiding the artificial divide that might exist between data collection, analysis and interpretation.

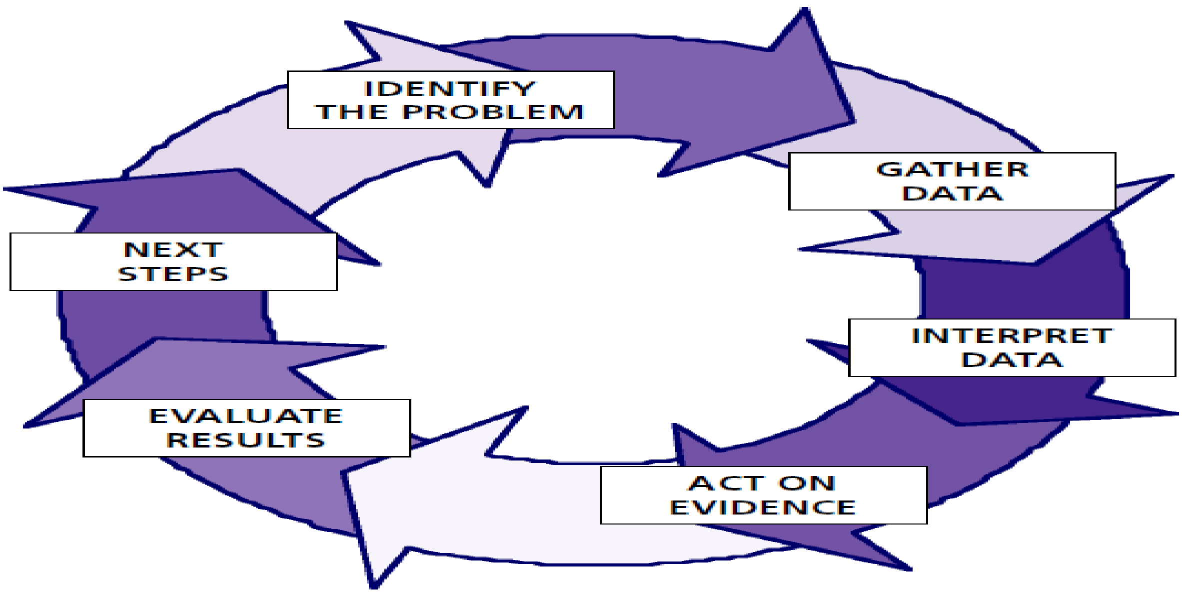



**Figure 4.2: Action Research cycle (adopted from Ferrance, 2000:9)**

The AR cycle equipped me and co-researchers with a way of learning from experience that was potentially flexible (Dick, 2001:9), whilst for Riel (2010:1) this form of research is an interactive, cyclical process of reflecting on practice, taking an action, reflecting, and taking further action. If the cycle is repeated with improvement or modification it forms a spiral activity. The AR spiral activities in Figure 4.3 flow from the repeated AR cycles in Figure 4.2, and were undertaken to address the themes in Chapter Three (3.6), as challenges to teaching Technology. The venture is guided by the six major characteristics of AR listed by Hult and Lennung (in Järvinen, 2007:41):

- AR aims at increasing understanding of an immediate social situation
- AR simultaneously assists in practical problem-solving and expands scientific knowledge
- AR is performed collaboratively and enhances the competencies of the respective actors
- AR is primarily applicable for the understanding of change process in social systems
- AR uses data feedback in a cyclical process
- AR is undertaken within a mutually acceptable ethical framework.

During AR my role shifted from that of an outsider professional who might provide information and advice (so-called *etic* approach) to an insider's participation and understanding (*emic* approach). This implies that I fulfilled the role of a Technology subject advisor as declared by Mankweng Circuit Manager during the member-checking session. Learning from those who understand an emic perspective to facilitate change, I had to enable other role players, i.e., the participants, in particular during a process of intervention, to play a leading role.

In this role-shifting activity I was guided by Susman (in O'Brien, 2010:4) who distinguishes five phases to be conducted within each research cycle:

1. Initially, a problem is identified
2. Data is collected for more details diagnosis
3. This is followed by a collective postulation of several possible solutions, from which a single plan of action emerges and is implemented
4. Data on the results of the intervention are collected and analyzed
5. Findings are interpreted in the light of how successful the action has been.

At this point the problem is re-assessed and the process begins another cycle, continuing until the problem is solved. This has been the AR journey that I travelled with the co-researchers as outlined in 4.6. Technology teachers' challenges as raised by the participants were debated and discussed in a common venue and I gave them an exercise to assess their understanding of the topic at hand.

Getting the exercise correct was a sign that participants were confident in applying the same phenomenon that was taught. Some of the exercises were done in the venue whereas others had to be taken home and returned the following day. Sometimes I randomly split the participants into two groups, each then preparing the exercise for the other, especially on the calculations of resistance. This was done so that participants could challenge each other and express both knowledge and understanding of electrical calculations under the theme of systems and control that was treated.

I took this opportunity to further present O'Brien's (2001:4) simple model of the cyclical nature of the typical AR model developed by Kemmis, which I likened to the one portrayed in Figure 4.3. Each loop is regarded as a complete cycle with four steps: plan, act, observe, and reflect. McKernan (1991:17) suggests that Lewin's model of AR is a series of spirals, as displayed in Figure 4.3, each of which incorporates a cycle of analysis, reconnaissance, reconceptualization of the problem, planning of the intervention, and evaluation of the effectiveness of the intervention.

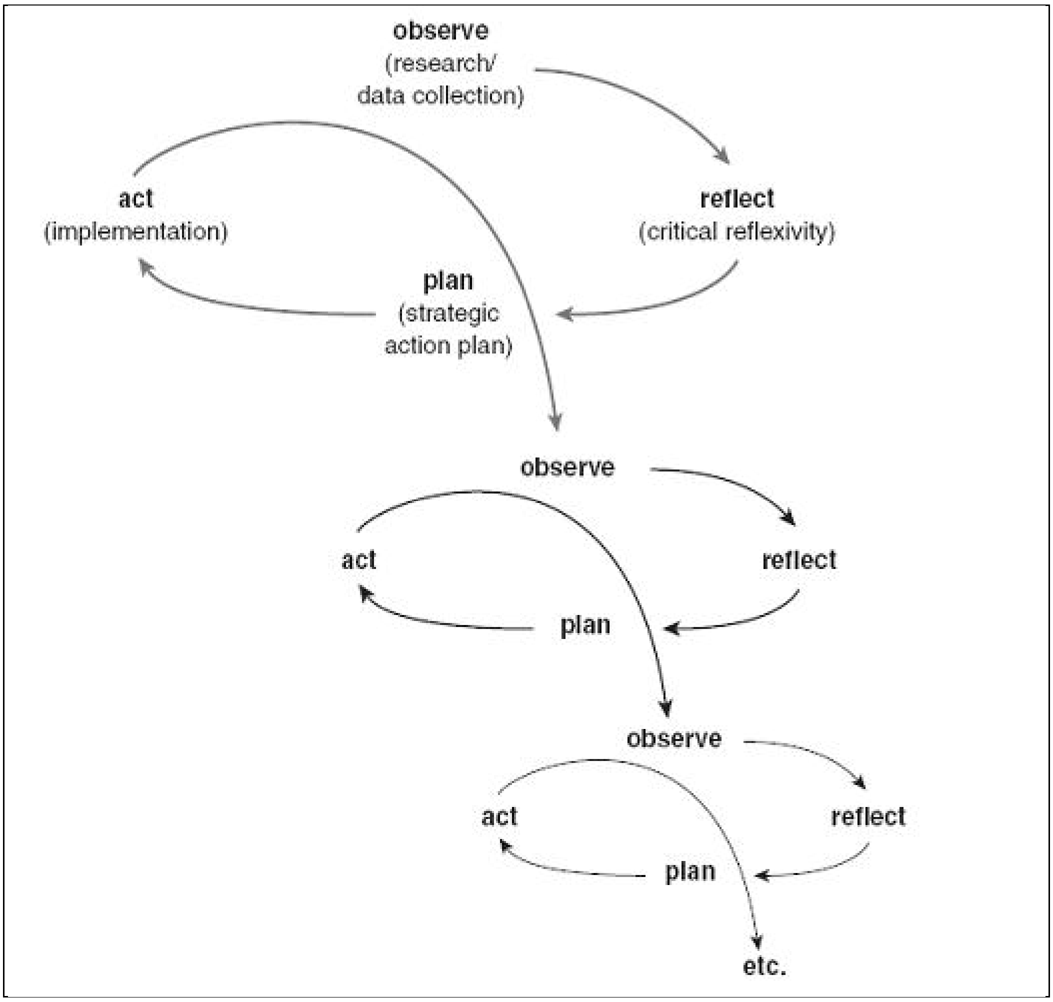



**Figure 4.3: Action Research spiral activities**

It should be noted that if an exercise is a project the results have to be evident in the next contact session.

The next section is a continuation of Chapter One (1.5.4), in which other methods for data collection were added to the three (observations, interviews and questionnaires) used during the reconnaissance study.

## 4.3 METHODS USED DURING THE MAIN ACTION RESEARCH

Dick (2001:9) highlights the importance of AR cycles:

> *"The action research cycle equips a researcher with a way of learning from experience that is potentially enormously flexible. One might*

*therefore adopt AR as a meta-methodology – a methodology you can use until you know enough about the situation to choose the most appropriate methodology".*

It should be noted that pivotal to the AR process is a desire to bring about change and improve practice, as alluded to by Watt and Jones (2002:236), hence I incorporated a number of AR methods for data collection.

### 4.3.1 Methods

The collection of data is an important step in deciding what action needs to be taken. Multiple sources of data were used to better understand the scope of happenings in the classroom or school. There are many vehicles for the collection of data but in this case I had to select those most appropriate for the issue being researched. Sources used during the main AR study were readily available and data collection was systematically organized and logically structured with the participants well in advance. I organized the data in a way that made it useful to identify trends and themes, collecting it from senior phase Technology teachers of Mankweng Circuit through non-participant observations, audiovisual tapes of lesson presentations and Technology classrooms, samples of learners' work (projects and portfolios), interviews, dairy, field notes, photographs, logs of focus group meetings, and questionnaires. The listed instruments are described briefly in the subsequent section.

### 4.3.2 Synopsis description of action research instruments used

Obtrusive and unobtrusive varieties of research techniques used for monitoring purposes during AR in this main study are briefly explained according to Kemmis and McTaggart (1988:100-104) and Wicks and Reason (2009:134-136) as follows:

- *Diary:* A personal journal which records action, gives descriptive accounts, interpretations, questions and explanations kept on day-to-day progress, including difficulties around topics of interest or concern. Planning, activities, challenges and progress made daily during AR cycle that I encountered and responses by participants during contact sessions were noted. It is the diary that tallies with the contact sessions programme. Whatever transpired during a weeklong AR contact session was recorded in it, including observations.
- *Non-participants observation:* A researcher sits at the back of the classroom but does not engage in the work of the group other than to record what is happening. In my case I sat at the front due to classroom learner congestion and used the observation grid within Technology classes to record my observations. During the observation I jotted down some important moments and facts in conjunction with the grid, to be translated into field notes after the observation session. A copy of an observation grid used to observe Technology lessons during reconnaissance study and last cycle can be examined in Appendix 1.8.
- *Field notes:* These comprise a running account of data collected in the field, including records, usually after the events, based on naturalistic observation. Field notes may be simply descriptive of facts of a social setting in suggesting, for instance, categories for speculating about theory, or may include reference to better lessons or the teacher not being aware. Attention is directed to the themes raised by the participants as they are thought to be items of interest to the study.
- *Use of video and audio records:* A researcher uses a video camera and audio technology to record the actual events related to the research problem in the setting. Photographs make useful reference points for subsequent interviews and discussion of the data. I used both digital still cameras for photo-capturing and digital audiovisual for recording teachers' Technology lesson presentations, as well as some of the meetings. This was carried out for later review and analysis.

- *Interviews:* These may be structured questions, as with the questionnaires, or unstructured, with the respondent given free rein to discuss ideas or opinions to prompt. It can be conducted face-to-face, via the Internet or through telephone conversations. I engaged participants in face-to-face structured interviews between contact sessions, since I had worked out a series of questions to ask and to control the conversation as an interviewer. A copy of a structured interview schedule used after Technology lessons during both reconnaissance study and last cycle can be viewed in Appendix 1.7.
- *Questionnaires:* These are self-report instruments, usually paper-based, completed by a respondent, with a series of questions either closed or open-ended. They constitute perhaps the most popular method of data collection in the social sciences and are essentially interviews by proxy, however a disadvantage may be low completion/return rates. A copy of a questionnaire used to be completed by respondents during reconnaissance study and last cycle can be look at in the Appendix 1.7.
- *Logs of meetings/workshops/seminars:* Cycle plans and activities thereof were jointly and fully discussed during meetings. During the contact sessions we ran several workshops around the theme or core content area of interest. On visiting participants at their own school I ran a seminar with them and their SMTs, and called them for member-checking.

The questionnaires that I used with the participants had scale rated questions, asking respondents to make a rating or evaluation, a form of assessment along a continuum or scale from high to low, good to bad and similar. They asked for an evaluation of an object or behaviour in terms of an estimated value. The questionnaires were completed during the AR Cycle 1 and at the end of the AR Cycle 2, which was the last contact session with the participants, designed to compare their responses before and after the AR cycles. This was meant to measure any change or growth in the Technology teachers' teaching.

Corey (1953) wrote that the value of AR lies in the change that occurs in everyday practice rather than generalization to a broader audience. He saw the need for teachers and researchers to work together. However, in the mid-1950s, AR was attacked as unscientific, little more than common sense, and the work of amateurs (McFarland and Stansell, 1993:15). With AR now being considered more scientific, I position the approach in an emancipatory paradigm in the next section.

## 4.4 ACTION RESEARCH PARADIGMS

A number of Action Research paradigms exist. Few are outlined in the next sections.

### 4.4.1 Situating action research in an emancipatory paradigm

According to Mertens (1998:15), emancipatory researchers argue that the constructivist/interpretive researchers "did change the rules; but did not change the nature of the game". For Cohen, Manion and Morrison (2000:231) the intention of the researchers of emancipatory paradigm is the emancipation of the individuals and groups in an egalitarian society. The individuals in this study refer to Technology teachers in each selected school, while the group comprised all senior phase Technology teachers in Mankweng Circuit.

Ontology, emancipation refers to a theory of being, which influences how we perceive ourselves in relation to our environment, including other people (Whitehead and McNiff, 2006:22; 2009:8). Ontology is not the same as cosmology which refers to worldview. Participants' ontological stance in 2010 perceived me as an outsider, especially during the reconnaissance phase of the study. Things shaped up in 2011 where I assumed an insider participative approach which involved me offering descriptions and explanations in this chapter of how I and the participants were involved in mutual relationships of influence. As a result, my theory of knowledge was influenced by my ontological stance, as demonstrated in the next paragraph.

Epistemology refers to a theory of knowledge which involves what is known and how it comes to be known (Whitehead and McNiff, 2006:23; 2009:8) and is influenced by one's ontological stance. An emancipatory paradigm regards the relationship between the researchers and the participants as interactive. Taking this point further, Kelly (in Mertens, 1998:20) contends: *"…the researcher should examine ways the research benefits or does not benefit the participants"*. AR spiral activities as displayed in Figure 4.3 were employed with participants to examine the cycle benefit for contact sessions or for the overall of the study. I believe that objectivity could be achieved by reflecting on the influence of the values of AR and my social standing with the participants. Since I interacted with Technology teachers in search for a better way of teaching Technology we needed to test and critique the different AR cycle stages. For us to judge our intervention strategies results we needed to include a methodology in our cyclic process.

Whitehead and McNiff (2006:23; 2009:8) state that, *"methodology refers to a theory of how things are done"*. They caution that it should not be confused with methods because these are specific techniques developed for finding something out. Emancipatory researchers use a variety of methods to obtain the desired knowledge and understanding. Participatory emancipatory researchers believe that it is essential to involve participants in the planning, conduct, analysis, interpretation, and the use of the research (Mertens, 1998). I thus involved participants in each cycle. This involvement concurred with the interactive relationship between me and participants as mentioned above and outlined in Figure 4.1. This is what other researchers call the inclusion of the diverse voices from the margin.

### 4.4.2 Major Action Research paradigms incorporated in this study

AR is an interactive inquiry process that balances problem-solving actions implemented in a collaborative context with data-driven collaborative analysis or research to understand underlying causes enabling future predictions about personal and organizational change (Reason and Bradbury, 2002). AR paradigms are very close to each other and I incorporated the major ones, namely action science, collaborative/co-operative enquiry, developmental action, living theory inquiry and participatory action research interchangeably with the participants in order to attempt to address some of the challenges that they raised. All major paradigms incorporated in this study are sourced from Wikipedia – Action Research (2010).

Chris Argyris' Action science begins with the study of how human beings design their actions in difficult situations. Human actions are designed to achieve intended consequences and are governed by a set of environment variables. The human beings referred to in this study are senior phase Technology teachers. Intended consequences refer to Technology teaching emancipation. The teachers' environmental variables include but are not limited to Technology challenges listed as themes in Chapter Three (3.6). Action science is different from experimental research, in which environmental variables are controlled and researchers try to find out cause and effect in isolated environment. Action science was applied in the study after analyzing the participants' reconnaissance data, which became clear that they experienced similar challenges. Data analysis results pointed out that since the participants found themselves in a challenging situation of grappling with the didactic of Technology, the whole team and I should design an action to get out of that difficult situation. The how of getting out of this challenging situation needed some collaborative enquiry from all AR role players.

Cooperative enquiry, also known as collaborative enquiry, was first proposed by John Heron in 1971 and later expanded by Peter Reason. The major idea of cooperative inquiry is to research 'with' rather than 'on' people. It emphasizes that all active participants are fully involved in research decisions as co-researchers. We (the senior phase Technology teachers and I) jointly outlined the plan of action to tackle what was regarded as hindrances to deliver Technology lessons. Cooperative enquiry creates a research cycle among four different types of knowledge: propositional knowing (as in contemporary science), practical knowing (the knowledge that comes with actually doing what you propose), experiential knowing (the feedback we get in real time about our interaction with the larger world) and presentational knowing (the artistic rehearsal process through which we craft new practices). The research process included these four stages at each cycle with deepening experience and knowledge of the initial proposition, or of new propositions, at every cycle. I engaged the co-researchers within this paradigm as it stresses that I have to research with them. Through this collaborative/co-operative enquiry paradigm the research team (the participants and I) created knowledge within practical knowing and the experiential knowing domain of Technology policy interpretation and implementation. This exercise of sharing topics from the list of challenges as in Chapter Three (3.6.6), (Table 3.3), (4.6.2) and Chapter Four (Table 4.1) inspired participants to present certain topics that they were good at to their peers; hence the team was led to a developmental action enquiry.

William Torbert's developmental action enquiry was incorporated in both Phase 1 and Phase 2 of this AR study – fact-finding and in the main AR study to address the challenges raised by participants. The developmental action enquiry is a "way of simultaneously conducting action and enquiry as a disciplined leadership practice that increases the wider effectiveness of actions. Such action helps individuals, teams, organizations become more capable of self-transformation and thus more creative, more aware, more just and more sustainable" (Torbert in Wikipedia – Action Research, 2010:3). This type of enquiry helped me to facilitate the group dynamics of reflection, which was done before and after the contact session. The participants were asked to write their reflections on a pre-arranged template on our last day of the contact session. When analyzing those reflections it was clear that in the next contact session when we met I had to engage them with a living theory to express their Technology teaching concerns from the analyzed reflections.

In generating a living educational paradigm, Whitehead most recently argued (in Whitehead and McNiff, 2006:32), that individuals generate explanations of their educational influences in their own learning, in the learning of others and in the learning of social formations. They generate the explanations from experiencing themselves as living contradictions in enquiries of the kind, “How do I improve what I am doing?” They use action reflection cycles of expressing concerns, imagining possibilities in developing action plans, acting and gathering data, evaluating the influences of action, modifying concerns, ideas and action in the light of the evaluations. As the researcher facilitator who was an insider using participatory approach, I was involved in participants’ action reflection guided by Paulo Freire’s participation action research.

Paulo Freire's participatory action research (PAR) emerged in recent years as a significant methodology for intervention, development and change within communities and groups. It is now promoted and implemented by many international development agencies and university programmes, as well as countless local community organizations around the world. PAR builds onto the critical pedagogy put forward by Paulo Freire as a response to the traditional formal models of education where the teacher stands at the front and imparts information to the learners who are passive recipients. This was further developed in adult education models throughout Latin America.

After undertaking a developmental action enquiry of Torbert during reconnaissance study, the AR team were all cooperating and collaborating from Reason’s perspective and further engaged Whitehead’s living theory to build a critical didactic through PAR of Paulo Freire.

In this section I explained how I used different paradigms to emancipate the participants. The next section gives details on how this was undertaken.

## 4.5 EMANCIPATION OF TECHNOLOGY TEACHERS THROUGH ACTION RESEARCH

This study incorporated the approach taught by Stephen Kemmis and Robin McTaggart (1988:25) at Deakin University, which stresses the use of a defined cycle of research and participatory methods to produce emancipation. They call their approach emancipatory action research and draw on European sources, especially on the critical theory of the Frankfurt school (Dick, 2010:16). Seeing that most of the Technology teachers did not have prior training in Technology during their tertiary training and were unqualified, while some are under-qualified, it was imperative to engage in emancipatory paradigm or critical theory with them as highlighted in Chapter Three. After I had shared some light on the theory behind the Technology variable in Chapter Three (textbox 3.1), I will first highlight the challenges I encountered during my interaction with the participants. Thus, the next sections give an account of AR challenges that arose during both minor AR Phase 1 and major AR Phase 2 of this study.

### 4.5.1 Action research contact session challenges

I experienced the following listed challenges after the AR minor Phase 1 and just before the beginning of the major AR Phase 2.

- FIFA soccer competition from May/June 2010 for the first time on African soil and hosted by South Africa. I was worried about the backlog in my research due to the events building up to the hosting of FIFA 2010 interfering with my planned AR schedule;
- Teachers' voted for an industrial action about salary negotiations after soccer competition. When the strike was called off, the teachers started to prepare learners for examinations in 2010;

- One secondary school redeployed 50% of its staff in 2010 and among such there were Technology teachers;
- Some of the teachers had new subject allocation for 2011, which caused them to technically withdraw from participating in my AR activities;
- Some two female Technology teachers from the same school went on maternity leave in between the AR cycles;
- The worst was the termination of teaching contracts for some Technology teachers;
- At some days of the contact sessions the Maths, Science and Technology Education's (MSTE) Heads of Department (HODs) were not willing to release Technology teachers due to some school related duties, e.g., examinations invigilation and some of the HODs were monitoring the examinations processes, hence they did not show up either;
- Financial constrains and time constraints added to the list of the 2010/2011 challenges;
- AR cycles were done with 5 secondary schools. Those are KMK secondary school 7(3), i.e., I started the AR project with seven and completed with three Technology teachers. At VMV secondary school 3(1+2)I started with three and remained with one, though gained two new Technology teachers, meaning that I lost two Technology teachers. At RMR secondary school I continued with three (two plus one) Technology teachers. At WHW I continued with two Technology teachers. At BMB I continued with three (two plus one) Technology teachers. The numbers representing the teachers are explained subsequently.

In 2010, 18 participants signed a consent form to be part of the AR process. It is in the consent form that teachers were made aware of their freedom to withdraw from the process. This can be observed from the last bullet above in terms of participants' statistics:

- at KMK secondary school I started with seven teachers in 2010 but ended up with three teachers in 2011; that could be attributed to the 2011 subject allocation.
- at VMV secondary school I started with three, I continued with one and gained two in 2011, which implies that I lost two in 2010;
- at RMR secondary school I started with three teachers in 2010, continued with two in 2011, and gained 1 in 2011, but lost one.
- at BMB secondary school I started with three teachers in 2010, but I lost them all due to new subject allocation in 2011. I started 2011 with the new Technology teacher until my last cycle.
- at WHW secondary school I started and completed all the cycles with two Technology teachers. The third teacher from the same school just visited us once and never again.

I winded up my AR study in 2011 with 12 participants from the same five schools. I understand the course of the loss of some participants, which can be attributed to bullets three to five in the above challenges. Despite all these challenges, the teachers and I managed to plan and engage participants in the AR journey of contact sessions packed with activities as outlined in the next section and displayed in Figure 4.4.

### 4.5.2 Unfolding Action Research programme of activities

I formally invited participants to the sessions as a way to try to motivate the desired attendance (see sample of the invitation in Appendix 4.1). Appendix4.1 is a sample and example based on the invitation of participants to the AR Cycle 4. Figure 4.4 gives a summary schedule of the AR contact sessions during 2011 with the participants, respondents or informants. All sessions were captured on both digital still and digital video for co-coding purposes.

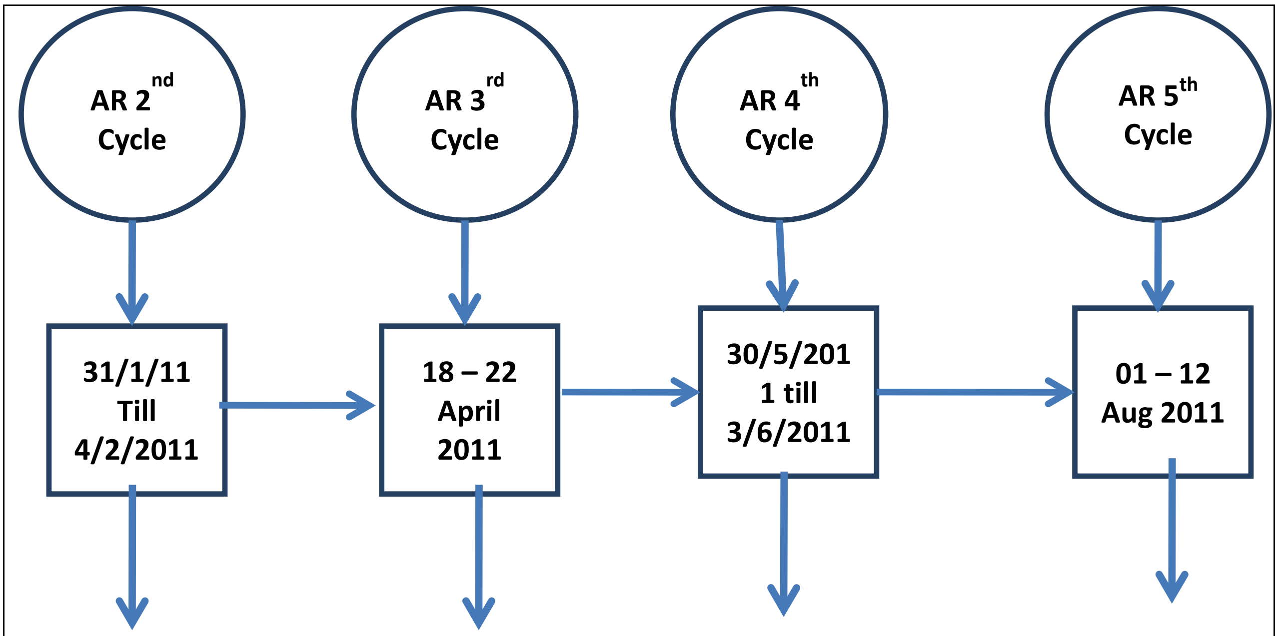



**Figure 4.4: Phase 2 intervention sessions of AR cycles**

HWH secondary school was used as a centre for the contact session. A verbal request was made to the MSTE HODs and was processed further to the deputy principal who gave a go-ahead. Topics per contact session of AR cycle were addressed based on the local circuit work schedule, findings of a preliminary research and on the participants' request. All sessions started with the reflection of the previous one, observation of what was agreed upon, re-planning and action. Participants took the lead in empowering each other while I facilitated the process to ensure focus on what I planned to get for purposes of the study. All sessions were a week long and almost two to three hours per day in the afternoon. At the end of the session on the last day, participants were given questions which prompted them to reflect on the session. Adequate time should be made available for teacher studies and planning if effective curriculum implementation is to succeed (Laine& Otto, 2000), especially of new learning areas like Technology. Hence, I embarked on the AR cycles with the participants.

The next section outlines the questions that participants had to respond to in each cycle.

### 4.5.3 Questions participants responded to per cycle

I hereby offer a list of questions that participants responded to at the end of each cycle during the AR Phase 2. From cycle 2 to 4 participants were to respond to the above listed questions. Findings from their responses will be deliberated in Chapter Five.

- What have you learned from this AR cycle activities?
- What are you taking along to your school from this cycle contact sessions?
- Indicate technological themes that you can now implement with confidence in your lesson presentation especially those that you couldn't before the cycle.
- What gaps have you identified that still need to be filled regarding your knowledge of Technology?
- Any other inputs/suggestions/proposal you have way forward?

## 4.6 ACTION RESEARCH ACTIVITIES PER CYCLE

The engagement of Grade 8 and 9 Technology teachers from the selected secondary schools started in 2010 by observing participants teaching Technology, conducting structured interviews with them and letting them complete the rated interview schedule. On 10 and 11 January 2011 I called principals, HODs and Technology teachers at different schools which were earmarked to participate in this AR study to inform them about the continuation of AR cycles in 2011. A weeklong contact session starting from 12h00 till 15h00 was set aside daily for the interventions strategies through the AR cycles with the participants. The schedule was embarked on based on a collective agreement with the co-researchers to address the challenges that they encountered in their Technology classes as pointed out in Chapter Three. The cycle reflections were done with the participants as a means of charting a way forward.

### 4.6.1 AR Cycle 2: Feedback from AR Cycle 1 and action plan

This cycle was conducted by visiting each secondary school from 31 January 2011 to 4 February 2011 with all senior phase Technology teachers from the five secondary schools. The purpose of the visit was to provide feedback and discuss feed forward for each school concerning the preliminary study conducted in March 2010.

There follows a short description of my daily activities within my visit.

#### 4.6.1.1 Vignette of Cycle 2 activities:

During Cycle 2, I met the participants at their respective schools to share the feedback (findings) from the three instruments (observation, interviews and questionnaires) that I used during data collection in Cycle 1 – Reconnaissance study. This was a weeklong visit to Limpopo Province to join our AR chain of activities. In all the selected secondary schools that I visited the schedule of activities and my purpose of the visit was the same. The visit was the whole day long per school during Cycle 2:

**Textbox 4.1: Cycle 2 schedule of activities**

1. An order of visit to selected secondary schools: VMV, BMB, RMR, KMK, WHW.

1.1 Meet school's SMT and provide purpose of my visit.

1.2Meet with technology educators outline the activities earmarked.

1.3Discuss and gave participants feedback around reconnaissance study.

1.4Developing themes and discuss the findings of preliminary study.

1.5 Discuss next cycle programme based district work schedule.

I managed to take pictures of the Technology milieu and Technology lesson presentations by video. From the analysis of the findings, which were presented in Chapter Two (2.4), it was evident that all selected schools were experiencing similar challenges regarding the teaching of Technology. Cycle 2 findings are presented as Technology teaching challenges. In some schools, Technology teachers had been allocated new subjects to teach other than Technology in 2011. This had a direct bearing on some of the participants continuing with their participation in the AR, as well as their envisaged empowerment on Technology teaching. At RMR secondary school I found out that 50% of the staff had been redeployed towards the end of 2010. That included the school principal and the school management team (SMT), and among such were Technology teachers. VMV secondary school had two of its Technology teachers on maternity leave who were replaced by contract teachers that were supposed to be part of the AR study. The third Technology male teacher at VMV secondary school was mostly absent from school because of his dual professions of teaching and medical qualifications.

From these challenges, themes were developed (Chapter Two) and strategies decided upon to address these themes as outlined in the third AR cycle. I proposed to invite the Technology lecturer from the University of Limpopo (UL) which is based in Mankweng Circuit during the third AR cycle to share facilitation in addressing the themes as outlined in table 4.1. The move was welcomed by all the participants since the UL lecturer is within their reach whilst I am over 300 kilometres away from them. In this sense the UL Technology lecturer would be their convenient resource person in times when help is needed. The aim of introducing UL lecturer was to sustain continuous intervention of participants for empowerment.

### 4.6.2 AR Cycle 3: Implementation of action

The third AR cycle took place from 18-22 April 2011, with the sole reason to address thematically the challenges raised by participants. We started first by having a meeting to reflect on the second AR cycle and structure the way forward. I kept notes in the diary about the discussions held.

**Photo 4.1: Grade 8 participants** **Photo 4.2: Grade 9 participants**

Teachers were then split into two groups, those teaching Grade 8 as in photo 4.1 and those teaching Grade 9 grouped themselves as in photo 4.2 to discuss both the project and its rubric. The two groups are discussing the projects that they must give to their learners. They are also thrashing out the rubric to assess the learners' projects. The Grade 8 teachers agreed to come up with a project under containerisation and transportation of the chemistry test tubes. The project was designed for their learners to make. They named their project "Test Tube Containers".

It was during this cycle that the UL Technology lecturer joined us. I introduced him to the participants. The third cycle is used as an example of activities embarked on during the contact session. The cycle session was held at WHW secondary school and the full details of what actually transpired during the session are included in table 4.1. The session followed the participants' work schedule (see Appendix 4.1) from Mankweng Circuit. They were treating the theme of Processing. After discussing the policy based on Processing per grade as (table 4.1) on day 3, we all agreed to come up with some common projects per grade (8 and 9), as well as their assessment rubrics (see Appendix 4.2 for Grade 8 and 9 respectively).

The challenging themes that were addressed during this cycle include: unpacking the Technology curriculum policy; contextualizing the teaching of Technology; processing as a theme per work schedule; systems and control as the core theme covered; graphics in Technology; and interrelationship on the Technology themes as contained in Learning Outcome 2 (LO2). The Grade 9 team settled for a “Classroom Dustbin” as a project which their learners should construct under the theme containerisation. The two groups went further to design a marking rubric for their grade projects. The samples of project pictures and their portfolios are part of the next chapter.

Topics on Systems and Control under Electrical Systems were unpacked using the following sub-topics from the policy document: resistor and resistance, Ohm’s Law and colour coding, and logic gates (according to their work schedule this was planned to be treated in the third term of 2011). Addressing Electrical Systems was done in response to the participants’ request and to prepare them for the next cycle in the next term. In table 4.1 I share the weeklong session with the UL Technology lecturer. The third session went on well except on day four – Thursday 21 April 2011, as there was a provincial union meeting for teachers called by the South African Democratic Teachers Union (SADTU) from 8h30 in the morning at the local community hall.

**Table 4.1: AR Cycle 3: weekly schedule**

| | Day1 | | Day2 | | Day 3 | | Day 4 | Day 5 |
|---|---|---|---|---|---|---|---|---|
| **Themes** | ▪ Purpose of the session<br>▪ Cycle 2 reflection<br>▪ Curriculum transformation<br>▪ Electrical system | ▪ In class technology challenges<br>▪ Exploring curriculum policy | ▪Technology learning programme<br>▪ Technology work schedule | ▪Technology lesson plan<br>▪Assessment in technology<br>▪Mechanical systems | ▪Contextualiz e- zing resources<br>▪ Technology PCK – LO2<br>▪ Processing as on work schedule | ▪ Support in technology<br>▪Technological skills<br>▪ Structures | ▪ No contact session due to SADTU meeting at community hall from 8H30 | ▪ Barriers to learning<br>▪ LO3 with its three ASs<br>▪ Drawing in technology: types, instruments, etc. |
| **Facilitator** | Mapotse UNISA Lecturer | UL technology Lecturer | Mapotse UNISA lecturer | UL technology Lecturer | Mapotse UNISA lecturer | UL technology lecturer | Limpopo SADTU leadership | UNISA lecturer and UL lecturer |

#### 4.6.2.1 Themes for third cycle project reflections

During the contact session, participants were expected to reflect on their school experiences in engaging their learners with the chosen projects under the following sub-topics:

a) Core Knowledge: Processing.
b) Circuit Theme: Containerisation.
   - Challenges – time, materials and group assessment.
   - Success – workmanship, skills learned presentation or communication, aesthetic and ergonomics.
   - Gaps identified during the making of the project.
   - Project roll-out by learners – duration, team work, capabilities, resources and assessment.

Each school had to share its experience openly with the team of researchers. I then requested the participants to file their reflection in their Technology files. At the end of the third cycle I let the participants complete the interview questionnaire schedule, which, like in other cycles, I analysed. Analysis of participants' responses were discussed with and reported to them in the beginning of the fourth cycle.

### 4.6.3 AR Cycle 4: Feedback and reflections

The following is a breakdown of the AR Cycle 4.

#### 4.6.3.1 Day 1

The participants were called before I came just to remind them of the commencement of the fourth AR Cycle. According to their year plan there was nothing serious to stop or interfere with the cycle sessions. We arrived at WHW secondary school on Monday prior to the starting time to arrange the venue. Only two schools were represented by two teachers. Those were from RMR and WHW secondary schools. RMR secondary school teachers brought along projects done by both Grade 8 and 9 learners for a show-off as agreed upon during the third cycle. This was for the first time teachers let their learners make Technology projects.

Both teachers wrote down their reflections of the project process which covered the challenges encountered, gaps identified, and remedies. The teachers were also given the inventory of the learning styles. This was intended to emphasise to them that they had diverse learners in their Technology classes; therefore they were advised to vary their presentation strategies. I handed out the weekly programme to those teachers present. I asked them about their Technology colleagues including those from other schools. They gave me different reasons why they could not come, like health related reasons. Copies of sections to be dealt with during the week were also given to teachers to prepare themselves. These were drafted based on their interview responses and work schedule.

Most teachers were invigilating exams in different grades. I requested them to make some internal arrangement so not to miss the sessions.

#### 4.6.3.2 Day 2

I travelled to other schools that were supposed to be part of the sessions in the Technology, who did not show up on Day 1. The early morning of Tuesday I just sent all the participants who were absent an SMS of concern to say that I had not seen them the previous day (Monday).

Arriving at the first school I travelled to, which was BMB secondary school, I found that the Technology MSTE HOD was absent. I met with the Technology teacher. The teacher showed me the learners' projects from the Grade 8 group. I asked him why he was not coming for the sessions. He said that he had confused the dates and thought that the sessions were scheduled for the following week. He promised to come from Wednesday.

I then travelled to VMV secondary school. The MSTE HOD indicated that he had the exams so he could not attend the sessions. I then went to consult with Technology teachers through the HOD's permission. I was a bit shocked about their responses for not attending the sessions. Two teachers on contract from the one VMV school who were relieving those on maternity leave related their course of non-attendance as follows:

- "I was really busy with the examinations and at my school we only attend any meeting or workshop if there is a formal circular from the circuit".
- "The HOD gave me another Technology project to do and I have to suspend the AR one".
- "Today is my last day at school as my contract ends today 30/05/2011".
- "I was working on a contract and I am finishing on the end of June 2011".

One of them promised to come on Wednesday.

**4.6.3.3 Day 3**

I travelled to both KMK secondary school and RMR secondary school with the same mission to establish the reasons for the non-attendance of teachers. I met the MSTE HOD who informed me that the teachers from his school came on Day 1 but they claimed that they could not locate us at WHW secondary school. I told him that sessions were on as planned. From KMK secondary school I drove to RMR secondary school. I met one Technology lady teacher on arrival who was ready to go to the contact session. I also met with the HOD who showed the interest of coming but said that the exams were on.

At WHW secondary school only three schools were represented save VMV for Day 3 sessions. A revision on graphics was made. An exercise on Electricity was given as a springboard to check the last session presentation. It was quite interesting since the answers were not the same. The debate continued until common consensus was reached guided by the responses given.

Participants were asked to do some drawing activities at home and bring them on the following day – activities 7 and 9 from the manual provided.

### 4.6.3.4 Day 4

At least teachers' attendance was impressive except VMV secondary school. I called the Technology HOD of VHV secondary school to find out why his school was not represented. He told me that his staff was busy with exam invigilation. Trying to negotiate for internal arrangement to be made, he insisted that I should continue with those that just started as a replacement for those who went on leave. My negotiation went on wherein I advised him that it would not benefit the school since their contracts had come to an end. He would not understand.

The session went on well, with graphics and introduction to mechanical systems and assessment discussed. The activities that were given to them pertaining to graphics were controlled. They were not done perfectly, accurately or competently. We were impressed by a lady teacher from RMR secondary school who had a perfect scale grid. She said that she was helped by a colleague who had a drawing background.

### 4.6.3.5 Day 5

Day 5 was the last day of Cycle 4 contact sessions. The participants had to structure the lesson presentation for the next cycle. The date, time and periods had to be coordinated from this session. The session started with all the participants from the three schools except VMV secondary school and other two schools joined us later. The session started with the unpacking of the Curriculum and Assessment Policy Statement (CAPS) documents. From the documents we learned that the LOs and Assessment Standards (ASs) are no more stated as they appeared in the Technology policy document.

Together we had to reflect on the session and plan for two weeks long Cycle 5 contact session. Participants are shown on photo 4.1 planning and reflecting on Cycle 4 together.

**Photo 4.1: Participants during AR planning and reflection session**

CAPS also stress AR as its delivery mode in some of its content topics. I then gave the participants the definition of AR which I considered to be the more succinct to our programme from Wikipedia (2012:25) which states: *"Action research is a reflective process of progressive problem solving led by individuals working with others in teams or as part of a community of practice to improve the way they address issues and solve problems"*.

The UL lecturer also joined us to share the how of assessing Technology in details. I advised the participants to fully consult with the UL lecturer concerning Technology related matters, especially the sub-themes under Systems and Control. The core themes of CAPS are the LOs of the policy document where Systems and Control and Electricity have now been divided. The LOs and ASs have been listed from CAPS as independent core themes and topics (see table 4.2 about the example for Grade 9).

**Table 4.2: Sample of Action Research in CAPS**

| | | |
|---|---|---|
| ***"ANNUAL TEACHING PLAN*** | ***GRADE 9*** | ***TERM 2: MECHANICAL SYSTEMS & CONTROL*** |

*It is compulsory to cover the given topics in the term indicated. The sequence of the topics within the term must be adhered to. Skills like investigating, drawing, designing, making and presenting should improve progressively from term to term.*

| | |
|---|---|
| ***WEEK 1: for 12*** | ***TOPIC: Using pneumatics and hydraulics to increase human strength*** |

| ***Enabling tasks*** | ***Content*** |
|---|---|

***Revision****: Syringe mechanics using two equal sized syringes linked by a tube. Force transfer between the syringes filled with: a) Compressed air – pneumatic system; and b) Water – hydraulic system. Action research: Learners experiment with two different sized syringes linked by a tube and filled with hydraulic fluid (water). Learners experience force transfer with either force multiplication or force division (depending on which syringe is the driver / master lesson: Gases (like air) are compressible. Liquids (like water, oils) are incompressible. Action research: Pascal's principle – pressure exerted on one part of a hydraulic system will be transferred equally, without any loss, in all directions to other parts of the system. Note that equal volumes of liquid are moved through the systems, and this results in different extensions where syringes (cylinders) are of different sizes, so less distance/more force (M.A > 1); and more distance/less force (M.A < 1)."*

The participants completed the fourth AR cycle reflections. We then negotiated the programme and details of the fifth AR cycle. The disadvantage was that teachers from RMR secondary school should have a neutral venue to conduct their lesson presentation since at their school it was not easy to use any camera.

### 4.6.4 AR Cycle 5: Final lesson presentations

It is in this cycle that I was closing down my AR cycle for contact sessions. This was the longest AR cycle ever for it lasted for two weeks. Analysis and comparison of before and after AR interventions will be made in Chapter Five.

Table 4.3 shows our major events of the fifth cycle. The main action of the events was to capture the Technology lesson presentations by the participants. After lesson presentations, evaluation of the very lesson presentations was done and feedback given by the peers from the same school, their HODs and me. The schedule was jointly drafted during cycle 4. Each participant was assigned a date for lesson presentation.

The fifth AR cycle involved Technology teachers and their School Management Teams (SMTs). The cycle programme was faxed to the participants' HODs (see Appendix 4.1) as a reminder, a week before embarking on the presentations.

**Table 4.3: Final video capturing schedule of lesson presentations**

| DAY | DATE | EVENT |
|---|---|---|
| Day 1: Monday | 01/08/2011 | Co-researchers gather at WHW high School, then move to University of Limpopo (UL) for a working lunch. |
| Day 2: Tuesday | 02/08/2011 | KMK High School lesson presentation capturing on a video and team assessment. |
| Day 3: Wednesday | 03/08/2011 | At KMK High School for lesson video capturing and team assessment. |
| Day 4: Thursday | 04/08/2011 | At WHW High School for RMR teachers, arrangement on lesson presentation capturing on a video and team assessment |
| Day 5: Friday | 05/08/2011 | At WHW High School for its technology teachers lesson presentation capturing on a video camera and team assessment and feedback. |
| Day 6: Monday<br><br>Public holiday | 08/08/2011<br><br>National school holiday | At the hotel conference room for a working lunch. AR cycles reflection. Address by the Circuit Manager. Member-checking with the participants. Post-doctoral community engagement planning with all stakeholders. |
| Day 7: Tuesday<br>Public holiday | 09/08/2011<br>National Women's' day | Writing and collating report and field notes. |
| Day 8: Wednesday | 10/08/2011 | At BMB and WHW High Schools respectively for BMB and WHW technology teachers' lesson capturing. KMK teachers also present their lessons at WHW. |

| DAY | DATE | EVENT |
|---|---|---|
| Day 9: Thursday | 11/08/2011 | At VMV High School for technology lesson presentation capturing. |
| Day 10: Friday | 12/08/2011 | At UL with all co-researchers. AR reflection, feedback and feed-forward. |

Participants and their circuit manager showed reasonable commitment to the course of Technology teaching improvement by sacrificing their holiday on 8 August 2011 to meet at the hotel conference centre with me and reflected on the 2010 – 2011 AR experiences. I was very humbled by this act of sacrifice. Findings from this session will be shared in Chapter Five.

I took pictures of the Technology milieu (see Chapter Two Section 2.3.2) as well as recorded participants' final lesson presentations on videos (see Chapter Five). I organized a seminar at WHW secondary school on 01 August 2011, a working lunch on 08 August 2011 at the hotel and finally a workshop lunch on 12 August 2011 at UL. A seminar was to structure the programme for two weeks with the participants. A working lunch was for member checking and reporting to the circuit manager, whereas the workshop lunch at UL was for wrapping up the whole AR study, evaluating the whole process and discussing the full report written per school by the MSTE HODs around the AR journey travelled for two years with their subordinates.

## 4.7 DATA ANALYSIS METHOD

This section presents the chosen data analysis method of the study.

### 4.7.1 Data set 'interim analysis' method

The word analysis comes from *analyein,* which is Greek for "to break up" (Maritz, 2010:33). In the same breath, Henning, Van Rensburg & Smit (2004:127) write that the word analysis is defined as "means to apart words, sentences and paragraph which is an important act in the research project in order to make sense of the data". It is helpful to break a problem or phenomenon into small manageable independent pieces or aspects. If one can make sense of each aspect or piece then that process will make it easier to have a better understanding of the whole. Data will be analysed by using data sets approach. Data set in this study will emanate from data collection instruments I incorporated in the major AR Phase 2. Johnson and Christensen (2004:434) refer to 'data set' as a set of data the researcher uses in an attempt to convey the essential characteristics of data by arranging data into more interpretable form. Mills (2003:98) suggests that the next step in the AR process after collecting data is to reflect on what one has learned and summarise the meaning of data.

Data was collected with the following aim in mind (Chapter One, 1.3): "To establish intervention strategies to empower and emancipate senior phase Technology teachers in Mankweng Circuit of Limpopo Province from the constraints that they faced in teaching Technology". Mentioning the aim of the study at this stage helped me organize my data set accordingly and focus my analysis (McNamara, 2012:2). I adopted 'interim analysis' method during the implementation of my data sets. Interim analysis according to Miles and Huberman (in Burke and Larry, 2004:500) is cyclical or recursive process of collecting data, analyzing the data, collecting additional data, analyzing those data, collecting additional data, analyzing that data, and so on throughout the research project.

Chapter Two integrated findings from three data sources according to the identified themes. The themes were Technology teaching experience; Technology planning for teaching; assessment in Technology; support in Technology; resources in Technology; curriculum policy interpretation, implementation and learning outcomes; and teacher-learner ratio. I arranged themes into interpretable form after reconnaissance study. In this chapter I will integrate themes as challenges for teaching Technology with data collected per cycle for 'interim analysis' purposes and reflect what I have learned from those data. This will be classified as 'data set' but the themes are attended to during the implementation stage of this analysis method as displayed in Table 4.4. (below), since 'interim analysis' is cyclical or recursive process of collecting data and analyze that data, this is in line with the AR process for each cycle. Since Cycle 1, I engaged the participants in the process of collecting data to resolve their challenges per cycle. I planned to interpret data according to the following 'data set' categories as in Table 4.4., which explains how I implemented each instrument to gather data.

**Table 4.4: Data analysis methods**

| **DATA SET** | **INTERIM ANALYSIS METHOD** | **IMPLEMENTATION** |
|---|---|---|
| Digital still photos and digital visual photos | Photo analysis guide by:<br>▪ Tally (in Joseph, 2002:1)<br>▪ Harris (n.d)<br>Photo analysis worksheet:<br>▪ Education staff, National archives and administration. | I took photos of the Technology teachers and their milieus where Technology was being taught. As the cycles unfolded I took pictures of learners' projects. I further captured participants presenting their technology lessons during the 1st and 5th AR cycles by a video camera. |
| Observation | Using observation grid | During the 1st and 5th cycles. These two cycles were used to measure the extent of participants' emancipation. |
| Field Notes | Textual in conjunction with the observation grid. | These were jotted down during observations in all the contact sessions. |
| Scheduled Interviews | Standard questions asked at the end of each cycle to assess the cycle. | Sets of interview schedules. First set was implemented during the end of the 3rd till the last (5th) cycles. |
| Structured Interviews | Thematic approach guided by questions on the prepared interview schedule | The structured interviews were used in the 1st and the last (5th) cycles. These two cycles were used to measure the extent of participants' emancipation addressing the themes raised by participants per cycle. |

| DATA SET | INTERIM ANALYSIS METHOD | IMPLEMENTATION |
|---|---|---|
| | | |
| Logs of meetings | Planning and reflection sessions. Feedback and feed forward. | Introducing myself, planning and reflecting together with the participants. Peer empowerment on challenging Technology themes. Peer assessment after lesson presentation. |
| Diary | Multilevel modelling | I recorded all important dates for our sessions, incidences that affected or enhanced the contact sessions. Telephonic conversations with AR role players including the provincial ministry of education in Limpopo Province. |

The findings of this analyzed data in this chapter are reflected in detail in Chapter Five. Interim analysis has been a handy tool in this action research study. This was true in my study as data collection started with reconnaissance study. The analysis of data from the preliminary study brought forth the themes as Senior Phase Technology teachers' teaching challenges. The challenges raised by teachers were resolved by employing AR cycles of contact sessions guided by data sets.

Photographs were mainly taken for each cycle as a means of data collection. Interim analysis of some photos taken during the first cycle is undertaken in this section. I analyzed the photographs (2.1; 2.2; 2.3 & 2.4) which are displayed in Chapter Two (2.3.2). I tabulated questions from photograph analysis guide of Joseph and Harris, highlighted in Table 4.4 within Table 4.5. Table 4.5 outlines the interim analysis of photographs taken during reconnaissance study.

**Table 4.5: Interim analysis of photos taken during reconnaissance study**

| PHOTOS<br><br>QUESTIONS | 2.1 from WHW secondary school | 2.2 from BMB high secondary | 2.3 from VMV high secondary | 2.4 from VMV high secondary |
|---|---|---|---|---|
| Who/what is seen on the photo? | The teacher presenting a lesson in class | Learners being taught | Learners are fully packed in a class | Chalkboard for technology class |
| What is the message conveyed by the photo? | Overcrowding is eminent | Learner-ratio looks fine | Overcrowding is eminent | The chalkboard is old and shabby |
| What is the situation on the photo? | The teacher manage to do his best in the situation | Learners are attentive but their desks limit some activities | No space for the teacher to move in between learners | Teachers writing seem not to be clear from the back of the class |
| Any improvement needed based on the situation, | A bigger class or a manageable teacher-leaner ratio | Desks that learners can move to form a group | A bigger class or a manageable teacher-leaner ratio | The chalkboard needs to be painted or replaced |
| The effect the photo have in the public domain | It will be well received | It will be well received | It will not be well received | It will not be well received |

Within the AR cycles data was collected and analyzed in one way or another, hence interim analysis was applied. The next section reports on the AR data analysis techniques from Cycles 2 to 5.

### 4.7.2 Reporting techniques of data gathering from Cycles 2 to 5

Riel (2010:4) reverberates that AR takes place in cycles and each cycle is a discrete experiment of taking action as a way of studying change. The report can either be detailed by cycle or a report of the cycles in a more summary format (ibid.). Riel (2010:4) outlines the following techniques as a guidepost to the analysis process:

- Cycle research questions: Questions that are listed in 4.5.3 were asked at the end of Cycles 3 to 5, for cycle reflection purposes.
- Evidence used to evaluate the action: Final video capturing schedule of participants' lesson presentations at their respective schools per grade between Grade 8 and 9 (Table 4.3). Observation lesson assessment grid was used by peers and participants' HODs. A meeting was arranged same day to give participants feedback on their lesson.
- Evaluation: How did I evaluate the plan of my action? In 4.5.2 I evaluated my planned action by using reflection questionnaires at the end of a contact session.
- Reflection: I looked back on my action with the benefit of data and thought if I were to do this again what would be included, and lastly, if I noticed any surprises from the collected data what would I do to follow that up.

I presented data analysis in a report form based on the cycle activities. This summative reporting format flows from the activities which I engaged the participants in per cycle. Mills (2003:104) also shares some procedures which can be employed for AR data analysis as follows:

- Indentifying themes during data collection process;
- Coding survey, interviews and/or questionnaires to find patterns in the collected data as well as group together topics that relate to each other;
- Asking key questions since they are a starting point for individual or collective analysis;
- Doing organizational progress review in relation to the research problem;
- Concept mapping to ascertain consistencies and inconsistencies between the disparate groups.

I combined the AR data analyses strategies of both Riel and Mills. It is in this section that I analyzed the implementation plans of the AR activities by cycle, starting with Cycle 2 since the analysis for Cycle 1 was done in Chapter Two, in which I followed Mills' scope of data analysis. The difference in the questions was considered in Cycle 5, that is, in addition to the cycle-based questions I repeated the questions on the data collection instrument used in cycle 1 in order to measure the extent of participants' emancipation. In Cycle 5 I wrapped up the AR contact sessions with the participants and therefore lesson presentations had to be assessed by participants' peers and their HODs.

### 4.7.3 Data analyses of cycle activities

Cycle research questions; action evaluation evidence; action plan evaluation process; reflection of intervention action; themes identified; data coding; Technology teachers' progress review and concept mapping were reported considering the first and the fifth cycles. Discussions of the analysis were only on the techniques applied as follows:

- Cycle research questions: Research questions from data collection instruments used in Cycle 1 helped in shaping the roll out of the whole study from Cycle 2 up until Cycle 5.
- Action evaluation evidence: From the findings of Cycle 1 participants raised a number of challenges. Those challenges led to themes and cycles that were planned jointly to address those challenges.
- Evaluation process of action plan: Challenging topics from the participants' work schedule were deliberated on at a common venue, which is WHW secondary school. I interchanged roles with the participants to address their Technology concerns.
- Reflection on the intervention action: On the last day of each and every cycle participants were given the opportunity through the interview script to reflect on the session activities. This exercise was incorporated to respond to Technology teachers' pedagogical challenges in the next cycle.

- Themes identified/data coding: Themes were identified or data was coded in Cycle 1. The developed themes led to the acceptance of the research question with minor rephrasing. As the cycles unfolded, themes were dealt with and the objectives of the study attended to.
- Technology teachers' progress review: Exercises were done during the contact sessions especially under Systems and Control. The assignment on graphic communication was given to participants to be marked in the next contact session. Between the sessions I had an informal chat with the participating HODs to update me on the progress of their Technology teachers at their respective schools.
- Concept mapping between the first and the fifth cycles: I used concept mapping not to ascertain consistencies and inconsistencies but to measure the extent of emancipation between Cycles 1 and 5.

During the data analysis stage it was imperative to establish the trustworthiness of the study.

## 4.8 TRUSTWORTHINESS

Whitehead and McNiff (2006:97) claim that validity is about establishing the truth value, or trustworthiness of the claim to knowledge. My colleagues within the College of Education served as critical readers and discussants during the monthly research activity for master's and doctoral students, called Brown Bag Seminar (BBS). During BBS one's work is being peer-reviewed and critiqued by senior colleagues. The supervisor has to be present during one's presentation to confirm progress. Questions are asked from the floor and advice is offered for one to consider incorporating into the study moving forward. I managed to present my progress twice in two years at the BBS. I also presented my study progress in three Technology conferences during which experienced Technology lecturers or researchers served as validation groups to shape the study further and cautioned me of strengths and areas seeking improvement. In the AR process, practitioners use validity and legitimacy as a means to show that any conclusions that they come to are reasonably fair and accurate. Validity and legitimacy are different but interrelated concepts (Whitehead and McNiff, 2006:97). The extent to which the research results are trusted will depend on how well the validity has been ensured (Merriam, 2001:198). To ensure validity I further engaged the UL Technology lecturer during the AR cycle as a participant observer and sometimes as a co-facilitator. According to Neuman (2000:126) there are strategies that are employed to research to ensure the trustworthiness of the research findings. These strategies are briefly explained subsequently.

### 4.8.1 Strategies for trustworthiness

This study operationalized the strategies of credibility, applicability, dependability and confirmability as described by Lincoln and Guba (in Steyn, 2010:165; Maritz, 2010:27) for trustworthiness purposes. Based on the AR interventions in this study, Table 4.6 (below) shows how the strategies were operationalized during the cycle of contact sessions so as to warrant validity and legitimacy. The table is adapted from Maritz (2010:29-31).

**Table 4.6: Operationalizing the strategies for trustworthiness**

| STRATEGY | CRITERIA | APPLICABILITY |
|---|---|---|
| Credibility | Reconnaissance study as AR Phase 1 | • Preliminary study was conducted for fact-finding before embarking on a full roll out of the AR enquiry.<br>• Served to shape the progress of the whole study as themes were developed from AR Phase 1 findings. |
| | Triangulation | • Three methods were used for data collection during the initial phase of the study – observations, interviews and questionnaires. |
| | Prolonged study | • The study ran for three years with successive two years (2010/2011) of direct contact session with the participants in implementing AR intervention strategies. |
| | Reflectivity | • Reflective meetings were held with the participants before and after the contact sessions.<br>• To reflect on the cycles the participants |

| STRATEGY | CRITERIA | APPLICABILITY |
|---|---|---|
| | | completed an interview questionnaire which I collected and analysed before the next cycle.<br>• I also used reflective journal and field notes. |
| | Member checking (see table 4.2, Day 6) | • Since all the interventions were captured on a video, be it a seminar, workshop, meeting or lesson presentation, a day was organized with all the participants and their circuit manager was invited to view video clip recordings of their two year AR journey.<br>• Discussions with the respondents on the organised day did provide participants with an opportunity to add more information make changes and offer interpretations. |
| Transferability | Dense description | • Cluster sampling was used.<br>• Demographics of the participants were described.<br>• Both baseline data and summative data were discussed in depth.<br>• The results were re-contextualized in the AR cycles. |
| Dependability | Input to study progress and data coding and recoding. | • All aspects of the research were fully described. This includes methodology, characteristics of the sample, AR process and data analysis by the supervisor, *SANPAD peers and their research leaders.<br>• Data quality checks by member checking, brown bag series, paper presentation on different conferences, supervision and in 2010 I was a full member of SANPAD programme.<br>• Challenges were treated as themes and themes serve as codes to be addressed by AR cycles. |
| Confirmability | Uniqueness of AR | • In AR cycles procedures are dynamic and depend on a number of factors that can be beyond the researcher's control, e.g., participants' prior knowledge and background might differ that has direct bearing on their emancipation to tackle their challenges. |

*SANPAD stands for 'The South Africa Netherlands research Programme on Alternative in Development'.

Of interest during the cycles was that participants presented topics to the co-researchers on the areas which they were good at, e.g., graphics was handled by WHW secondary school teachers since they had a rich technical drawing background and taught national certificate level for many years.

### 4.8.2 Establishing validity and legitimacy

It is in this section that both validity and legitimacy of the study are established. This is done to reflect both the genuineness and authenticity of the data within this action research study.

#### 4.8.2.1 Establishing validity

Establishing validity has to do with showing the authenticity of evidence base, explaining the standard of judgement used, and demonstrating the reasonableness of the claim (Whitehead & McNiff, 2006:98). Kumar (1999:137) defines validity as the degree to which the researcher has measured what he has set out to measure. According to Babbie (1990:133), validity reflects the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration. Validity refers to the degree to which a study accurately assesses the specific concept that the researcher is attempting to measure (Maruyama & Deno, 1992:69). Table 4.3 (above) displays how I established validity by incorporating different strategies in the AR study. AR has a benefit for Limpopo Province Technology teachers, their principals and district office personnel – it promises progress in the professional development of teachers. The process allows Technology teachers to experience problem solving and to model it for their learners. They carefully collected data to diagnose problems, search for solutions, take action on promising possibilities, and monitor whether and how well the action worked. The cycle can repeat itself many times, focusing on the same problem or on another. The process can help develop a professional problem-solving ethos (Corey, 1953; Schaefer, 1967; Sirotnik, 1987; Joyce, 1991).

#### 4.8.2.2 Establishing legitimacy

Whitehead and McNiff (2006:98-99) maintain that establishing legitimacy is about getting other people to accept the validity of one's claim, but often this has to do with power than rationality. Those in power may intimidate the AR practitioners to the extent that the practitioners recant their research claims. History has good cases of those courageous individuals who stood in opposition to the illegitimate use of power against their beliefs (Whitehead & McNiff, 2006:99). For example, Socrates drank the hemlock; Jesus went to the cross; Steve Biko went to the law, and then to his death. These individuals refused to be silenced, but died for their convictions. Based on the AR journey I travelled with the participants, I could notice that they were emancipated and empowered to teach Technology. I still refer to Table 4.3 to claim authenticity and validity of this AR study as the practitioner who spent some time in the field with the participants. Kemmis and McTaggart (1988:25) emphasise that AR enables a practitioner to give a reasoned justification of educational work to others. For purposes of my study I could show the evidence that I gathered and the critical reflection that I undertook helped me to create a developed, tested and critically examined rationale for what I did with the participants. This claim is based on what the participants said and/or did as evident to their emancipation through participatory activities of AR cycles.

Contrary to trustworthiness in AR, I offer the words of Todd at this stage. Todd (n.d.) contends that AR occurs within a specific classroom situation, is usually conducted by the teacher as classroom participant, and aims to develop the situation and the teacher-researcher rather than generate additions to the pool of human knowledge. Since AR does not aim to increase knowledge, issues of research reliability and validity can generally be downplayed in AR while practicality and immediate usefulness become more important. For this reason, AR often seems an attractive option for teachers who are new to research. It looks easy – action researchers do not have to worry about creating valid research designs, about statistics, or about concepts like triangulation and replicability. While these points are to some extent true, conducting useful AR still requires serious devotion of time and effort and a lot of thoughtful consideration. However, while not easy, AR should still be an attractive option for classroom teachers, albeit for different reasons. In conducting AR with senior phase Technology teachers, I served as a facilitator during contact sessions and interchanged roles with them in peer teaching and assessment.

AR can revitalize the entire learning community, as well as aid teachers in changing or reflecting on their classroom practices (Calhoun, 1993:62-65). This was true for the cohort of Technology teachers' from selected schools of Limpopo Provinces as articulated in the next chapter.

## 4.9 CONCLUDING REMARKS

Data collection happens within a produced plan and is immediately followed by a methodical analysis and presentation. This chapter was dedicated to outlining the methods and strategies applied to collect and analyse the data. The research approach, data-collection methods and techniques for data analysis were spelt out. The paradigms incorporated in this AR approach were chosen and detailed. The analyses strategy for the collected data was discussed. Validity and legitimacy were considered in this study so that findings could be used to develop strategies for improving the teaching of Technology in the senior schooling phase and for further research. A sample of cycle preparation and participants' invitation, cycle programme following the circuit theme, cycle activities, cycle facilitation schedule and outcomes per cycle were discussed in this chapter.

The subsequent chapter looks at all collected data – from reconnaissance to the last cycle and further presents the findings in the light of the previously discussed AR cycle analyses and data sets.

# CHAPTER FIVE

# FINDINGS OF THE MAIN ACTION RESEARCH STUDY

It is the teacher who makes the difference in the classroom. By far the most important factor to school learning is the ability of the teacher. The more capable the teacher, the more successful will be the students (Nelson, 2008:5).

## 5.1 INTRODUCTION

Chapter Four presented the data collection activities of the main action research (AR). This chapter presents findings from such collected data. These are findings of the AR cycles based on the intervention strategies on planning, implementation, empowerment of the participants, learning and evaluation of the learning processes which were designed to have an impact on the Technology teaching in Limpopo Province. The findings during the AR cycles were deduced from the myriad of methods and instruments used for data collection as listed in Chapter Four (4.3). That includes workshops, field notes, non-participants observations, audiovisual tapes of lesson presentations, samples of learners' work (projects and portfolios), interviews, dairy, photos, logs of focus group meetings and questionnaires with rating scales. As a result, findings are presented in this chapter following the AR cyclical and data set approaches. In each case, a brief explanation about what transpired during data gathering will be given to facilitate the understanding of the findings.

## 5.2 PROCESS OF REPORTING ACTION RESEARCH FINDINGS

Before the findings are reported, the process of reporting them is first exposed in the sections that ensue.

### 5.2.1 Process of reporting findings from action research cycles

I will anchor these cycles' findings by Riel's (2010:2) action research goals. She states that the goals of AR include:

**First goal**: The improvement of professional practice through continual learning and progressive problem solving. This goal supports the purpose of the study as mentioned in Chapter One (1.3). In order to construct teachers' challenges on Technology it was necessary first to engage participants in a reconnaissance study by asking them relevant questions regarding their Technology teachings. Consequently, a plan for contact sessions was developed which comprised of five cycles which were spent in Limpopo Province with the aim to emancipate the Technology teachers. Data was gathered per cycle and were analyzed. The findings from these cycles are expected to show improvement of professional practice in participants' Technology teaching. The AR cycles addressed participants' challenges.

**Second goal**: A deep understanding of practice and development of a well specified theory of actions. In the second goal I shed some light on critical theory, which grounded the study as discussed in Chapter Three (3.2). Critical theory has some emancipatory intent. This theory indicates that there is fundamental dialectical relationship between theory and practice, and that they are indivisible, especially in Technology, as seen in the facilitation of learners' projects by participants. As applied to my study, this theory was important in framing the study as affected teachers in those selected schools of Limpopo Province were involved in the intervention through action research to influence their Technology teaching practice. Teachers' emancipation can therefore be followed through the findings presented in this chapter.

**Third goal**: An improvement in the community in which one's practice is embedded through participatory research. I incorporated Paulo Freire's participatory action research (PAR) in Chapter Four (4.4.2) with the participants among the AR major paradigms. PAR builds onto the critical pedagogy as a response to the traditional formal models of teaching where 'chalk and talk' is dominant. The participants were engage in PAR so as to among other things relate well and consult among themselves on their areas of expertise. Findings per cycle reveal the benefits of PAR.

The cycles were conducted with the participants as scheduled in Table 5.1.

**Table 5.1: Schedule for action research cycles**

| **Cycle** | 1(a week) | 2 (a week) | 3 (a week) | 4 (a week) | 5 (two weeks) |
|---|---|---|---|---|---|
| **Date** | 08 until 12 March 2010 | 31 January 2011 until 04 February 2011 | 18 until 22 April 2011 | 30 May 2011 until 03 June 2011 | 01 August 2011 until 12 August 2011 |
| **Data gathering instrumen ts** | Observations of lessons supported by digital still and visual pictures, interviews and questionnaire s. Meeting to structure the way forward. | Seminar on technology challenges identified. Field notes were written down. Recording of activities using audio visual camera was done. Interview cycle schedule was filled and questionnair es were completed. Meeting to structure the way forward. | Workshop to address Technology challenges as themes were organized. Recording of activities using audio visual camera was done. Interview cycle schedule and questionnair es were completed. Meeting to structure the way forward. | Workshop to address Technology challenges as themes were organized. Recording of activities using audio visual camera was done. Interview cycle schedule and questionnair es were completed. Meeting to structure the way forward. | Observations of lessons supported by digital still and visual cameras, interviews and questionnaire s. Included peer and HOD lesson presentation assessments. Seminar on participants' lesson assessment. Meeting to evaluate the whole AR project. |

Different instruments for data collection were incorporated in line with the nature of activities per cycle. The findings of the above applied data gathering strategies are discussed by cycle after 5.2.2. Where necessary the cycle activities will be briefly highlighted before the findings to provide a brief background to what transpired.

### 5.2.2 Processing results from action research data sets

To strengthen the credibility of data, several strategies of data sets were analyzed using 'interim analysis' in Chapter Four (4.7.1). Findings were processed from the data sets explained below. Data set (Table 4.3) findings are narrated from the photograph analysis; observation grids of the first and last cycles as well as field notes analysis; last cycle structured interviews and questionnaire analysis (these questions are the same as the once asked in the first cycle); and incidences during the contact sessions recorded in my dairy. Data set findings report mainly on how the team (co-researchers, that is the participants and I addressed challenges from the reconnaissance study themes mentioned in Chapter Two. I went beyond triangulation in reporting the findings to include the crystallization component as discussed in 2.3 and 2.3.1.

## 5.3 REPORTING FINDINGS FROM ACTION RESEARCH CYCLES

The upcoming sections will be reporting findings of the action research study as apparent per cycle.

### 5.3.1 Cycle1: A brief overview of findings from reconnaissance study

I embarked on the first data collection activity during the first term of 2010 and the participants were a little sceptical because I was an outsider. I used three instruments for data collection as a fact-finding strategy, named reconnaissance study. It was during this Cycle 1, after data from those three instruments were analysed, that I managed to establish my first set of findings as participants' biography (Table, 2.1) Section 2.3.4. The rest of the findings from these instruments were used to develop themes, as discussed in 2.3.3. The details of Cycle 1's findings and how they impacted on the participants' teaching of Technology were fully discussed in Chapter Two (2.3). I also found out from one HOD during member-checking on 8 August 2011 (Table 4.2, Day 6): "Your approach in the first cycle, Mr Mapotse, did scare some of the teachers for the mere fact you wanted to observe them in their classes during your first visit". This possibly contributed to losing some participants in the process. However, the real contributing factor was the allocation of a new subject to some of these teachers in the following year. The HOD further commended me for my approach in Cycle 2 about presenting the findings and structuring a plan to resolve the participants' challenges. Cycle 1 was a minor AR, Phase 1 of this AR study. Its purpose was to shape the study and produce and guide the ensuing cycles, commencing with Cycle 2 in the major AR, Phase 2. Cycle 1 findings were triangulated in Cycle 2.

### 5.3.2 Cycle 2: Overview of Phase 1 findings

For a week, Technology teachers and I met at their respective schools and I shared the findings of Cycle 1 as outlined in Chapter Two (2.3.3: Integrated findings from the three data sources according to themes). Cycle 1 findings were therefore presented and discussed in Chapter Two during Cycle 2 contact session. During interaction with the participants in Cycle 2, I introduced a reflection questionnaire to be completed after the cycle activities starting with Cycle 3 onwards.

### 5.3.3 Cycle 3: Findings after implementing action plan

The activities of Cycle 3 will be briefly highlighted before sharing their findings. This will help in linking the findings to the activities. In sharing the findings attention will be drawn to activities participants engaged their learners, what transpired at the contact session venue and findings from end of the cycle reflection.

#### 5.3.3.1 Delineating findings from Cycle 3 activities

The plans for Cycle 3 were tabled in Chapter Four (4.6.2 and Table 4.1). The *how's* of executing the plans which then translated into activities of this cycle are listed in the Vignette of Cycle 3. There follows a schedule for research activities of Cycle 3 in Limpopo Province at Mankweng Circuit. These activities took place during the 3rd AR cycle from 18 to 21 April 2011. All participants from the five selected secondary schools were assembled at WHW secondary school as our common venue for our contact sessions to address the themes raised. The presentations of activities were shared among ourselves per topic. Table 4.1 only indicates the UL lecturer and me taking the lead in session facilitation. This was part of the planning from my side. The reality on the ground changed the plan since I found out that the Technology teachers from WHW secondary school had taught technical drawing for more than a decade. The next piece displays a list of daily activities undertaken during Cycle 3.

Daily activities during Cycle 3 covered the following topics: curriculum transformation, lesson planning which flows from the work schedule, contextualizing Technology, assessment in Technology, utilizing local resources, PCK – pedagogic content knowledge in Technology LO2, accommodating learners with barriers to learning, and unpacking LO3. Each day had a theme to cover. Within that theme there were specific topics that were covered based on the participants' request. The details of the sub-themes are indicated in Appendix 4.1. The themes were discussed and structured respectively as follows: Day 1 - Electrical system; Day 2 - Mechanical systems; Day 3 – Structures and Processing; Day 4 – No theme, no contact session due to SADTU meeting; Day 5 – Drawing. Findings from these activities are thrashed in the following section.

#### 5.3.3.2 Vignette of both activities and findings from Cycle 3: At the contact session venue

During the intervention with the participants, I respected and adhered to their normal regional work schedule of Technology. However, we were able to implement what teachers gained from interpreting the policy documents. The participants had a clearer understanding of designing learner projects as part of their normal schedule. This cycle was more of a show off from the participants' side and to prove that Technology is a hands-on subject. For the first time the many participants let their learners come up with some projects in following their work schedule more so by utilizing recyclable materials locally available.

Photos 5.1 and 5.2 display the Grade 8 products under the theme 'Containerization'. These two artefacts are in their open mode. Photos 5.1 to 5.6 are a display of Grade 8 learners' sample of projects. The containers in both photos 5.1 and 5.2 promise to can transport nine (9) chemistry test tubes safely.

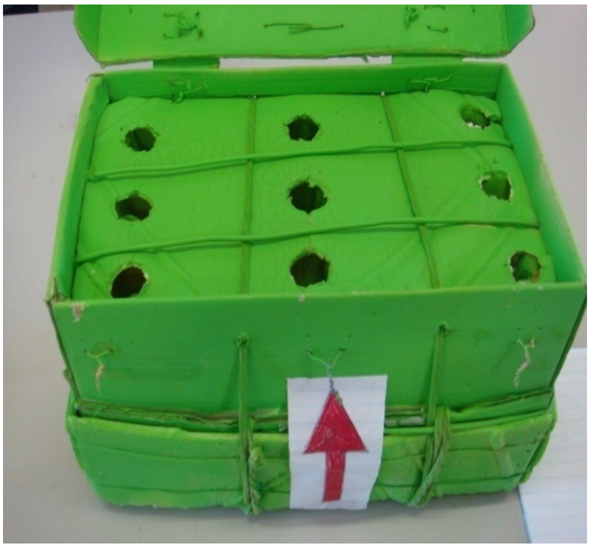


**Photo 5.1: RMR Sec container**

**Photo 5.2: BMB Sec container**

Our venue for contact sessions at WHW secondary school was a chemistry laboratory, so we managed to evaluate the products from different schools if they served the purpose which they were designed for. All assessors, meaning the AR team members reached some conclusion that the test tube containers made could safely carry the test tubes from one point to another. Of importance is that both containers bear a sign – the red arrow – to show which side one should open as well as that this product should be handled with care. Photo 5.2 shows a remarkable sign that the learners went further to indicate that the product contained fragile material.

Photos 5.3 and 5.4 show how teachers motivated their learners to use readily available materials from their local community to make these test tube containers. Photo 5.3 displays the ready to transport closed container together with its portfolio. The container is made out of spongy material within and without. Photo 5.4 displays the container made out of cardboard box material covered with a transparent plastic material and the test tubes are separated by spongy material within the nine holes.


**Photo 5.3: Container & portfolio**


**Photo 5.4: Packed test tube container**

Notice boards were another option for Grade 8 product. One group of Grade 8 learners from BMB secondary school, after realizing that they had a choice of either to develop a notice board or test tube container as one of their containerization product, decided to develop a lockable notice board. Photos 5.5 and 5.6 display an artefact of lockable notice board in a closed and opened position respectively. The participants agreed that this type of notice board would be useful to display important information without learners or anyone tempering with the information contained on it.

**Photo 5.5: Closed notice board** **Photo 5.6: Open notice board**

The Grade 9 teachers had only one choice of a project for their learners. They came up with an indoor dustbin project. Photos 5.7 and photo 5.8 display a sample of the classroom dustbin project which was constructed by Grade 9 from RMR secondary school.


**Photo 5.7: A closed rubbish bin** **Photo 5.8: An opened rubbish bin from RMR secondary**

This product is made out of wire and black refuse bag. The wire was used to construct the bin while the refuse bag material was used to wrap the wire. The bin also can be used as a teaching aid in addressing systems and control – mechanical systems – levers. The bin is opened by applying ones foot on the paddle so that internal mechanisms can open the lid. During member-checking (table 4.1; Day 6) with the participants and their Circuit Manger, this rubbish bin constructed by learners was officially presented to the Circuit Manager. The presentation was a 'thank you' to remind the manager about the AR journey once travelled within the Mankweng Circuit.

This confirms that Technology teachers can teach this subject effectively and efficiently as long as they can be a little bit creative and instil this creativity in their learners. There is no need to lament much about lack of resources as recyclable materials can serve as a substitute while waiting for proper material from either the school or the provincial department of education.

#### 5.3.3.3 Findings from Cycle 3 activities

The findings are extracted from the activities of Vignette of Cycle 3 per day at the contact session.

**Day 1**: Emancipation on this day was on curriculum transformation; exploring, interpreting and implementing Technology curriculum policy; and electrical under system and control as the theme of the day.

The day before the session I called all the MST HODs to request their Technology teachers to bring along their Technology policy documents. During reconnaissance study in 2010 the participants claimed that they did not have any policy documents. Many said that, "It is hard to teach Technology without textbooks, policy and resources". I found the situation to be different in 2011, as all the participating schools had a copy of the policy document. In addition I supplied each participant with a copy of CAPS Technology as they only heard about it and they were waiting for the district to provide it to them. Upon hearing that the participants received CAPS handouts, the circuit manager acknowledged that by saying: "Mr. Mapotse, thanks for letting those teachers to be ahead of their colleagues in the district, may you please also drop me a copy of CAPS in my office". I yielded to this telephonic conversation's request between me and the circuit manager by providing him with a copy. I facilitated the unpacking of the policy's LOs and their ASs per phase per grade. I gave them an exercise to measure their understanding around the policy. I requested that the participants develop a table where one LO and its ASs are made easy to the Technology teachers in their neighbouring schools. It was very encouraging to see participants devise Table 3.3 – senior phase Technology AS1 of LO1 under (3.6.6 and 3.6.6.2). The participants found this exercise enhancing and doable after I had taken them through textbox 3.2 of Chapter Three - unpacking Technology GET curriculum and policy.

Pertaining to two questions on curriculum transformation that I asked the participants in our focus group meeting: "Are you aware what CAPS entail?" and "What is your district doing to make sure that you are coping with rapid unprecedented curriculum changes?" the participants confirmed that they were aware of the wind of change that was blowing within the South African curriculum and acknowledged that it affected them negatively since they did not have Technology support structures in place within the district and the school. As one participant who was also an HOD contended that:

> *"In our circuit we don't have curriculum advisors, so we use laymen's knowledge to teach this subject Technology. In many schools this subject is taught by teachers who cannot fit anywhere in the school curriculum. The school just allocate this subject to those teachers so that the school can secure both the teacher and the post".*

I played the participants a slide in Figure 3.1 about education transformation in South Africa (see 3.5 in this regard). The participants started to realize and developed a deeper meaning of the transition from Report/NATED 550 through NCS to CAPS. We reached a consensus that CAPS is a vehicle to implement NCS. I requested that the participants unpack CAPS by using their textbox 3.2 experiences. The team was able to identify the usage of the following words from NCS to CAPS (given in brackets) which replace those in the NCS: educator (teacher), learning area (subject), outcome (aims and objectives) and curriculum (syllabus).

As the comparison exercise became increasingly interesting one of the participants claimed: “I have found out that systems and control have been split into two categories – Electrical and Mechanical”. These two sub-topics used to be one theme, Systems and Control, in the NCS. I reminded the participants that Electrical system was the theme of the day. They would treat it in their next term according to their 2011 work schedule.

The participants confirmed what they had expressed during the reconnaissance study, that they did not know LO2 is the content of Technology. They also declared that both Mechanical and Electrical systems were quite challenging to them. The University of Limpopo lecturer took them back to the policy document to see what areas they requested to cover per grade on Mechanical and Electrical systems. They had to realise the scope – the breath, depth and height, that their teaching should cover per grade as one commented: “I never realised the importance of this policy document until today”. Day 1 was closed with the request that the participants should bring along their personal Technology file to the contact session on the next day.

**Day 2**: Teachers’ empowerment on this day was focused on planning for Technology presentation as well as assessment in the Technology class.

I treated the theme on planning and the focus point was Technology – learning programme, work schedule and lesson plan. The University of Limpopo lecturer addressed both assessment in Technology and the theme of the day that is Mechanical system.

I gave the participants an electrical exercise to do in pairs so as to check their understanding on what was covered on Day 1(see task in Appendix

5.1). They fared well. Only a pair let us to explain every question in detail so they could connect it well with what  would be covered on the second day. I continued to ask the participants to take out all documents related to the day's session from their personal file. One participant commented:

> *"We are no longer expected to have a learning programme. We are being provided with a work schedule from the district. Pertaining to the lesson plan each school do it their way. The district gave us common dates for assessment in 2011".*

I discussed with them the importance of a learning programme even though they were no longer personally involved. The work schedule was discussed during Cycle 2 of 2011 when cycle planning was jointly finalised. When it came to the Technology lesson planning it was done in diverse ways by the same district teachers. Each school had its own way of lesson planning; here are my findings on lesson plans:

- BMB secondary school used readymade lessons from one publisher in their teacher's guide booklet;
- VMV secondary school used a standard lesson plan common to all designed by the MST HOD;
- In RMR secondary school everyone did his or her planning differently;
- At KMK secondary school the Technology teachers together with their HOD agreed to have key component concepts included in the lesson plan;
- WHW secondary school conducted its Technology lesson planning in the same manner as BMB secondary school.

The samples of such lesson plans are in the attached Appendix 5.2.

The University of Limpopo lecturer started to unpack Technology assessment to the participants referring them to different documents relating to assessment. Those are, for instance, protocol on assessment, teachers' guide on assessment; and Technology policy document. From the participants' responses during reconnaissance, teachers limited their assessment to class work, homework, tests and examinations. Many methods of assessment were exposed including peer assessment, collage, posters, projects, charts, and the use of a rubric during assessment. This was an 'aha' moment to the participants as attested by saying the following statements when asked what form of assessment they incorporated in their classes: "Peer assessment, informal assessment, formal assessment baseline assessment". Another participant responded in the following manner: "Rubrics for projects, tests and assignments".

Pertaining to the theme of the day, Mechanical systems, the participants were asked to raise their challenges. Technology teachers asked questions that bothered them and we jointly attempted to respond to them. In their responses to the second but last interview reflection question about the gaps that they think they still need to be emancipated on, the participants stated that they a need to be empowered around Mechanical systems as some said: "I am having a problem in pneumatic system and mechanical system"; "Levers: Identifying classes of levers and their performance"; "The mechanics, i.e., mechanical systems".

**Day 3**: Capacitating teachers on this day was focused on contextualization of resources and technological skills.

I handled technological knowledge LO2 with specific reference to Processing in accordance with teachers' work schedule, and technology resources. The UL lecturer addressed support in Technology, technological skills and the theme of the day on Structures.

The participants were directed to their common work schedule. I noted that they had to cover 'Processing' (LO2 AS2) in both Grades 8 and 9 according to their work schedule. They were then advised to come up with a project by grade based on circuit theme of 'Containerisation' as well as the assessment rubric for that project. The Grade 8 teachers decided to come up with two projects for their learners: 'test tube safe container and lockable notice board'. The Grade 9 teachers agreed about 'dustbin' as their learners' project. The participants were given a sheet of a drawing grid to complete and submit on Day 5.

**Day 4**: There were no contact sessions on this day due to teachers' union, South African Democratic Teachers Union (SADTU) urgent meeting at the community hall from 8H30 am.

**Day 5**: Teacher empowerment on this day was focused on barriers to learning and LO3 and Drawing/Graphic communication.

We started our day by reflecting on Day 3's contact session. I introduced drawing to them which would be handled fully in the next cycle. I then handed over to WHW secondary school teachers to continue from there. They asked the teachers to submit the drawing grid they had been given on Day 3 to complete as an exercise. Others had forgotten the homework. Among those that did very well one participant from RMR secondary school was asked how did she manage to complete the drawing grid so well and she responded: "I consulted with one of my colleagues with whom we were together in 2010 first cycle, my colleagues explained to me further on how to draw from a grid. My male colleague asks me to make several pages copies of a grid given at the contact session, for exercise purposes. He then showed me how to do to the exercise. I then followed his example".

The two teachers interchanged on the teaching, one concentrating on free-hand drawing and the other on drawing by using technical drawing instruments. Types of instruments used, e.g., pair of divider, set square, T-square, protector, and types of drawing, e.g., isometric, two dimensional, 3-dimensional, oblique, were touched on by these drawing experts. I promised the participants that we would continue with these drawing activities in the next cycle.

I handled barriers to learning and LO3. The UL lecturer addressed LO3. The theme of the day, drawing, was treated by WHW secondary school teachers. The rest from these topics facilitation are reflected in detail in the next section.

#### 5.3.3.4 End of Cycle 3 findings from interview cycle reflection

As mentioned above, on the last day of each cycle the participants had a common standard reflection questionnaire to complete, which helped to assess the AR spiral activities of contact sessions. This type of questionnaire was introduced as from the third cycle onwards so that it could further shape the next cycle and asses as to whether some degree of emancipation had taken place as expected. Since the questionnaire was standard and applied from this cycle to the last it maintained the same standing questions. After the participants had responded to the questionnaire I took it along to begin with the analysis. The next section gives account of the findings from the reflection questionnaire. Before the findings are presented I list the questions contained in the questionnaire:

- What have you learned from this AR cycle activities?
- What are you taking along to your school from this cycle sessions?
- Indicate technological themes that you can now implement with confidence in your lesson presentation especially those that you couldn't before the cycle.
- What gaps have you identified that still need to be filled regarding your knowledge of Technology?
- Any other inputs/suggestions/proposal you have way forward?

The next section presents the findings from responses of the above listed questions.

**a) What have you learned from this Action Research cycle activities?**

Critical theory intends to emancipate (Gibson, 1983:44), whereas AR engenders powerful learning for participants (McIntosh, 2010:38). The combination of critical theory and AR in an educational setting therefore brings forth an emancipated teacher who has gained knowledge in the area of concern. So, participants were also empowered during this Cycle 3 as learning (gaining of knowledge) has took place, this can be read from their responses to the above question:

> "The actual setup of the learning area Technology was clearly analyzed and gave me a strong foundation into understanding the Learning Outcomes and how they relate to their Assessment Standard. The progressions of the Learning Outcomes and Assessment Standards for one grade to the next were clearly outlined. Some sections were clearly expanded which were always a problem to most of the teachers, for example resistors and their calculations. The OR-gates and AND-gates and their application".

Another teacher benefited from how the policy and lesson presentation methods:

> "As a new Technology educator I learned a lot about the policy, Learning Outcomes and Assessment Standards. I now understand and know how they are interrelated from one grade to the next, for example Grade 8 to Grade 9, and also Grade 7.Again, I learned more about the resistors and the OR-gate and the AND-gate and their symbols and calculations. I learned about colour codes and also the interpretations of all the colours and the simple method that could help me to present Technology better than before to my learners. The methods of presenting this subject are going to improve and I hope learners are going to enjoy the subject".

Besides what the participants learned from logic gates and the interpretation and implementation of the policy, one participant indicated that he could also calculate the resistance of resistor. The participants' technological background differed, hence within this cycle they learned different things in relation to their challenges in the teaching of Technology. They reiterated their benefiting from unpacking the Technology policy:

> "I can be able to use the curriculum policy book. I was struggling to make use of it. I can calculate the resistance concerning systems and control".

**b) What are you taking along to your school from this cycle sessions?**

Action research involves the development of knowledge and understanding of a unique kind (McIntosh, 2010:38), whereas Technology is a comprehensive, experience-based educational program for learners to know about, do and value Technology (Israel, in Williams & Williams, 1996:7). For Technology teachers to participate in the AR cycles their knowledge and understanding of how to teach Technology increased substantially to an extent that they stated things that they were taking along to their schools. Those issues are expressed below:

> "Now, I'm very confident to teach this subject in my school. I now have the knowledge and understanding of what is required about the subject and how to present it. The skills from our mentor have also contributed a lot to the little that I had, I'm now skilful than before".

One other teacher put it this way:

> "I am taking to my school the ways in which Systems and control should be taught guided by the Revised National Curriculum Statement".

Yet another teacher was taking the following to school:

> "The electrical section of Technology, specifically the importance of resistors and all that was mentioned in question 1, and teaching learners about assessment standards from the technological process, for example, how they should investigate locally and nationally".

**c) Indicate technological themes that you can now implement with confidence in your lesson presentation especially those that you couldn't before the cycle.**

Empowerment is evident in the sense that the participants showcase explicitly what they have a learned and experienced. In line with McIntosh (2010:38) action research is conducted by a collaborative partnership of participants and researchers. Technology is concerned with solving problems where there are not right or wrong answers, only good or bad solutions to problems (Williams & Williams, 1996:7). To this end, as a researcher, I have been engaged in a collaborative partnership with the participants to tackle their Technology teaching challenges. I therefore present the participants' findings from this inquiry:

> "Binary notation and conversion into the decimal, resistors and resistance. Determining and calculating the resistance using the colour codes arrangements according to sequence 1$^{st}$, 2$^{nd}$ 3$^{rd}$ up to the last, and significant numbers zero and multiples plus tolerance".

The other participants gained some confidence in some areas of Technology, "I can now present with confidence the following themes in Technology: Structures, Systems and control, and Indigenous technology and culture". Collaboration added value to these participants to an extent that they were taking turns in presenting to their peers the following: Design process through electrical system (electricity), Calculating the resistance of the resistor, Explaining the TRUTH table of the AND-gate and OR-gate, being able to read with understanding colours of the resistors, defining and/or writing SI units and symbols of resistors, Ohms, Current, Voltage, Structures and Gear systems.

**d) What gaps have you identified that still need to be filled regarding your knowledge of Technology?**

Participants indicated that they still needed to be capacitated in handling the following aspects of Technology expressed verbatim:

- I am having a problem in pneumatic system and mechanical system.
- Technology teachers in most case lack the knowledge content as such they should be equipped with skills and also be encouraged to consult the Revised National Curriculum Statement when planning for their lessons.
- Practical work such as creating model should also be something that is encouraged as it helps learners to implement the technological processes practically.

Due to time constraints we could not cover everything about Systems and control and other cycle challenges. The nature of Technology also has some influence in one way or the other to be completed within few cycles as I already mentioned that participants' background differed. It is true what Williams and Williams (1996:6) proclaim that Technology Education encompasses many entities; it has grown out of the curriculum areas that preceded it; it has accommodated many new aspects and it is still evolving, and it will continue to do so.

**e) Any other inputs/suggestions/proposals you have as a way forward?**

This was an open-ended question. From the list of comments received I highlight some that seem to be urgent and doable. The participants called for more Technology workshops. This call is supported by McIntosh (2010:38), who asserts that action research involves exploratory engagement with a wide range of existing knowledge. By having a number of workshops as suggested below we will be engaged with the core themes of Technology contained in the policy document and focus on the participants' work schedule:

> "More contact workshops/sessions be conducted and on regular basis. The Department of Education involves Universities to develop curriculum advisors in this field".

The participants recommend post-doctoral intervention:

> "I also wish to have someone (why not Mr. Mapotse again?) again to explain more on Systems and control. Initially this is very good and is more fruitful for our community".

The respondents also suggested a reward in the form of a certificate as a proof for their cycle attendance to encourage them.

In the upcoming Cycle 4 the participants had to give account of the process that they had been through with their learners during the design-make-evaluate of the containerization projects.

### 5.3.4 Cycle 4: Findings from feedback and reflections

The activities of Cycle 4 will be briefly emphasized before sharing their findings. This will help in associating the findings to the activities. In sharing the findings attention will be drawn to activities participants engaged their learners, what transpired at the contact session venue and findings from end of the cycle reflection.

#### 5.3.4.1 Findings from activities

In this cycle I share the findings from the participants' responses regarding the interviews conducted during Cycle 3. Participants were asked to reflect on the projects that they made with their learners during the contact sessions. I developed a guide to be used for reflection purposes. The guide comprised topics and sub-topics which served as a lead for reflections. The topics and sub-topics are pursued as vignette of both activities and findings in the following order:

- *Challenges*: time, materials and group assessment.
- *Success*: workmanship, acquired skills and presentation or communication.
- *Gaps identified:* constrains (resources, hand tools); working within the limited time and specifications.
- *Project rollout by learners*: duration, team work, capabilities and resources, and assessment.

#### 5.3.4.2 Vignette of both activities and findings from Cycle 4: At the contact session venue

Core knowledge policy theme: Processing; Circuit theme: Containerization.
Topics and sub-topics for reflection:

***a)*** **Challenges: time and materials**

Participants indicated that learners encountered an element of time constraint to an extent that the Technology teachers ended up being a little bit pushy. The responses indicated challenges encountered: some learners did not submit their project on time; others' measurements were incorrect; learners were not active enough to design the dustbin; some learners used to leave their work at home; some were not participating. This did not come as a surprise because the teachers indicated that it was their first time that they experienced to engage their learners in project design and making. On the contrary, one teacher from one secondary school indicated:

> "It is difficult for learners to collect materials and tools which are expensive like glue, measuring tapes and electrical equipment".

Concerning materials, things went on well as learners used readily available materials from their surroundings. However, some teachers encountered challenges:

> "Material also contributed too much too time consuming. Some groups took much time to come up with materials as they reside about six to eleven kilometres far apart from each other".

**b) Success: workmanship, acquired skills and presentation or communication**

i) Workmanship

In many schools, learners' workmanship seems to be a very serious challenge to both teachers and learners, and in this case "learners did not trust each other especially when collecting materials. Some just relaxed". They "were arguing in doing the work. They were not working harmoniously with each other". Only one school had a positive report about workmanship:

> "It was good based on the evidence of few groups that I did interview as an educator when they submit their projects. They indicated that they collectively and collaboratively worked together for a common course – their project".

Many of the teachers reported that their learners had not developed team spirit to achieve a specific goal. This had a direct bearing on the target date of submission.

ii) Skills acquired

Teachers' responses indicated that learners learned how to measure accurately. They could manipulate a combination of materials, hard and soft. They could design different types of dustbins. They also learned that some materials such as plastic, steel and wire, which are thrown away, can be recycled and make something more useful and attractive, even profitable if learners are supervised. The teachers also confirmed that their learners had acquired a variety of skills, such as how to make the structure stable; in some cases it was the how of interpreting the project specifications; how to bend wires; how to cut cardboard to a required size, and so on.

iii) Aesthetics

Teachers were impressed with the learners' projects:

> "Their products are attractive and beautiful. They look like real dustbins. The product is decorated with different colours".

I agree to a greater extent with the teachers' claim that the learners' realized designs were attractive, especially given the fact that this, according to the teachers, was their first attempt at engaging learners in a design project. One of them could be viewed from Photos: 5.7 and 5.8 (5.3.3.3).

iv) Ergonomics

The teachers viewed the product as user-friendly because "the product is made of card box and edges are trimmed". However, one participant raised a concern about the learners' background, "more time is still needed to work on learners' efficiency, especially the Grade 8 learners. It seems that the learners never had a good or proper foundation on Technology project or research".

**c) Gaps identified**

Participants argued that hand tools such as pliers needed to be purchased for future use. They also emphasized that consumable materials should always be available in order to speed up the learners' project turnaround time as it was felt that there was shortage of materials and lack of participation. These teachers' responses revealed that learners could not measure accurately and could not convert the units of measurements, e.g. centimetre to millimetre. One participant actually identified this as a matter of teacher preparedness:

"Educators still need to be empowered more about the concepts, skills, workshop and others".

**d) Project rollout by learners: Duration, team work, capabilities, resources and assessment**

i) Duration

The Technology teachers gave the learners two weeks to design, complete and submit their projects. That was our agreement in the previous cycle. Nonetheless, learners' turnaround time differed from one school to another. At one school, one teacher responded, "my learners took a month and few days but only 70% of projects were submitted". Teachers responded further that majority of their learners showed commitment to their projects and were capable to deliver an envisaged project per grade. For this project in particular, resources were not an issue as learners' utilized recyclable material from their surroundings except those that reside in the school hostels.

ii) Team work

The learners were grouped mixed in gender of seven per group, but one teacher had this to say about the team work and the final product, "in the groups were female learners are dominant their project were colourfully decorated". One teacher responded that his learners took only three days to complete the project. I can only attribute that to strong teamwork and the type of project. "Team work was good", declared one teacher. "Team spirit was at 60% even though there were individuals, who were just spectators", another teacher contended.

iii) Capabilities and resources

It was realized that the project and the teams helped learners to talk to each other more often. The teachers also stressed that the fewer the members in a group the more manageable it was. Even though resources were not easily accessible to some, learners in both grades (8 & 9) managed to use card box, glue, colours, spongy materials, wires and waste plastic bags.

iv) Project Assessment: peer (classmates and colleagues) and Technology teachers' assessment

The Technology teachers reported that by class and grade they could let learners display their finished projects and the learners engage in peer assessment. After this first round of assessment the two best projects per class competed with the other best two from other classes, these being Technology teachers involving themselves in assessment. It was during this second round of assessment that the best two were brought forward to the contact session to represent their school. Peer assessment within each class was undertaken based on aesthetics and ergonomics, hence only the best two per category per grade were brought to the contact session.

As stated above, the team of co-researchers developed an assessment rubric for both grades' project. The marking rubric used to assess the project is included in Appendix 4.3. One teacher commented in this regard:

> "The final product projects were assessed using the rubric as the guideline for both learners and educators".

#### 5.3.4.3 End of Cycle 4 findings from interview cycle reflections

**a) What have you learned from this AR cycle activities?**

Participants showed appreciation of the role change for self-empowerment. I let them indicate which Technology topics from the 2011 work schedule which they comfortable in sharing. Teachers from WHW secondary school were quite good in technical drawing. I let them change roles by making them take the lead in empowering all other participants on drawing instruments, types of drawing, how to use a grid for drawing and graphics in general. They responded in this manner to indicate what they had learned from this cycle:

> "I have learned the way I can present a lesson for graphic design, e.g. two dimensional drawing, three dimensional drawing".

> "We have learned about action research that is a methodology which has the dual aims of action and research".

Action within AR is to bring about a change in some community or organization or programme (cf.1.6.1), as it is with this community of senior phase technology teachers. Research is meant to increase understanding on the part of the researcher (cf. 1.6.1), as highlighted in Chapter One and reflected in Chapter Six. The participants support both action and research within AR by reiterating that: "We have study about processing of food, metals, plastic and textile. We are now skilled on how to allocate the marks when setting a test. We have also gained knowledge on how to apply different methods of assessment". The participants further postulated that they were now equipped with skills to draw different types of drawing and variety of Technology assessment methods. As one mentioned, "from today I can use a grid to draw; I can also draft: 2D and 3D drawing. This cycle and the learners' projects taught me other forms of assessment, that is Tests/Exams, Assignment and Projects evaluation, exclaim the other one".

Whatever participants have said during the cycle reflection was not a futile exercise, as we built on this foundation of the previous cycle and also the comments made by Technology teachers during their reflections. Participants further indicated that they could differentiate the types of shapes – drawing, drawing instrument, 2D drawings, 3D drawings, isometric drawing and drawing grid, oblique drawling and drawing grid, shapes, circles, quadrilaterals, triangles, polygons, as well as content, knowledge, skills, attitude, forms of assessment, test, assignment, research, project and case study.

My interchanging of roles with the participants had added value to the contact session cycle. When participants stressed those new methods of assessments have learned and alluded that they were ready to integrate them in their Technology teaching that is a clear statement of their progress. Here is their account:

> "I learned that each learner is unique and understand or learn best differently, e.g., visual and audio learning. Each learner must be accommodated within my lesson presentation. I also learned the approach to Technology as a subject and various forms of assessment to use, which include but not limited to case study, research or investigation, projects, assignments and test or exams".

Teachers also learned about drawing and planning of lessons.

**b) What are you taking along to your school from this cycle sessions?**

The teachers boldly indicated that from hence forth they had been equipped on "how to teach technological content and administer assessment to learners" and "resource tasks, case tasks; capability tasks; file organizing, e.g., lesson plans".

**c) Indicate technological themes that you can now implement with confidence in your lesson presentation especially those that you couldn't before the cycle**

With reference to Cycle 3, the participants had something to treasure. Some of the things that used to worry some, they were now able to unpack and clarify:

> "We can implement Systems and control with confidence because we realized that there are more practical things that we do in our daily lives, but we were not aware that Technology is around us. We can also teach design, make, evaluate and communicate, like the structure to place a water tank on".

The participants could now utilise the available resources from their surroundings to design, make and evaluate technological products, systems and processes, as evident from the Grade 8 and Grade 9 projects (photos 5.3, 5.4, 5.5, 5.6, 5.7, 5.8). The participants stated that they could now teach different tasks within Technology– resource task, case study task and capability task. They pointed out that they would be able to classify any task they gave to their learners under resource task, case study task or capability task. Of importance to me as an action researcher was when the participants declared that they could apply the design process to their Technology teaching, since I reported in Chapter Three (3.6.5 and textbox 3.2) that the design process was the method of teaching Technology, and which the Department of Basic Education asserts is the backbone of Technology teaching. To sum up this question around them, I quote one participants who boldly said: “I manage to encourage learners to use readily available resources within their reach during containerization project”.

**d) What gaps have you identified that still need to be filled regarding your knowledge of technology?**

The cycles could not cover all areas of the concerns raised by the participants due to time constraints and challenges mentioned in Chapter Four (4.6.3.2). Participants still needed to be grounded on the theme ‘Systems and Control’ under the topic ‘Mechanical Systems’ in the context of the title, ‘Gears and Pulleys’. They also wanted to learn more about technological skills and processes, e.g., drawing skill. Furthermore they wanted to know more as to how different machines are operated and how to decide on the projects suitable for the grades that teach. These teachers “would like to be helped on how to approach the learning outcomes in Technology”. Others remarked that they were not yet fully confident to incorporate resource tasks within their lesson presentation. Making a model was still a concern to some:

> “I need to be equipped with drawing skills and designing the projects. I also need to be taught how to design a case study as a form of assessment”.

**e) Any other inputs/suggestions/proposal you have as a way forward**

The participants' deepest desire was that I should not cut contacts with them even after my research:

> "We wish that Mr. Honourable Mapotse should always be behind or on our side to show us more on this subject, Technology. We also wish to be with him again about hydraulic system".

They wished that we could grow together in the Technology subject with the changes imminent from CAPS. Secondly, they were not in favour of a cascading model of filtering information as they suggested that all Technology teachers from their schools should attend Technology workshops for the grades by phase, "to have a workshop where all Technology educators will be invited"; "to have more workshops as this is my first time to teach Technology"; "I need to learn more". Lastly, the participants were of the opinion that if possible they should have Technology competitions, resources and some Technology subject advisors. They felt strongly that schools needed to be well equipped with technological resources and the Technology subject advisors to hold workshops time and again. They advised, as a way to motivate them and learners, that there was a dire need for competitions the one with Science Olympiad where learners could showcase their creativity and capabilities of doing technological things.

### 5.3.5 Cycle 5: Findings from final lesson presentations

The activities of Cycle 5 will be briefly stressed before sharing their findings. This will help in connecting the findings to the activities. In sharing the findings attention will be drawn to activities participants engaged their learners, what transpired at the contact session venue and findings from end of the cycle reflection.

#### 5.3.5.1 Activities findings

Seeing that this was the last and two weeks long AR cycle, its findings are many, based on the different activities undertaken at different places within this cycle. The core of this cycle was lesson presentations by the participants and their assessment of those lessons in comparison to Cycle 1's lesson presentations. The participants were playing a double role – as teachers when they presented their lessons and as peer assessors. They taught their learners by following their circuit work schedule while their peer participants and HODs assessed them. According to the participants' work schedule they were on 'Mechanical systems'.

#### 5.3.5.2 Vignette of both activities and findings from Cycle 5: In participants' different schools

Photos 5.9 and 5.10 show how this teacher could be creative and innovative with available resources. The teacher is seen here in photos 5.9 and 5.10 using an out-of-order DVD player to demonstrate types of gears. This Technology teacher said that he requested the DVD from the local TV and electronics equipment repair technician.

**Photo 5.9: The teacher uses disassembled old DVD player**

**Photo 5.10: Types of gears are used for demonstration**

As indicated above, the participants played a double role during Cycle 5, that is, they presented their lessons on some days and on other days acted as peer assessors. Photos 5.11 and 5:12 serve as a good example of that role interchange. On these two photos one can see that the teacher presented a lesson as displayed in photo 5.11, and that the same teacher peer assessed later.

**Photo 5.11: Teacher presenting Technology lesson**

**Photo 5.12: Same teacher on photo 5.11 engaged in peer assessment**

There follow the findings from the first working lunch with the participants at the hotel in accordance with our planning in Chapter Four. The main purpose of this gathering was for member-checking and for updating the Circuit Manager about the AR progress thus far. Findings emanated from the schedule in Chapter Four (4.6.4, table 4.3). Table 4.6.4 outlines two weeks of the AR activities with the participants. This working lunch was organized during the national school holiday at the hotel conference centre on day 6, which was Monday of 8 August 2011.


**Photo 5.13: Working lunch screen**

**Photo 5.14: Working lunch pc**

**Photo 5.15** **Photo 5.16**

**Photo 5.15 and photo 5.16 display participants during working lunch and member-checking.**

Only one school was not represented on this day, namely KMK secondary school. The members present for member-checking process were participants from the other four selected high schools, and at least one HOD from BMB high and Mankweng Circuit Manager. I used a *PowerPoint* presentation to cover the journey travelled from 2010 to 2011 with the participants. At each and every stage I would pause for verification, clarity and open the floor for discussion around the issues raised. The participants had to agree or reshape what was expressed on their slides. Most of the concerns that day were directed to the circiut manager. The HOD present that day stressed the issue of continuity within a subject until one was fully grounded in that learning area.

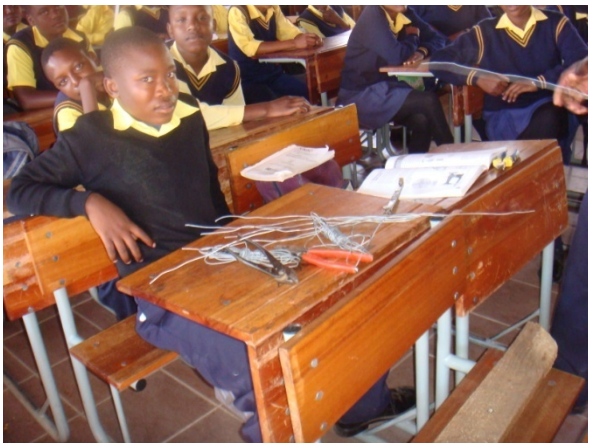
**Photo 5.17: Working lunch on a holiday at the hotel conference centre**

The Circuit Manager stressed partnership with Unisa to uplift the Mankweng Circuit. He postulated that a project like this AR journey should be fully communicated to the principals and their School Management Teams for a buy-in before their full roll-out. He further urged the AR team members to take the lead in cascading what they had learned to other schools within the circuit. Even though participants raised the issue of the lack of subject advisors in Technology, the Circuit Manager declared:

> "Colleagues you had Mr. Mapotse as your Technology subject advisor in 2010 and 2011, the rest we leave in the hands of the top management to hire and supply us. Those are the standing items in our management meeting with the provincial HOD".

It was fulfilling to me to realize such appreciation and that my study made an impact in the teachers' Technology teaching.

After member-checking on Monday, the AR activities of lesson presentation by participants had to be resumed from Tuesday onwards. The teacher at BMB secondary school impressed us (the assessment team – his HOD, peers and I) by improvising for teaching and learning resources during his lesson presentation. He brought along hand tools from his car, after he had gone through the AR cycles, for the lesson demonstration purposes as displayed in photos 5.18 and 5.19. He also brought some few materials from his home for the sake of his learners.



**Photos 5.18 & 5.19: Teacher brings along personal tools and material from home to Technology class**

At VMV secondary school the female teacher also brought along a handy toolkit to the classroom to facilitate the learning of 'Mechanical Systems', focusing on the theme 'Hydraulics and Pneumatics' as evident in Figure 5.20. The toolkit comprised syringes, pipes and valves together with some water for her demonstration (see photo 5.21 as well). The teacher engaged her learners during her lesson demonstration about types of systems that are being referred to as hydraulic and how do they differ from pneumatic ones. Picture 5.20 shows the colleague standing at the far corner for peer assessment. The HOD was within the class observing and assessing. This is one of those schools in which the MST HOD was also teaching Technology. Out of the five schools involved, only two MST HODs taught Technology together with their subordinates. Generally they were very supportive and attended some of the contact sessions.

**Photo 5.20: Teacher teaching & colleague observing & assessing**

**Photo 5.21: Teacher uses media during lesson presentation**

This teacher's colleague in the corner in photo 5.20 was now presenting in photos 5.22 and 5.23. The three of us (her HOD, her colleague and I) served as the observation panel. She was handling the theme 'Mechanical systems' and her topic was on gears. She displayed types of gears on the chart in picture 5.22 and demonstrated those gears in real life situation in picture 5.23.

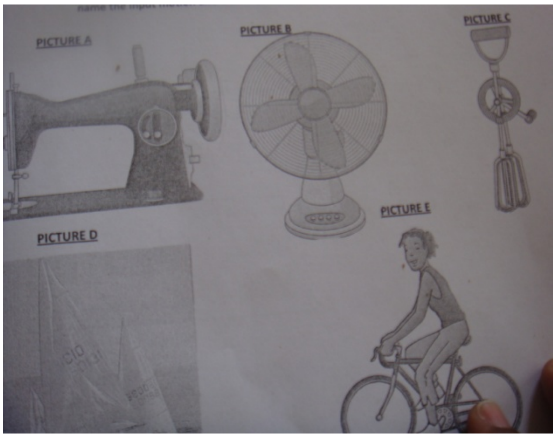



**Photo 5.22: Gears on a chart**

**Photo 5.23: From theory to practice**

The female teacher who assessed her peer in photo 5.20 now presented her lesson and was assessed as shown in photos 5.22 and 5.23. The presentation was also quite impressive as different learnig styles were catered for through audio, visual and kinaesthetic.

**Photo 5.24 & 5.25: Learners working in groups to do an activity**

Charts were complemented by the real equipment to enhance learning. Learners were finally given an exercise to work on as a group activity to check if they had comprehended the lesson of the day as it can be seen in photos 5.24 and 5.25. This was the participants' moment of excitement in teaching a theme that they normally bothered to tackle or seemed to be challenged by it. A teacher from RMR secondary school looks full of energy, zeal and passion to present 'Mechanical systems' to the learners using charts and media from a motor car engine. Photo 5.26 illustrates the participant from RMR secondary school presenting a lesson. A colleague at the corner on the same photo was busy with peer assessment. Photo 5.27 put on view the Technology teacher in full swing of lesson presentation. Photo 5.28 shows the presenter's HOD assessing her.

**Photo 5.26: Teacher presenting**

**Photo 5.27: Teacher using charts**

**Photo 5.28: HOD observing and assessing a colleague in photos 5.26 and 5.27**

To culminate the two weeks and wrap up the AR cycle of two years, I orgarnized the second working lunch at the University of Limpopo (UL), as shown in photos 5.29, 5.30 and 5.31. The members present in this gathering were myself, UL lecturer, participants and their HODs. What was stressed in this seminar was that the participants encouraged me not to lose touch with them in 2012. They requested me to continue with them on a post-doctoral level with a Technology project as part of my community engagement. They emphasized that they did not cover all the aspects of Technology adequately due to the 2010 list of challenges presented in Chapter Four.

**Photo 5.29: Seminar and wrapping up AR cycles at UL**

**Photo 5.30: Seminar at UL.** **Photo 5.31: Seminar at UL.**

The participants wished me a safe journey to the City of Tshwane as well as the best on my studies. They thanked me for choosing their schools within the whole circuit for Technology emancipation journey travelled together and more so applying the AR approach. The UL lecturer thanked me for according him an opportunity to be part of the study in terms of providing support to the teachers and contributing to the life of his neighbouring secondary schools. He also availed himself to help the teachers further in case they needed assistance, explanation and/or implementation of any Technology concepts on their work shedule. The UL lecturer encouraged the participants to persue their studies further in the field of Technology education.

#### 5.3.5.3 End of Cycle 5 findings from lesson observations (self, peers and HOD) assessment

The participants were engaged in lesson presentation at their schools with the Grade 8 and 9 learners. It was during this time that they were subjected to observation assessment by their peers and HODs. The reason for assessing them was that they had to show practically all the observers their lesson presentation to confirm their emancipation regarding the teaching of Technology. The observation assessment schedule (see Appendix 5.1) covers the following main categories with their lists of criteria:

- Technology teaching
- Technology process
- Technology classroom management
- Assessment in Technology
- Resources in Technology
- Technology policy implementation
- Support in Technology
- Technology teachers' reflections on their presentation.

The observer's schedule had some marks to score the teacher as well as the comment column for the observer to make. The total national codes of 1 to 4 were used as the overall results for the participants. All participants scored either '3' or '4', where '3' stands for 'has satisfied' and is equivalent to 50% – 74%; and '4' means 'has exceeded expectation' and is equivalent to 75% and above.

After the assessment the participants were given their assessed sheets to inform their reflections. The following four questions were asked as part the participants' reflections on their lesson presentation, accompanied by few responses each:

**a) What can you do differently and why, if you have to present the same lesson next week?**

I would do better and make sure that more teaching aids are arranged for learners to have enough to demonstrate for themselves.

I will improve my time management because I did not finish the lesson.

**b) How did you teach the same topic before the AR cycles?**

I was teaching it badly because I did not have enough knowledge.

I now understand how to tackle some processes. There were no resources, now there are resources.

**c) What has changed in the way of approaching and presenting the same topic?**

I can introduce my lesson well and use resources positively.

I have changed and started to understand Technology and I wish we can have more workshops.

**d) Mention the gaps that still have to be covered within the topic in question in general.**

Lack of time, support in terms of circuit providing curriculum advisors.

I still have a problem with calculations especially in mechanical and electrical processes.

Reading from the participants' responses it can be realized that some degree of emancipation took place in the participants' practice. These Technology teachers also reflected an element of confidence in their Technology teaching after the AR intervention. Nonetheless there is still a deep cry for them to be empowered around the core theme of 'Systems and control'.

### 5.3.5.4 End of Cycle 5 findings from the interview cycle reflections

**a) What have you learned from this AR cycle activities?**

The participants indicated a variety of things that they learned throughout the AR journey. The following is one participant's explanation about what was learned from unpacking the Technology policy, teaching Technology, helping learners to design a project and evaluating it, and assessing learners:

> "I learned the policies, CAPS and also how to apply them in a real classroom situation. I have also learned much about the basic skills and knowledge of helping learners to do projects, to organize groups according to their places of stay and resources. I also learned how to come up with the proper rubric for evaluating the project done by learners. Lastly teaching Technology everywhere including classroom situation is no longer a problem".

Another participant seemed to have learned the importance of both collegiality and consultation with peers as well as sharing technology knowledge so as to stay motivated:

> "Technology is more interesting when you have people to share ideas with. The projects become easy to do because you know exactly what must be done. You get to know many things better. Sometimes you might think you know something better, only to realize that there are those who know and can help a lot, and as such your knowledge expands. If the teacher is motivated, learners will perform better".

Technology becomes easily understood by learners when the teacher has the relevant resources at his or her disposal:

> "I have learned that cooperative learning is vital and also learned that Technology cannot be taught theoretically but resources are needed for learners to see what you mean, for example when you teach about different types of systems you need to actually show them those systems and they can relate to the topic by giving their own examples of those systems. I have also learned that Technology can be so challenging and frustrating when you don't have resources as a Technology educator".

The AR cycle sessions seem to have achieved to a great extent, enhancement of confidence in teachers by empowering them, "I have learned how to present a lesson with confidence. I have learned that projects are very much important. I have learned that Technology is very much experimental". Teachers' responses to this question also showed that they had learned to develop themes for learning activities, forms of assessment targeting assessment standards, a project portfolio, and to prepare a test or assignment.

**b) What are you taking along to your school from this cycle sessions?**

It would seem that teachers learned to a greater extent from the AR engagements. The responses indicated that teachers learned:

- the knowledge of different topics and how to teach or introduce them by using relevant resources
- better lesson planning, new ideas to my school
- types of projects to give learners, assigning group and individual
- how to teach Technology through project based approach
- a sense of independence for one to prove his/her competence skill
- correct and relevant information to the school
- the proper way of teaching and controlling learning support materials and teaching aids
- helping one another as teachers.

**c) Indicate technological themes that you can now implement with confidence in your lesson presentation especially those that you couldn't before the cycle.**

Each of the teachers was impacted the transmutation their technological knowledge in terms of understanding gears, pulleys and friction forces; the technological process; approach to systems and control; hydraulic systems; pneumatic systems; structures; electricity; mechanical; recycling; preserving; levers and their calculations.

**d) What gaps have you identified that still need to be filled regarding your knowledge of technology?**

The areas that teachers identified that they needed more help on include hydraulic systems; use of valves to control the flow of the liquid in a hydraulic system; electronics; design; indigenous Technology; biases in Technology; calculations; gear system. They also were still lacking to some extent in "building up the confidence as the Technology educator".

**e) Any other inputs/suggestions/proposal you have as a way forward?**

The participants recommended the AR project to be sustained in the form of a community engagement project:

> "Could you still be our mentor since we haven't specialized in Technology? Your present is made a huge difference in our schools and in our lives. Please come back next year to address some gaps that we have identified".

It was suggested that team work should be sustained as it helped greatly with the preparation of lessons. They suggested more Technology workshops where Technology teachers could meet to share their experiences and to strategize how they could improve in teaching the subject. They further suggested that at the beginning of each term Technology teachers should discuss the work schedule and what exactly is expected to be done. Subject clusters and proper monitoring were also recommended by teachers. The section that ensues daliberates on findings from both reconnaissance findings and and the main action research findings.

### 5.3.6 Action research themes and data set findings between Phase 1 and Phase 2.

Findings from both Phase 1 and Phase 2 of the study based on AR themes and data set are highlighted in the next sections. This helps in linking the findings of the reconnaissance study and AR main study. In sharing the findings attention will be drawn to the AR journey travelled with the participants from Phase 1 to Phase 2.

#### 5.3.6.1 Integration of findings

The themes were selected to cover aspects of Technology teaching from policy interpretation to the classroom practice. These themes include Technology-specific teaching experience, Technology lesson planning, Technology assessment, level of internal and external support for Technology teaching, resources for Technology teaching and learning, Technology curriculum policy interpretation and implementation, and teacher-learner ratio in a Technology class. In South Africa Technology curriculum is centralized nationally the difference of which is the nature of knowledge that the teacher has to deliver based on regional contexts (cf. 3.5).

I will now illustrate participants' responses to the questions asked related to the teaching of Technology. Some of the responses in cycle 1 which were developed from the reconnaissance can be found in Chapter Two (2.3.2). Those responses can be read in conjunction with the ones stated in this section as they all fall within 'before AR cycles' category. For the 'after AR cycles' category I cite more than one example since they appear for the first time. Teachers' responses will be prepared in two versions, before AR (i.e. Cycle 1) and after AR cycles (referring to last day of Cycle 5) of contact sessions.

**5.3.6.2 Juxtaposing action research Phase 1 and Phase 2**

Findings from both themes and data sets are juxtaposed in accordance with the 'before' and 'after' AR cycles. This is done to compare Technology teachers' degree of emancipation throughout the cycles. Figure 5.1 displays the AR journey travelled from Phase 1 to Phase 2. The intention of displaying Figure 5.1 is to map out the process of the emancipation of Technology teachers from their challenges to the stage where they felt confident with their knowledge of Technology and its pedagogy.

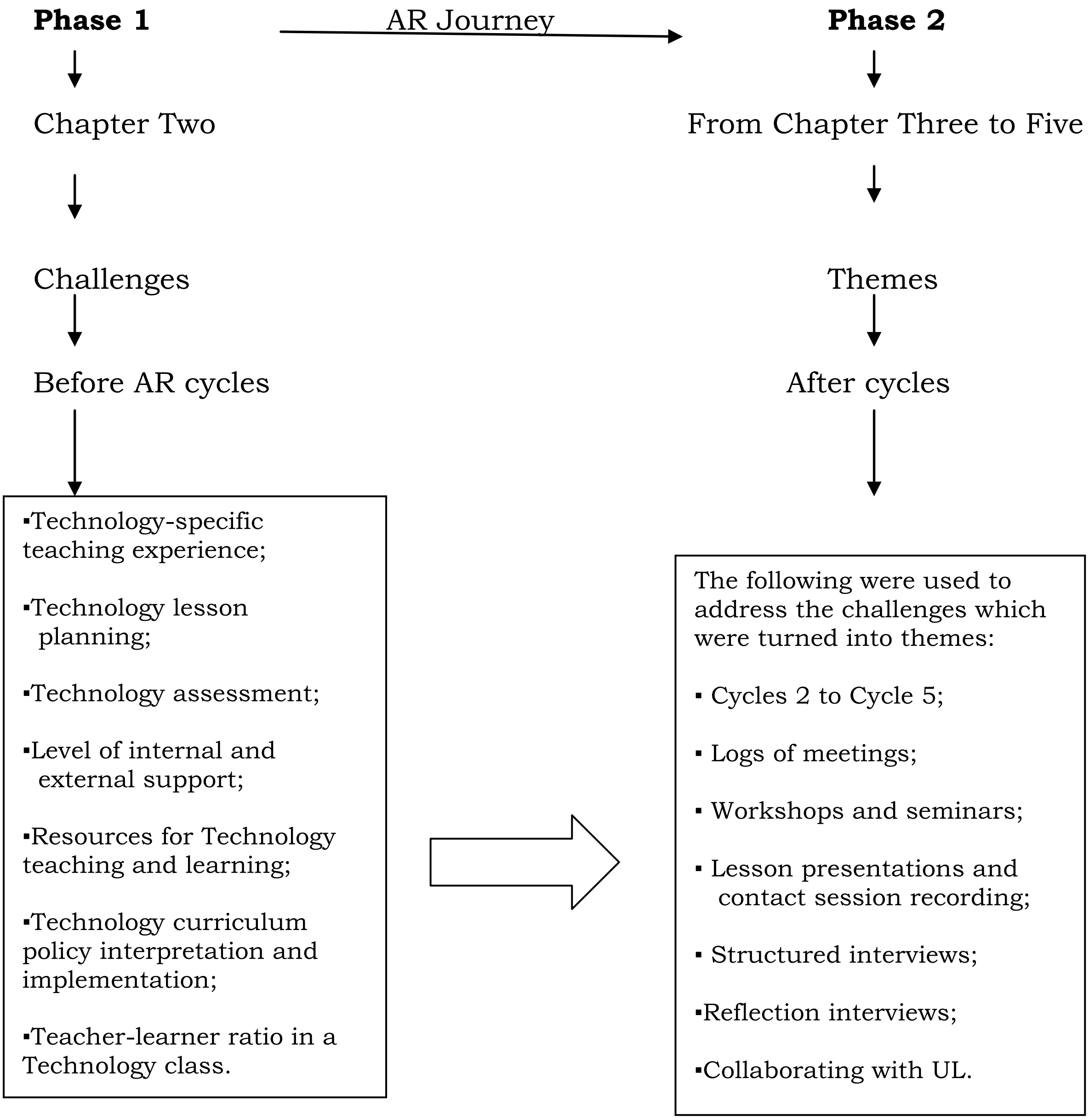



**Figure 5.1: Comparing findings between Phase 1 and Phase 2**

During Phase 1 challenges were identified and during Phase 2 they were addressed. From these challenges, themes were developed (Chapter Two) and strategies decided upon to address these themes as outlined in the third AR cycle (cf. 4.6.1.1).

The findings between the two phases are discussed in the next section.

#### 5.3.6.3 Comparing participants' degree of emancipation before and after action research cycles

Before AR cycles (during reconnaissance Phase 1, Cycle 1) a total of 18 Technology teachers ascertained their biographical information as in table 2.1.I winded up my AR study in 2011 with 12 participants from the same five secondary schools (reasons are attributed to AR contact session challenges in 4.5.1). The participants were asked the same questions before and after the action research cycle so as to gauge their extent of growth within their Technology teaching practices. This is in line with what the Centre for Technology Education – Action Research, (2010:02) asserts as presented in Chapter Two (2.2), that before one begins with intervention one needs to gather baseline data. It further stresses that knowing how participants performed before the beginning of the study give a starting point for comparing the results. The comparisons of the preliminary and main findings were promised to be done in this chapter.

**a) Technology teaching**

Before AR cycles the teachers' biographical information confirmed their lack of content knowledge, qualification or experience to a greater extent (table 2.1). Most of Technology teachers are generally uncomfortable with the pedagogy of Technology (DoE, 2003b:31), as was observed and revealed from the interviews and further confirmed by the ministry of education (cf.1.2). Some had an interest of teaching Technology but encountered some challenges during their teaching. The aim of this study (cf. 1.3) was to establish intervention strategies to empower and emancipate them from the constraints that they faced in teaching Technology.

From the data gathered and analyzed in Phase 2 and the findings that flowed from the interpretations, it become clear that participants could now teach Technology with some degree of confidence compared to before the AR intervention. When Technology was not interesting to some to teach due to their lack of understanding, they now found it interesting and practical to teach.

Technology teaching experience supports critical theory (CT) as cited in Chapter Three that CT has an emancipatory intent (cf. 3.2). The emancipation of the Technology teachers through critical theory was a viable option given the need for the participants to develop a sense of their current knowledge and teaching of TLA and how it could be critically transformed with the mission to empower them.

**b) Technology lesson planning**

One of the statutory requirements for teachers is to develop their lesson plans before conducting them. Department of Education (2006:87) stresses that the planning process should be seen as an ongoing cycle. The situation of Technology teachers has serious implications for their level of capacity in terms of planning lessons for Technology teaching. Before AR only 10 participants could plan their Technology lessons whereas eight indicated that they needed some help (table 2.1). After AR cycles they knew how to implement and follow the Technology design process of IDMEC to plan and teach their lessons. This could address the concern raised by the review committee that the Limpopo Province teachers were uncomfortable with planning to teach Technology (cf. 3.6.3.2).

**c) Technology assessment**

Before the AR intervention many Technology teachers only confined themselves to giving assignments, class work, homework, tests and examinations. The Review Committee Report also stresses that overcrowding in class compounds the difficulty of informal assessment and formal assessment for teachers. However, after the teachers had engaged their learners in the containerization project some new ways of assessing came to play in addition to the ones that they were accustomed to. One of the milestones of their emancipation in this regard is that they were able to design a rubric for their choice project. This emancipation implies the teaching and learning principles central to Technology teaching – facilitation of learning, learner-centeredness, active and participative learning, creative and critical thinking and problem solving; they appear to be consonant with the approaches considered appropriate for effective learning and instruction in Technology Education(Reddy, Ankiewicz, Swart & Gross, 2003: 27-28).

**d) Internal and external support**

Technology, being relatively new in the curriculum may not thrive without a concerted commitment to empower Technology teachers. Teachers would like to be supported from within and outside their schools so as to develop their Technology practice. The teachers wished for their SMTs to take Technology very seriously and to allocate both its budget and teachers accordingly. However, the responses from the questionnaire before intervention indicated that a support from the district office through subject advisor was rated the least as compared to their colleagues and their SMTs.

Subject advisors are seen as resourceful in terms of guiding teachers in regards to the technological content knowledge and pedagogical knowledge. Teachers operate on their low knowledge ebbs in the absence of the subject advisors' support (cf. 3.6.5). The Committee's Review Report (2009: 8) states that there are too few subject advisors nationwide to do justice to thorough and qualitative in-class support for teachers. Many subject advisors do not have sufficient knowledge and skill to offer teachers the support that they require to improve learner performance. Teachers needed support given the demands made on them by the curriculum reviews (Mahomed, 2004:4). Whilst teachers were concerned about lack of support, they seemed self-reliant and engaged, through my facilitation, in collegial workshop for their own emancipation. The teachers' level of support is incomplete without availability of resources.

**e) Resources for Technology teaching and learning**

Observation confirms lack of textbooks for both teachers and learners as none could be seen from the learners and teachers to the extent of sharing a textbook at some schools. The interview findings revealed that resources were a dire need for the teaching of Technology. Teachers called for the Department of Education Limpopo Province and their schools to help provide resources. Through their reflection on the action cycles, teachers expressed their concerns, imagined possibilities in developing action plans, acted and gathered data, evaluated the influences of their action, modified their concerns, ideas and action (see Whitehead's living theory in 4.4.2). In all the selected schools engaged in this study, I observed that none had set aside any room(s) for Technology practicals. Teachers needed adequate, accessible and relevant resources in order to implement their schemes of work successfully. Certainly the type of equipment has changed over the last few years (Eggleston, 2000:9) but it is of concern to realize that selected schools did not even have the outdated equipment. What was encouraging, however, was the fact that after the intervention teachers became aware of the materials available in their surroundings to can use to teach Technology. A critical pondering on how they could beef up their lessons could now create awareness about what was immediately available that could be used in waiting for fully fledged resourced rooms.

**f) Technology curriculum policy interpretation and implementation**

Through this collaborative/co-operative enquiry paradigm the research team (the participants and I) created knowledge on practical and experiential knowing of the domain of Technology policy interpretation and implementation. This exercise of sharing topics from the list of challenges as in Chapter Three (3.6.6), (table 3.3), (4.6.2) and Chapter Four (table 4.1) inspired teachers to present certain topics that they are good at to their peers; hence the team was led to a developmental action enquiry.

Madaus and Kelleghan (1992:128) assert that, *"a curriculum consists of six components, those are content, general objectives, specific objectives,* *curriculum materials, transaction and results"*. Technology teachers were not content with the curriculum reform or its materials since no one was updating them with those developments. It was through critical theory within action research that bridged the technological gap between the curriculum and TLA. Theory is also an explanation that discusses how a phenomenon operates and why it operates as it does. It serves the purpose of making sense out of current knowledge by integrating and summarizing this knowledge, and thus it can be used to guide research by making predictions (Johnson and Christensen, 2004:58).

When teachers were asked from the interviews or questionnaire about the interpretation and implementation of the curriculum policy their responses pointed out that before AR cycles they did not have the policy document in 2010, therefore there was nothing to interpret. These same teachers developed table 3.3 after I had taken them through policy interpretation exercise using table 3.2 and Technology policy document as tools. This demonstrated that with proper intervention teachers could change their situation around.

**g) Teacher-learner ratio in a Technology class**

Teacher-learner ratio at four selected schools dramatically affected teachers' marking turn-around of learners work. Overcrowding in classes is a serious concern for effective teaching. Number of learners within one class render classroom management and discipline a challenge. Seemingly, no group work can be done in a crowded classroom. Large numbers of learners in a class deprive them active participation and limit their thinking process. I observed that teachers' movement within a class and their interaction with learners was also limited due to over-crowdedness. It was difficult for me to have a chair or even a space to sit down. The teacher-learner ratio ranged from 1:60 to 1:90.

As applied to this study, I pursued critical theory with the hope that the intervention through action research would influence the teaching practice of Technology teachers. Hence, given the many learners in class to one teacher, my assumption was that engaging teachers in critical theory had the potential to improve how they dealt with large classes. By assigning a project to the learners and managing the groups in the context of the intervention that was given, teachers realized that large classes were not necessarily a hindrance, but a matter of what one did with them.

## 5.4 CONCLUDING REMARKS

This chapter reported findings from AR cycles starting from Cycle 2 (Phase 2 up to the last Cycle 5). These findings demonstrated how Technology teachers were empowered to teach it. The findings were a confirmation of the action that was taken to address the challenges faced by the Technology teachers. It follows that Technology teachers await an intervener to unlock their capacity to can implement the teaching of Technology. Teachers do not have to fold their arms waiting for a miracle to happen. With the intervention that was affected in this study it became clear that challenging situations can as well present opportunities for developing and enriching lessons, more so that Technology is a practical subject and that technology is always available in all the contexts.

The next chapter concludes the study and provides recommendations and a model about intervening in the training of Technology teachers to the ministry of education and higher education institutions engaging teacher development.

## CHAPTER SIX

# CONCLSIONS AND RECOMMENDATIONS FROM THE STUDY

Limpopo Province clarion call to action for all the provincial teachers: *"If you are not in education for good results and the joy that it brings, then what are you doing in school?"*I observed the clarion displayed in all sample schools' notice boards in 2010.

## 6.1 INTRODUCTION

The clarion call for Limpopo Province teachers seem to be in line with the South African president's call to two central education stakeholders within a school who are teachers and learners. In his State of the nation Address in February 2011, President Jacob Zuma admonished teachers to work harder. There is little doubt that many teachers (though not all) deserve this admonition. However, in the case of Mathematics, Science and Technology, for instance, teachers should be motivated by financial incentives among other things (Centre for Development and Enterprise – CDE Executive summary, 2011). In this context, CDE has examined the situation in the country surrounding teacher supply and demand. Its overall conclusion is that South Africa urgently needs more and better teachers. The shortage of good teachers is a key reason why the education system is underperforming, particularly in scarce but vital subjects such as Mathematics, Science and Technology. Teachers play a central role in determining the outcome of any education system, and South Africa is no exception to this rule. Engaging teachers who are teaching scarce skill subjects in action research can turn things around and produce better teachers who will put their education system in a well above par performance, as evident in this study.

Senior phase Technology teachers of Limpopo Province have been through AR cycles to groom them to take the reins in cascading what they learned to their learners and fellow Technology colleagues within the circuit. In this chapter I am concluding this AR study. The chapter offers flaws, limitation and successes behind the study. Thus, this chapter draws the conclusions of the study per chapter, summarizes the main findings, offers study limitations and recommendations. The chapter closes with the schematic representation of the guidelines to implement AR, model for AR emancipation and a six week plan to develop teachers' content knowledge. The chapter also highlights the study's final reflections and conclusions.

## 6.2 DRAWING CONCLUSIONS FROM THE STUDY

Conclusions are drawn per chapter so as wrap up the main activities undertaken in addressing the main research problem.

### 6.2.1 Chapter One

The aim of this chapter was to report gaps that were identified in the teaching of Technology by Grades 8 and 9 teachers in the Mankweng Circuit of Limpopo Province. This was done so that appropriate action research-based intervention strategies could be embarked on to address this problem. A reconnaissance or preliminary study as the first cycle stage of action research was instrumental in identifying these gaps. Observation, interview and questionnaire were employed in gathering data from the teachers from the five sampled secondary schools. The findings revealed Technology teachers' incapacity in the areas of Technology teaching experience, Technology lesson planning, Technology assessment, level of internal and external support for Technology teaching, resources for Technology teaching and learning, Technology curriculum policy interpretation and implementation, and teacher-learner ratio in a Technology class. The chapter closed by displaying the programme of the study.

### 6.2.2 Chapter Two

This chapter presented the findings of the minor empirical research that is reconnaissance study (Phase 1) in terms of themes. Technology teachers' challenges were spelled out from the findings. Most importantly, the chapter drew me to making a decision about the main research problem. I maintained it with minor rephrasing as informed by the findings. Briefly, I explained how the study shaped up further from this point onwards (Phase

2). It was assumed from the findings that the Technology gaps which existed between the teachers and Technology methods could be bridged through the AR interventions. I witnessed and heard participants' challenges. Thus, I took action to address the challenges as revealed. I started by providing a theoretical background of the challenges as raised by the teachers, in Chapter Three.

### 6.2.3 Chapter Three

"What is the nature of teaching Technology?" This was the research sub-question tabled in Chapter Two (2.4) which received treatment in this very chapter. This chapter provided a background about the developments of Technology Education. It was deemed necessary to provide such background since Technology Education is still a relatively new subject. Then relevant literature was presented to base the challenges that teachers faced.

### 6.2.4 Chapter Four

The research approach, data-collection methods and techniques for data analysis received attention in this chapter. The paradigms incorporated in the adopted AR approach were chosen and detailed. Validity and legitimacy were considered explained in this chapter so that the findings could be used to develop guidelines, model and intervention programme for improving the teaching of Technology in the senior phase and for further research.

### 6.2.5 Chapter Five

This chapter reported findings from AR cycles starting from Cycle 2 of Phase 2 to the last Cycle 5. Findings were also reported from the observations, interviews and questionnaires that were conducted. The extent of the Technology teachers' emancipation between Phase 1 and Phase 2 was presented ultimately. The findings revealed some degree of emancipation of Technology teachers from the challenges that they faced before the AR intervention was executed.

## 6.3 INDICATING THE GAPS, SHORTCOMINGS, FLAWS AND LIMITATION OF THE STUDY

I must submit that it is quite restraining to undertake research during curriculum transformation, review, reform, and transmutation. I further admit that I cannot claim finality on a topic such as Technology teacher emancipation. Policies, technological content knowledge and ways of doing things change spontaneously and in AR study that can even be a worse scenario in the sense that one needs to keep abreast of educational developments before the next meeting with the participants. A case in mind is developments about the NCS, the merging of Science and Technology in the intermediate phase, and the introduction of CAPS. These developments impact on the researcher's pattern of thoughts and proceedings and as a result one cannot claim total control with having to manage the process. However, I am convinced that the study is in the right context in the midst of these educational developments to advance conscientisation about further developments in Technology Education by using action research approach.

The nature of the action research method dictates that the researcher spends a long time in the research field gathering data (Gumbo, 2003:384). Curriculum transformation is also a crucial factor that sometimes derails data gathering procedures and prolongs the research process, as I have experienced in this study. At times teachers would be called for meetings by teacher unions, or they would be needed to attend workshops. That meant disturbance to our weekly AR programme and a halt to the appointments that I made with teachers. Challenges encountered during the AR cycles were listed in Chapter Four, Section 4.5, sub-section 4.5.1.

According to Gilbert (1996:13), any research is theory dependent and furthermore pure empirical research is inconceivable whether that theory is acknowledged or not. At the simplest level theory may merely involve assumptions on how the world or the phenomenon in question is perceived (Pudi, 2002:236). This therefore is the source of limitations in any research. This study was faced with certain challenges and limitations during contact sessions. These challenges became more eminent after AR Cycle 1 and just before AR Cycle 2.

AR has its own challenges. Ebersöhn, Eloff and Ferreira (2010:135) support this view in stating that action researchers firstly face the challenges of earning the trust of participants so that they do not regard researchers as outsider experts but are comfortable in taking ownership of the process and allowing the researcher's insight into their perceptions and experiences. To address this I spent ample time on introductory sessions and relied on the social interaction during informal encounter. Another potential challenge raised by Cornwall, Musyoki and Pratt (Maree, 2010:135) is that of ignoring certain social relationship within the selected group of participants, which is by implication excluding certain voices which are not heard.

It was a challenge in 2010 to earn the participants' trust because they did not have a clue of what the AR activities would yield towards their technological teaching. It was in 2010 that some participants were slightly sceptical and opted to pull out of the AR process. This team of co-researchers managed to provide me with a rich data whose plan was presented in Chapter Four and findings interpreted in Chapter Five.

The next section provides the summary of the findings.

## 6.4 SUMMARY OF THE MAIN FINDINGS

The research was designed from both critical theory perspective and participatory paradigm. Instruments used to gather data included observations, interviews, questionnaires, field notes, video recording of lesson plans and logs of meetings. The research findings revealed that most Technology teachers were not trained or qualified to neither facilitate Technology nor teach it with confidence, and there was no chance of success until an intervention in the form of action research was introduced and changed their situation. It should be noted that AR has within this study generated findings applicable in Technology Education but the process of arriving at such can hopefully be adopted for use in other learning areas or subjects.

Action research, as argued, aims to develop the teaching situation and the teacher researcher. Action research aims to generate findings that are useful within a specific context rather than findings applicable across many different situations (Jantan, 2010:2). The summary of the main findings of the study follow:

- Technology teachers in Limpopo Province at selected schools did not have an ordered environment (workshop or lab) earmarked for Technology teaching, learning and practices;
- Most Technology teachers I was engaged with are un- and under-qualified to teach Technology;
- Teacher-learner ratio as a challenge could not be resolved fully during this AR study (in one incident during my contact session one school staff voted for industrial action against their SMT due to workload disparity between the two groups);
- Teacher–learner ratio impedes the hands-on nature of Technology as classes are overcrowded and class management as well as assessment are negatively affected;
- Technology teachers could not handle some of the themes in Technology until action research was structured and rolled out with them later. This endeavour contributed hugely on teacher pedagogy and teaching;
- It was difficult for senior phase Technology teachers in Limpopo to practice enhancement activities within their lesson presentations because of their technological incapacity;
- Resources and support were the major concern for Technology teachers;
- Action research with Technology teachers took them out of Technology survival activities as they could now teach Technology with

confidence, do projects with their learners, and interpret and implement Technology policy;

- Self-achievement in handling some of the Technology themes that they couldn't before the AR cycles boosted their self-esteem to handle TLA;
- Each contact session was a platform to transform Technology teachers and nourish their desire to learn more hence a call to continue with them at post-doctoral level.

I close this summary of main findings with the words of Nelson (2008:5), who stated that, *"Each person has unlimited potential. Humans are the only living things able to improve the quality of their lives"*. Technology teachers in Limpopo Province have realized their potential and the possibilities of improving their TLA teaching through AR cycles.

In the next section I present recommendations suggested by the findings of this study.

## 6.5 RECOMMENDATIONS

According to Ndaba (2002:38), action research, *"is concerned with every practical problems experienced by teachers in their encounter with learners in the teaching process"*. This action research study has demonstrated just that. The crucial thing that this study unravelled is the support that teachers need in order to come above their challenges in their practice. Hence, stakeholders and role players are implied. Thus, in the light of the pervasive influence of findings from this study recommendations are made aimed at three stakeholders: Provincial Districts; National Ministry of Education and Higher Educational Institutions.

### 6.5.1 Recommendations about intervening in emancipation of Technology teachers at district level

Carr and Kemmis (in Wilson, 2002:152-153) share this description regarding AR by advocating that it means to act following deliberate planning for strategic action while rigorously observing the effects or consequences during the spiral activities of planning, acting, observing, and reflecting; in this study culminating into critically reflecting as a team on the cycles, phases, outcomes and/or process of the research. I have been through the AR spiral but separate cyclical activities with teachers during the enquiry. Together we critically reflected on the outcomes per cycle from Cycle 1 to Cycle 5. The outcomes of the study were developed from Phase 1 and Phase 2. After data analysis from the cycles and interpretation of findings of the phases I recommend the following to the district officials regarding Technology teachers' emancipation:

- The district should build a relationship with other partners interested in advancing and developing Technology Education;
- Technology clusters should be formed in each circuit and each cluster should have a well established leadership;
- The district should organize MST Expo to motivate both Technology teachers and learners (Moeng, 2009:16);
- With sponsors from outside let the district based Technology subject advisors build curriculum related competitions, e.g., Technology Olympiad, Smart Young Mindz;
- The district should identify Technology teachers within a cluster who are good with technological content knowledge on certain core themes and let them be given opportunity to empower their colleagues on cluster level;
- A circuit meeting should be arranged, questionnaires issued out for Technology teachers to complete so as to indentify gaps in the Technology Education curriculum;
- The questionnaires should be analyzed and interpreted together with the cluster leaders;
- A four week emancipation schedule should be drawn up; that will be a week per term guided by yearly work schedule;
- One week should be used in the beginning of the term so that teachers know what to do in class with the learners and the other

weeks should be used to assess the work covered during the terms collectively and plan for the next term;

- Let the model in Figure 6.2 together with table 6.1 be used as a guide to emancipate Technology teachers who are un- and/or under-qualified to teach the subject.
- Let the Technology subject advisors fulfil all the 'code for quality education' promise as signed by Department of Education and teachers unions on the 5th October 2011 (annual World Teachers' Day). Kliptown Pledges (Hartley, 2011:104) stresses that the departmental official should:

    - ensure that all schools receive the necessary resources in time for teaching to commence;
    - always be available to assist schools, principals and teachers (especially those teaching Technology since it is a relatively new subject and full of challenges as such);
    - visit all schools within the district to offer support on regular basis;
    - ensure that all schools have their full staff allocation and that any vacancies are filled without delay so to keep teachers focused on teaching Technology;
    - respond to requests or concerns of education stakeholders

### 6.5.2 Recommendations to the Ministry of Education

The education landscape is changing rapidly and not only in South Africa, but throughout the whole continent (Motshekga, 2011:8). The DBE minister (ibid.) emphasizes that no education system can be better than its teachers. She further stresses that,

> *"Some argue for incentive-based performance systems, others blame the limited teacher training and assessment for the inconsistency in teaching quality. Whatever the case, we need to shift our thinking and reconsider*

*the social importance of the role the teacher and our approach to educational reform".*

This AR study does not blame the limited teacher training in Technology Education as its intention was to empower such. From the findings of the study point of view it has been proven that the AR approach study can be used to emancipate unqualified and under qualified Technology teachers within six week long AR cycles at least. Hence, one of the teachers has this to say at the end: "Now, I'm very confident to teach this subject to my school. I now have the knowledge and understanding or what is required about the subject and how to present it. The skills from our Mentor has also contributed a lot to the little that I had, I'm now skilful than before". With such positive notion from the teachers I therefore recommend the following to the Ministry of Education:

- Employ efficient and effective national Technology facilitator (NTF);
- Let the NTF make sure that each province has its own provincial Technology facilitator (PTF);
- Let the PTF surround him-/herself with regional Technology facilitators (RTF) who have a Technology Education;
- Let the RTF help the region to employ a circuit Technology advisor (CTA);
- Let the CTA follow all the recommendations listed in 6.5.1 from the first bullet till the last;
- The NTF should have a committee comprising of Technology lecturers from higher education institutions, curriculum planners and policy makers from DBE;
- This team should discuss the Technology policy and align activities by contextualizing them provincially;
- The Ministry of Education should support both national Technology Association (TA) conferences and Southern Africa Technology conferences – SAARMSTE.

Close collaboration between provincial Departments of Education and universities will still be essential in ensuring appropriate student teacher placement and in training and supporting teacher mentors in schools (DoE, 2006:25).

### 6.5.3 Recommendations to Higher Education Institutions

The South African higher education policy frameworks are contained in the following key documents: the Report of the National Commission on Higher Education, 1996; White Paper, 1997; Higher Education Act, 1997; South African Qualification Act, 1997; and National Plan for Higher Education, 2001. These key documents point towards a single nationally coordinated system with increased access and participation, increased responsiveness to the needs of the society and economic growth as well as programme differentiation, institutional niches and coordinated planning (Kraak, 2004: 246-252). It is the responsibility of higher education institutions to respond nationally to the needs of society in order to contribute to the economic growth within that society. TLA is the subject that has the potential to address human needs and in turn enhance the country's economy. In the same breath Ritchie (1995:197) concurs that, *"Design and Technology Education should equip future citizens with relevant, practical and useful skills, knowledge and understanding, attitudes and awareness for life in the twenty-first century"*. Ritchie (1995:199) further avers that, *"Design and Technology Education provides learners with the opportunity to learn how to approach problems, how to think creatively, how to work flexibly and collaboratively, and how to learn"*.

On the other hand, Makiya and Rogers (1992:3) bring to light that, *"Design and Technology Education is regarded as a foundation subject in the national curriculum"*. It is up to the teachers' training institutions to produce TLA teachers who can help their learners to realize the potential within themselves as recommended by Ritchie. Under the impetus of globalization, the image of the university as an agent of independent thinking and critique of society is being subsumed into the primary purpose of economic development (Musson, 2006:75) by producing graduates that enhance manpower and show capability to every department within a country. The higher education institutions should provide schools with better qualified teachers or else the schools will produce learners who will never cope or make it at tertiary level. I share the Education Minister sentiments during the 2011 Education Week convention, Angie Motshekga (2012:8) as she proclaims:

> *"Building quality in education is about improving the lives of learners that pass through the system. It is about preparing learners to make a smooth transition into higher education and equipping them with the skills necessary for the workplace".*

For higher education institutions to produce teachers with skills necessary for the workplace and those teachers to produce learners who will make a smooth transition into higher education, I recommend the following:

- The constituted forum of lecturers, NTF, policy makers and curriculum planners should meet at least twice a year to reflect on policy and practice, identify gaps and come up with a plan to address them;
- Policymakers and curriculum planners should update the lecturers about what type of Technology teacher they should produce;
- The NTF should report on the provincial development on Technology and the lecturers should report on their curriculum aligned Technology modules;
- The higher education institutions should review their study materials to align them to CAPS and other statutory requirements.

### 6.5.4 Recommendations for further research

Looking beyond this AR as guided by the findings, the following can be recommended for future research with Technology teachers:

- Application of participatory emancipation action research (PEAR) model at the circuit level to emancipate Technology teachers;
- Follow a six weeks long (at least) plan with intervention strategies with teachers who are un- or under-qualified to teach Technology;
- Develop a user-friendly guide for both teachers and learners under the theme Systems and Control which seems the most challenging to teachers;
- Design teachers' workbook which caters for Technology pace-setters, lesson plans, assessment and tasks (resource, capability and case study);
- Empower Technology teachers on how to conduct action research in their classes (as recommended by CAPS);
- Develop the Technology curriculum such that it synchronizes senior phase, FET phase and tertiary level;
- Provide hints on how to contextualize Technology and use resources available in the local context.

## 6.6 TEACHERS' EMANCIPATION GUIDELINES, MODEL AND PROGRAMME TO IMPLEMENT ACTION RESEARCH

The action research journey travelled with the participants and the findings per cycle has led to the guidelines that can be followed to develop teachers, designing of a model that can be implemented to emancipate technology teachers and a six week programme to empower un- and under- qualified technology teachers. The three instruments are unpacked below.

### 6.6.1 Guidelines to develop teachers through action research

The Centre for Collaborative Action Research (CCAR) is part of a process of developing the community of action researchers. Figure 6.1 (below) reflects the structure of teacher emancipation guidelines. In the CCAR programme, action researchers carry out their work learning circles – a structure for organizing group interaction within a set of guidelines. Combining this collaborative structure with action research process is an effective way of providing high levels of support and guide for action researchers as they design their action and engage in the process of studying the outcomes (Riel, 2010:5).

The guidelines to engage in target population discrimination before emancipation are reflected in Figure 6.1 below:

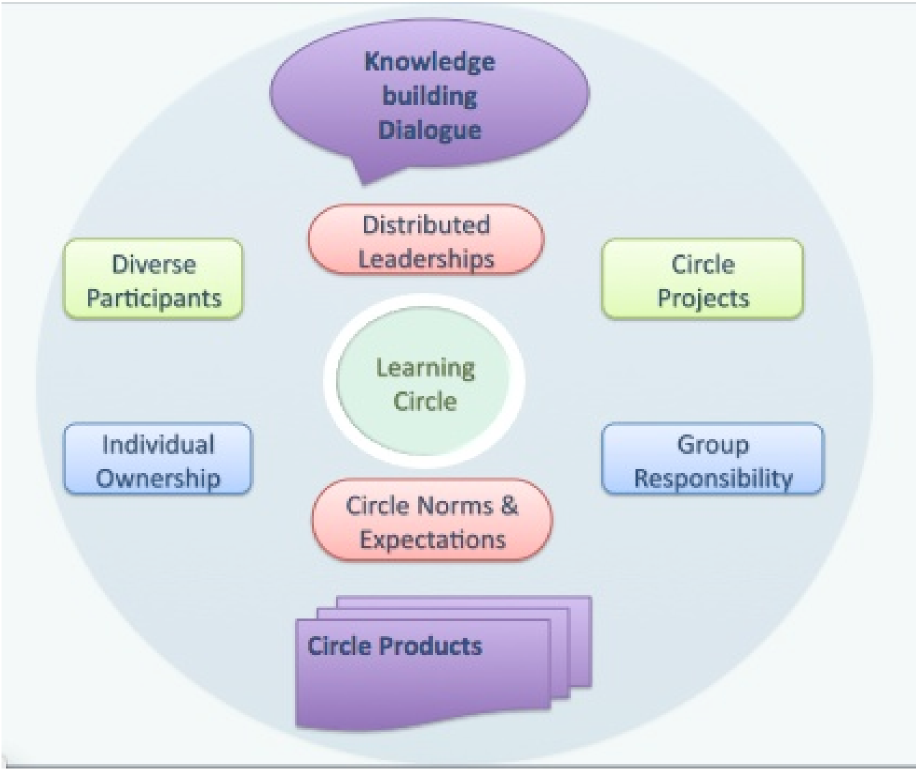



**Figure 6.1: Teachers' emancipation guidelines structure** Sourced from Riel (2010:5)

The guidelines have been inspired by the teachers' reflection at the end of a cycle starting from Cycle 3. This confirms Douglas quoted in Chapter One, who stresses that "all education is continuous dialogue – question and answer that pursue every problem to the horizon", and the action research facilitator should apply the guidelines in the following manner (this is just a guide, one is free to start anywhere):

- As a facilitator start a knowledge building dialogue with the participants based on the assumptions you hold about the study;

- Take into consideration that the participants are a community of diverse individuals from different backgrounds;
- Come up with mini projects within a bigger project and distribute leadership within the members and hold the group responsible and accountable on deliverables;
- The facilitator should carry out research work in learning circles – that is a structure for organizing group interaction within a set of guidelines to encourage individual ownership of the project; and
- Both the ethical norms and expectations during the AR journey should be spelled out and highlight the learning circle product as it can be used as a stepping stone towards the final research product.

Since Technology is one of the subjects that falls among some scarce skill, it was appropriate to engage senior phase Technology teachers with a collaborative action research study as an effective way to provide high levels of support in both teaching and learning of Technology. That was prompted by the audit of the DoE (2006:11) in reporting that:

> *"Whatever the fine details, there is clearly a lack of fit between overall demand and supply, and also between demand and supply for particular skills in particular schools. There is an oversupply in some subject areas, and an undersupply in others, and also imbalances in the deployment of teachers. Rural schools are particularly badly affected. Shortages are being experienced in scarce skills areas such as Mathematics, Science and Technology, in Languages and Arts, and in the Economic and Management Sciences. Shortages are also being reported for the Foundation and Intermediate Phases of the system".*

The guidelines could be used as target population discrimination in an effective way to provide high levels of support and guide for action researchers as they design their own action. Once the participants and the facilitator engage in the process of reflecting on the outcomes then emancipation model could be introduced.

### 6.6.2 Model to emancipate teachers through action research

The rationale of outlining the model in Chapter Four  Figure 4.1 - Emancipatory AR model for educational transformation, was to make it possible to formulate a PEAR model suitable for the intention of this study which is, *"The teaching practice of senior phase Technology Education teachers in selected schools of Limpopo Province: an Action Research study"*. The model proposed for teacher emancipation is persuaded by action research's cyclic and spiral processes displayed in Figures 4.2 and 4.3. Figure 6.2 (below) is the model I designed to emancipate Technology teachers through PEAR. The emancipation model can be tried or be implemented with other subjects during AR cyclic and spiral processes.

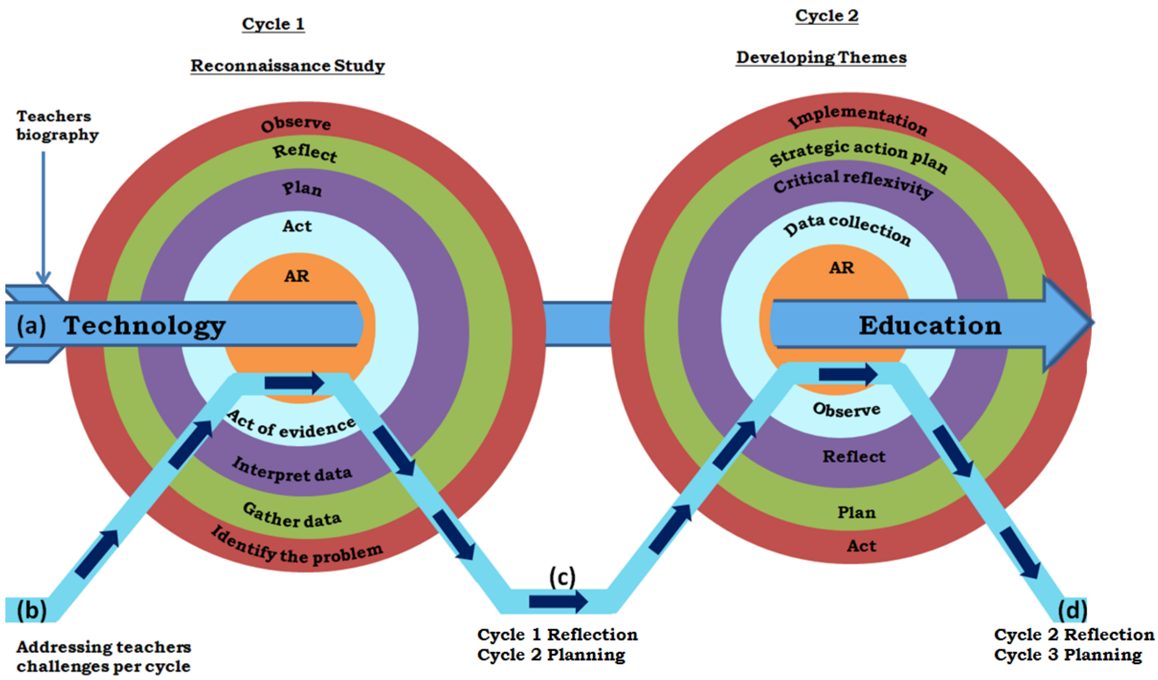



**Figure 6.2: Teachers' participatory emancipation action research (PEAR) model**

The designed PEAR model has the following features:

- The subject to be pursued during AR approach in this case is Technology Education and is represented by the big arrow (a);
- After a challenge(s) has been identified (Technology teaching) and target population discrimination done (Technology teachers), the researcher can get participants' biography to identify some gaps;

- The population should be placed at the AR journey from (b) through (c) to (d) till the cycle where the researcher is convinced that emancipation has taken place;
- The letter (b) stands for participants' challenges of which Cycle 1 will reveal more;
- The alphabet (c) denotes log of meetings to reflect and give feedback of the findings from the data gathering instruments used during reconnaissance;
- After Cycle 2 the researcher should organize a workshop/seminar at junction (d) to share what emerged during the cycle and the whole team should structure the way forward;
- The subject Technology Education is therefore the heartbeat and centre of focus of action research activities as it is piercing and weaving itself through the centre of each cycle;
- Cycles with their distinct sub-themes are identified in order to differentiate their roles from each other: Cycle 1 (Reconnaissance Study) and Cycle 2 (Developing themes from identified challenges);
- Activities per cycle are also outlined following the arrows (b – c - d) to the inner cycle and to the outer cycle;
- Teachers' path is represented by many up and down arrows – (b),which they follow through each cycle with the sole purpose of participatory emancipation;
- The actors are free to add more cycles and activities until they reach their ultimate goal;
- The model provides the research team with cycle process and the activities are spiral in their nature as the team moves from one cycle to another;
- The model is dynamic and flexible as it is open to creative ideas to address the current challenges within the curriculum and encourage interaction among all stakeholders.

Technology teachers need teaching models that can help them to approach Technology meaningfully and teach it effectively (cf. 3.6.1). There is a need for teacher education that is based on the technological understanding beyond specialized expertise to have the Technology teaching model that is supported by Hansen and Olson (1993:7) in Chapter Three (cf. 3.6.1). The model I have designed was inspired by Zuber-Skerritt's emancipation model in Figure 4.1, teachers' guidelines structure in Figure 6.1 and the model can be called participatory emancipation action research (PEAR) model.

**6.6.2.1 Following the model from Cycle 1 – Reconnaissance study**

In this model the researcher should first start by identifying the subject earmarked for emancipation purposes. In the model in Figure 6.2 I identified Technology Education as the subject of my focus. Thereafter the researcher should embark on fact-finding mission termed reconnaissance study or initial reflection. Then the researcher observes the situation and identifies the problem; the next step the researcher should reflect on the observations and the problem during and use other instruments to gather data. Thereafter the gathered data should be interpreted that will help in the planning phase of the whole AR project. The last part of Cycle 1 will culminate into putting the plan into action based on the evidence acquired. That will be setting the mood for Cycle 2.

**6.6.2.2 Continue with the model in Cycle 2 – Developing themes**

The AR spiral activities of observing, reflecting, planning and acting still repeat themselves in Cycle 2. The difference in Cycle 2 is the lead researcher activities. Challenges (if any) identified together by the research team in Cycle 1 should be used as a springboard to shape the study. The team should list and code challenges accordingly. Coding can be *open coding* which fractures the data and allows one to identify some categories, their properties, and dimensional locations or *axial coding,* which puts those data back together in new ways by making connections between a category and its sub-category or *selective coding,* in which data required are selected for analysis purposes (Straus and Corbin, in Ndlovu, 2004:62). From the coding choice themes could be tabulated as a means of paving the study's way forward. The team should strategically implement its action plan, reflect on the actions and as the actions unfold critically reflect on them. Lastly, the team should collect data and process them in the same way that it did in Cycle 1. Findings will feed into Cycle 3.

### 6.6.3 Six weeks programme to empower teachers through action research

The programme can be executed within a minimum of four weeks, which means a week of contact session per term. Six weeks is the maximum duration that the facilitator could intervene and interact with the participants. Tables 6.1 (below) highlights the six weeks intervention schedule for action research practitioner together with those that need to emancipate.

**Table 6.1: Action research intervention strategies to emancipate teachers**

| WEEK | ACTION | CYCLE |
|---|---|---|
| **ONE** | ▪Access, ethical observations and signing of consent;<br>▪Identify area of professional development or empowerment or emancipation. Embark on target population discrimination of your participants;<br>▪Sell action research to the participants;<br>▪Conduct reconnaissance (include observation) study to confirm the research problem;<br>▪Analyze data and prepare the findings. | **1** |
| **TWO** | ▪Share the findings, identify the challenges, convert these challenges into themes;<br>▪Plan together on how you are going to address these challenges;<br>▪Be guided by the theory and the action research paradigm(s).<br>▪Prioritize those themes through action planning; | **2** |
| **THREE** | ▪Reflect on the action plan;<br>▪Identify those who can handle some challenges from the participants; | **3** |

| WEEK | ACTION | CYCLE |
| --- | --- | --- |
| | ▪Incorporate such as co-researchers and facilitate the process of addressing the challenges;<br>▪Implement intervention strategies;<br>▪Reflect on the cycles. | |
| **FOUR** | ▪Continue to implement action plan cyclically and spirally by observing, planning, acting and reflecting;<br>▪Reflect on the activities of the cycle. | **4** |
| **FIVE** | ▪Let the emancipated participants display the sign of empowerment through learners' work. | **5** |
| **SIX** | ▪Repeat what you have done during reconnaissance so as to confirm the degree of emancipation;<br>▪Analyze and crystallize data. | **6** |
| **SEVEN** | ▪ Do member-checking and share the findings. | **7** |

## 6.7 REFLECTING ON THE SUCCESS OF THE STUDY

The AR team managed to address the Technology challenges listed in 3.6 of Chapter Three. The challenges ranged from Technology qualifications to lesson planning. The extent of un- and under-qualified teachers amongst Technology senior phase teachers has intensified and reinforced that action research be regarded as a tool for emancipation in the teaching of Technology as apparent in this study. The purpose of the study was thus to understand the Technology teaching practice from Technology teachers' perspective and intervene in the identified challenges. This study has reported the inquiry findings from the action research activities that took place in selected schools of Limpopo Province. For Technology Education – a foreign concept to many teachers and a new learning area in school curriculum both nationally and internationally – has found its way into the school environment. The question is, are teachers ready to teach, facilitate and present this subject?

Technology teachers who participated in this study can now apply a variety of methods in their assessment. They managed to lobby for support from the district, their SMTs and parents. It is of great significance that they are ready to contextualize and do Technology projects with their learners by utilizing available localized resources within the learners' community as seen in the previous chapters.

The study developed and improved the Technology teaching practice of teachers. Our interactions broadened, our relationship and their collaboration as they were able to meet over the weekend to discuss Technology related matters. For example, if one of the teachers' learners could be given a Technology project to do the teachers would consult or visit other co-researchers to plan together on how to execute such. Our professional knowledge as AR team has been enhanced by the AR cycles. The teachers expressed their relocation concern before their HODs and Circuit Manager during member-checking that they should be allocated Technology subject in 2012 as advocated by Moeng (2009:18) in Section 3.6. The participants stressed that they wanted to be rooted in the subject and expected my post-doctoral continued intervention. I have realized from this AR study that Technology teachers' reflection at the end of every cycle was vital to the improvement of their Technology teaching practice.

## 6.8 FINAL REFLECTION

Critical reflection is at the heart of action research and when this reflection is based on careful examination of evidence from multiple perspectives it can provide an effective strategy for improving the organization's ways of working and the whole organizational climate. It can be the process through which an organization learns. Riel (2010:13) conceptualizes action research as having three outcomes – on the personal, organizational and scholarly levels.

### 6.8.1 Personal AR ontological learning and reflection

I engaged Technology teachers in an AR study packed with actions per cycle, involving critical reflection with didactical emancipatory intent, and led the teachers in a participatory theme addressed. I will therefore call this activity, approach, method and strategy of intervention *critical or emancipation* *participatory action research.* This I say in support of following all cyclical processes listed in 4.2 by Zuber-Skerritt. The more the participants learned from each other and me per cycle the more confident they became and ensured they did not miss the next cycle. Mutual trust developed in the process; the boundary from being emic researcher to etic was broken. This type of action research has the power to really bond parties – the researcher and co-researchers. We are now a family of Technology elites at Mankweng Circuit. We really miss each other after making some imprints in each other's lives. Those that have registered and enrolled for Technology at higher education institutions used the contact session as a moment to ask me questions for their assignments.

I was overwhelmed by the benefit without measure from the participants' attendance and courage to tell their Circuit Manager during member-checking the need for continuous support from their SMT, circuit and Unisa. This is due to a collaborative relation we have among ourselves as supported by Riel. Action research is conducted in the workplace with others. It is a collaborative process. But, also, the doing of action research is more effective when action researchers can benefit from the help of a community of action researchers (Riel, 2010:14).

Riel and Lepori also paint a clear picture of AR at personal level the sentiments of which I share. At the personal level it is a systematic set of methods for interpreting and evaluating one's actions with the goal of improving practice (Riel and Lepori, 2011:1). Action research is often located in schools and carried out by teachers, but it can also be carried out in museums, medical organizations, corporations, churches and clubs – any setting where people are engaged in collective, goal directed activity. Equally important, not all teacher research is action research. Teachers can do ethnographic, evaluative or experimental research that is NOT action research. The process of doing action research involves progressive problem solving; balancing efficiency with innovation thereby developing what has been called an "adaptive" form of expertise.

Ontology as a theory of being, which influences how participants perceive themselves in relation to their Technology classroom, colleagues and learners was a bit pathetic before the AR cycles. The situation before AR cycles is supported by the statement raised by one HOD who said "we are using a layman's knowledge to teach the subject Technology". After the AR cycles the participants saw themselves as Technology teachers who engaged the policy in their teaching and consulted a variety of textbooks for their lesson planning. The sub-division that ensues after this one thrashes out how my ontological stance influenced the epistemology.

### 6.8.2 Epistemological reflections of Technology teachers' emancipation

In all the spiral activities of planning, observation, action and reflection during the AR cycle contact sessions with teachers, the main goal was to address the following research question: *How can action research intervention be used to improve the teaching practice of senior phase Technology teachers who are under qualified?* I argued that inadequate training of Technology teachers' impact negatively on their teaching practice. The study identified the gaps and appropriate progressive intervention was undertaken.

Curriculum reform, review, transmutation and transformation in South Africa were one of the strategic and symbolic changes since the first democratic election of 1994. C2005 was developed in which Technology was introduced as a new learning area. But many educational changes took place since then. These changes drastically affected Technology Education as one of the subjects in the curriculum and teachers' coping demands on both the subject content and pedagogy. Thus, a study of this nature was considered as it would contribute significantly to action research in Technology Education that is the study envisaged scholarly contributions. This also led me to conclude the following between AR and TE: Action Research and Technology Education are both the processes of addressing the need or want and/or challenges of Technology teachers through IDMEC by engaging teachers in PAOR (plan, act, observe and reflect) activities and follow the PEAR (participatory emancipation action research) steps with the intention to change the present situation.

Epistemology as a theory of knowledge in relation to this study was discussed (4.4 and 4.4.2). The theory of knowledge I held after reconnaissance study was that Technology teachers in Limpopo Province were incapacitated to teach Technology. Now, what is known after the AR cycles is different, Technology teachers can now teach Technology with confidence except the theme on Mechanical Systems which still needed some revisit.

The next section presents a concluding report of this action research study.

## 6.9 FINAL CONCLUSION OF THE STUDY

Chapter Six brought to a close this research and embraced the chapters' conclusions, limitations of the study, summary of findings, recommendations to Technology stakeholders, and reflections. The chapter's epitome is the guidelines to implement AR for empowerment purposes, the model for the emancipation of teachers and the progress of coming up with six weeks of intervention programme to develop teachers through AR. Those not trained can be emancipated, most probably by their district officials or cluster leaders, who may be able to apply PEAR proposed model in Figure 6.2. Alternatively, those who benefited and were emancipated from this study can be considered to train their colleagues. This will hopefully bring a dramatic change in the Technology teaching. This study has contributed to action research studies in Technology Education and the steps to capacitate the teaching of Technology by coming up with guiding steps, the cyclic model and a six weeks plan of intervention strategies.

I end this study by quoting the words of NAPTOSA (National Professional Teacher's Organization of South Africa) president, Ezrah Ramasehla

(2009:5-6), at the annual Gauteng provincial conference, who told the audience that there was an urgent need for improvement in the South African education system. He further stressed: “Let it be said to our children’s children that when we were tested, we refused to let this journey end, that we did not turn back, nor did we falter, and with our eyes fixed on the horizon, and with God’s grace upon us, we carried forth that great gift of teaching quality lessons with quality education as our benchmark”.

Let the Technology teachers deliver quality education and always treasure the words of Brynard (2009:6) who declares: “Teachers must be proud of what they are doing, because Jesus made each one of them special”.

*The AR mission undertaken is the emancipation vision accomplished, let the teachers who participated in the study be the judges!*

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# APPENDICES

## APPENDIX 1.1

## SAMPLE OF DAILY ACTIVITIES DURING CYCLE 1

**These activities will take place per school per day in the following identified schools:**

**Day 1: Monday the 08th March 2010**

1. Once-off meeting with the Mankweng Circuit Manager (a follow-up) to collect the permission letter for schools visit in his area
2. Visit to school A

2.1. Meet school's SMT and provide purpose of the visit
2.2. Signing of a consent form for the research by each participant
2.3. Class observations during Technology lessons
2.4. Interviews with Technology teachers
2.5. Collection of data from Technology teachers' files
2.6. Picture taking session (of classrooms and/or Technology laboratories)

**Day 2: Tuesday the 09th March 2010** 1. Visit to school B

1.1. Meet school's SMT and provide purpose of the visit
1.2. Signing of a consent form for the research by each participant
1.3. Class observations during Technology lessons
1.4. Interviews with Technology teachers
1.5. Collection of data from Technology teachers' files
1.6. Picture taking session (of classrooms and or Technology laboratories)

**Day 3: Wednesday the 10th March 2010** 1. Visit to school C

1.1 Meet school SMT and provide purpose of the visit
1.2 Signing of a consent form for the research by each participant
1.3 Class observations during Technology lessons
1.4 Interviews with Technology teachers
1.5 Collection of data from Technology teachers' files
1.6 Picture taking session (of classrooms and or Technology laboratories)

**Day 4: Thursday the 11th March 2010**

1. Visit to school D

1.1 Meet school SMT and provide purpose of the visit
1.2 Signing of a consent form for the research by each participant
1.3 Class observations during Technology lessons
1.4 Interviews with Technology teachers
1.5 Collection of data from Technology teachers' files
1.6 Picture taking session (of classrooms and or Technology laboratories)

**Day 5: Friday the 12th March 2010**

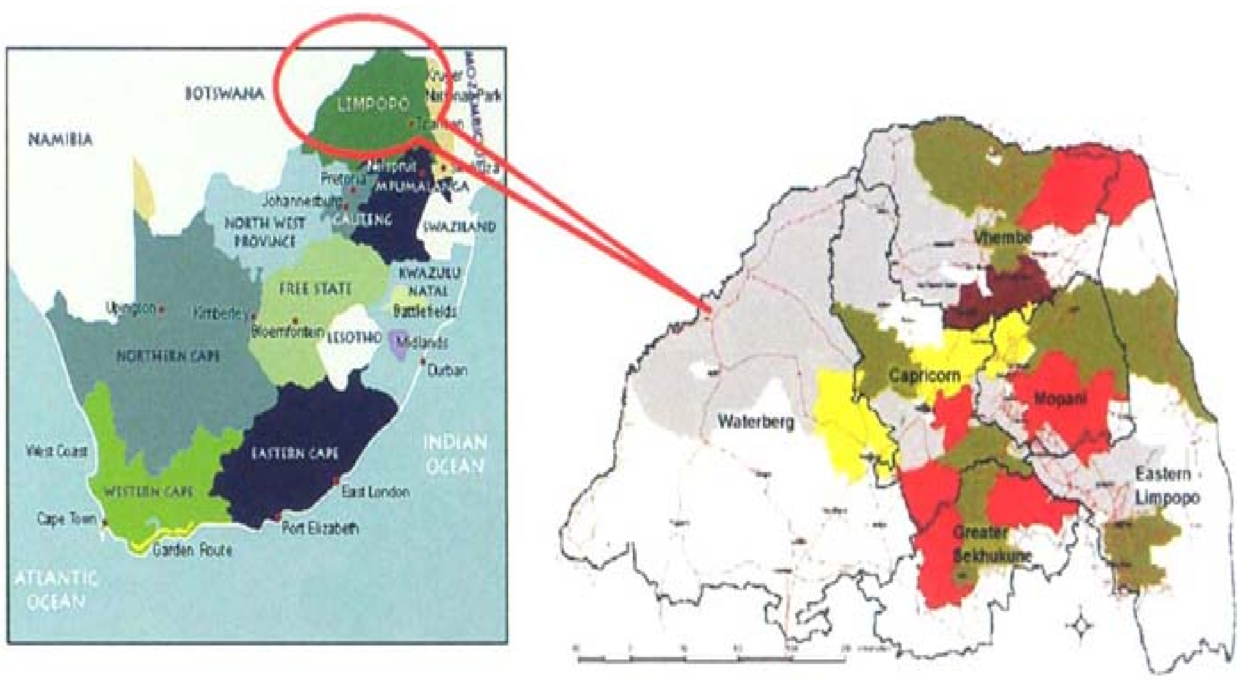
1. Visit Unisa regional centre library as part of the research process 1.1. Return to Pretoria

## APPENDIX 1.2

## PICTURED MAP OF LIMPOPO PROVINCE REGIONAL DISTRICTS

**PICTURE MODEL 1.1**

**South Africa** **Limpopo Province**




**Picture 1.1: The pictured map of Limpopo Province regional districts**

# APPENDIX 1.3

## CONSENT FORM SIGNED BY TEACHERS

**INFORMED CONSENT MEMO**

THE TEACHING PRACTICE OF SENIOR PHASE TECHNOLOGY EDUCATION TEACHERS IN LIMPOPO PROVINCE: AN ACTION RESEARCH STUDY

03 January 2011

Dear Technology Education Educator

You are invited to participate in a research project aimed at establishing challenges that senior phase teachers in Limpopo Province face regarding the teaching of Technology, and to apply the relevant research methods to intervene in these challenges.

Your participation in the research project is voluntary and confidential. For the purpose of the study you will be requested to participate in intervention sessions (which will take the form of interviews, workshops combined with group discussions). Of importance to both of us in this project is the capturing of your lesson presentations and contact sessions discussions by digital video camera and the class where Technology is taught by digital still camera. You won't be faceless since at some stage your seniors will be called and we will be addressing some challenges together. Your anonymous contributions, your school with a pseudo name and your pictures during action research interaction will be displayed in the final report. You are free to withdraw anytime from the programme.

The study forms part of my DEd curriculum studies at UNISA. Please complete and sign this letter as a declaration of your consent, i.e. you participate in this project willingly.

Yours Faithfully

01 April 2011

______________________ ______________________

**Mapotse, T.A.** **Date**
**Technology Lecturer**

---

Participant's Names: ......................................................................

School's Name: ..............................................................................

Ethnic group: ..............................................................................

Cell phone number: .......................................................................

Telephone: ...................................................................................

Convenient time and day to call: .......................................................

Postal Address: ............................................................................

Physical Address: ..........................................................................

E -mail address: ............................................................................

______________________ ______________________

Participants Signature Date

# APPENDIX 1.4

## CONSENT FORM SIGNED BY LEARNERS' PARENTS OR GUARDIANS

**Request to sign a consent form about conducting research at School by Mr. TA Mapotse**

Consent form

Parent/guardian of_______________________

Dear Sir or Madam

You are requested to sign the consent form to allow your child,_______________ (please, write your child's name) to participate in a Technology Lesson presentation. The class will be videotaped while being engaged in a technology lesson.

Signature:_____________________ Date:__________________

---

**Request to sign a consent form about conducting research at School by Mr. TA Mapotse**

Consent form

Parent/guardian of_______________________

Dear Sir or Madam

You are requested to sign the consent form to allow your child,_______________ (please, write your child's name) to participate in a Technology Lesson presentation. The class will be videotaped while being engaged in a technology lesson.

Signature:_____________________ Date:__________________

---

# APPENDIX 1.5

# LETTER REQUESTING PERMISSION TO CONDUCT RESEARCH IN LIMPOPO

Enquiries: TA Mapotse
Tel: 012 429 4480
Cell: Voda9244750
Fax: 0866528036
012 429 4922
Email: mapotta@unisa.ac.za

Office of the HOD
Rev Nevhutalu
HOD: Department of
Education Limpopo
Province
03 September 2009

Dear Rev Nevhutalu

**REQUEST TO CONDUCT RESEARCH**

I am a D.Ed (Technology Education) student at Unisa and supervised by Dr Gumbo. I am working on the topic: "**The teaching practice of senior phase Technology Education teachers in selected schools of Limpopo Province: an Action Research study**". I have chosen to conduct Action Research in Limpopo province with Technology teachers of five (5) schools at Capricorn region around Mankweng circuit.

I therefore request to be granted access and permission to the senior phase teachers in the said field so as to accomplish this mission.

Tomé Awshar, Mapotse (Mr.) Date: 03/09/2009

# APPENDIX 1.6
# RESPOND FROM LIMPOPO PROVINCIAL MINISTRY OF EDUCATION

LIMPOPO

PROVINCIAL GOVERNMENT

REPUBLIC OF SOUTH AFRICA

## DEPARTMENT OF EDUCATION

Enquires: Monnathebe T.L.L,
Telephone: 015 290 7942
E-mail: MonnathebeT@edu.limpopo.gov.za

MR. T.A MAPOTSE
476 BLOCK M
SOSHANGUVE
0152

Dear Researcher

**Request for Permission to Conduct Research**

1. Your letter of request bears reference.

2. The Department wishes to inform you that you are granted permission to conduct research at schools in the Mankweng Circuit in the Limpopo Province. The title of your research project is: **"The teaching practice of senior phase Technology Education teachers in selected schools of Limpopo Province: an Action Research study"**

3. The following conditions should be observed.
   a. The research should not have any financial implications for Limpopo Department of Education.
   b. Arrangements should be made with both the Circuits Office and the schools concerning the conduct of the study. Care should be taken to disrupt the academic programme at the schools.
   c. The study should be conducted during the first three terms of the calendar year as schools would be preparing themselves for the final end of year examinations during the fourth term.

d. The research is conducted in line with ethics in research. In particular, the principle of voluntary participation in this research should be respected.
e. You share with the Department, the final product of your study upon completion of the research assignment.

4. You are expected to produce this letter at schools/offices where you will be conducting your research, as evidence that permission for this activity has been granted.

5. The Department appreciates the contribution that you wish to make and wishes you success in your investigation.

.......................................

**Date: 04/11/2009**

**Head of Department**

Cnr 113 Biccard & 24 Excelsior Street,
POLOKWANE, 0700, Private Bag X9489, POLOKWANE, 0700
Tel: (015) 290 7600, Fax: (015) 297 6920/4220/4494

# APPENDIX 1.7
# STRUCTURED INTERVIEW SCHEDULE FOR RECONNAISSANCE STUDY AND LAST CYCLE

### STRUCTURES INTERVIEWS SCHEDULE

**A. GENERAL**

1. How long have you been teaching Technology Learning Area?
2. How do find it? Share some of your Technology teaching experiences?
3. Why are you teaching this learning area?
4. Do you have any idea why the National ministry of Education came up with this learning area?
5. How many Technology classes do you teach and what is the learner ratio in those classes?

**B. POLICY RELATED QUESTIONS**

1. What is the difference between Technology and Technology Education?
2. What does Learning Outcome $(LO)_3$ addresses
3. Why $LO_2$ is the key in teaching Technology Learning Area?
4. Can you regard $LO_1$ as a method of teaching Technology? Support your answer:
5. With whom and when do you plan your Learning Programme?

**C. TECHNOLOGY MATERIAL RESOURCES QUESTIONS**

1. As the Technology teacher, how do you contextualize the teaching of Technology?
2. Do you do projects with your learners? Which topic are you comfortable to present to your learners?

3. Where do you and your learners find resources/materials for Technology projects?
4. How is both parental involvement and School Management Team (SMT) support, pertaining to resources?
5. Does the school have its separate Technology budget? Support your answer:

**D. ASSESSMENT IN TECHNOLOGY LEARNING AREA**

1. What are we assessing in Technology and what are we evaluating?
2. What forms of assessment do you incorporate in your Technology teaching?
3. Are learners accorded an opportunity to discuss the assessment instrument prior to its implementation? Support your answer:
4. Do you have provincial or national guide to assessment?
5. How long is your turn-around time for results after your learners have submitted their tasks?

**ADDITIONAL INFORMATION/COMMENTS:**

……………………………………………………………………………………………

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## APPENDIX 1.8

## AR OBSERVATION GRID FOR TECNOLOGY LESSON DURING RECONNAISANCE STUDY AND LAST CYCLE

### AR OBSERVATION GRID FOR TECHNOLOGY LESSON OFFERED IN THE CLASSROOM

**A. RESOURCSES/MATERIAL/MEDIA/TEACHING AND LEARNING AID**

1. Any technological posters, drawing or collage hanging on the walls?........................................................................................................
2. Are technological projects or artefacts' made by learners somehow displayed?..................................................................................................
3. Does the material support the Learning Outcomes (LOs) in Senior Phase?...................................................................................................
4. Does the material integrate learning across the Learning Area?......................................................................................................
5. Does the material provide appropriate learning experience in Technology?.............................................................................................
6. Is the material suitable in terms of:
   - Level
   - Focus area
   - Context
   - Language of instruction (LOLT)

..................................................................................................................
..................................................................................................................

7. Do material include?
   - Case study tasks
   - Resource tasks

..................................................................................................................
..................................................................................................................
..................................................................................

8. Do the material provide support for evaluation and assessment? ..................................................................................................................
..................................................................................................................
..................................................................................................................
..................................................................................................................

**ADDITIONAL COMMENTS ON RESOURCSES AND/OR MATERIAL AND/OR MEDIA AND/OR TEACHING & LEARNING AID:**

**..................................................................................................................**
**..................................................................................................................**
**..................................................................................**

**B. ACTIVITIES**

1. Does the activities contain the use materials which are readily available?
……………………………………………………………………………………………………
……………………………………………………………………………………………………
………………………………………………………………………………………

2. Do the illustrations/demonstrations support the text, the teaching, provide background, include accurate detail and are interpreted easily?……………………………………………………………………………………………
……………………………………………………………………………………………………
………………………………………………………………………………………

3. Do activities include co-operative learning and individual tasks?……………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

4. Are activities policy based or textbook based
……………………………………………………………………………………………………
……………………………………………………………………………………………………
………………………………………………………………………………………

5. Is the current activity extrapolated from the teacher’s work schedule?
……………………………………………………………………………………………………
……………………………………………………………………………………………………
………………………………………………………………………………………

6. Can the other Technology teacher use the observed teachers’ lesson plan to be able to present the same activity?
……………………………………………………………………………………………………
……………………………………………………………………………………………………
…………

7. How is the class and the learners organized during the activity?……………………………………………………………………………………
………………………………………………………………………………

**ADDITIONAL COMMENTS ON ACTIVITIES:**
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

## APPENDIX 1.9

## QUESTIONNAIRE COPY FOR RECONNAISSANCE STUDY AND LAST CYCLE

For office
Use only
Card number [1] 1
Register number [ ] [ ] 2 – 3

**A. BIOGRAPHIC INFORMATION**

Complete the single variable scale below to complete your biography information. Please tick only a box, e.g. ☑

1. Gender: Male = ☐ or Female = ☐ 4
2. Your Technology teaching experience: Five years or less = ☐;
   Above five(5) years = ☐ 5
3. Possessing any Technology qualification:
   Yes = ☐ or No = ☐ 6
4. Teach Technology in rural area = ☐; urban = ☐ or
   semi- urban = ☐ 7
5. Able to draw up Technology Lesson Plans:
   Yes = ☐ or No = ☐ 8

**B. TECHNOLOGY TEACHING**

Apply constant sum scale to allocate 100 points to the following Technology Didactic attribute according to their importance in your planning:

1. Lesson Plan ______ 9
2. Learning Programme ______ 10
3. Policy document ______ 11
4. Work schedule ______ 12
5. Textbook ______ 13

TOTAL 100

**C. ASSESSMENT IN TECHNOLOGY**

Please endorse the rank order scale to rank the following assessment in Technology teaching as incorporated by you. The ranking should be follows: ( 1 = most important; 2 = 2nd most important; 3= 3rd most important; …. )

1. Assignment ________ 14
2. Portfolio ________ 15
3. Projects ________ 16
4. Collage ________ 17
5. Tasks ________ 18
6. Tests/Examinations ________ 19

**D. SUPPORT IN TECHNOLOGY**

Engage in a comparative rating scale for your Technology support

(a) In terms of support, how does your circuit support you as compared to your school? Circle you answer: e.g.⓪ 20

5. much better
4. somewhat better
3. about the same
2. somewhat worse
1. much worse

(b) Are your phase colleagues most resourceful for your Technology advancement, as compared to your school SMT? 21

5. much better
4. somewhat better
3. about the same
2. somewhat worse
1. much worse

(c) Which one can you understand and implement with ease, policy document as compared to textbook? 22

5. much better
4. somewhat better
3. about the same
2. somewhat worse
1. much worse

(d) Are you familiar with the how of setting learners task as compared to using technological process to develop projects 23

5. much better
4. somewhat better
3. about the same
2. somewhat worse
1. much worse

**E. LEARNING OUTCOMES IN TECHNOLOGY**

Use the scale below to reflect your opinion in the interpretation of Technology learning outcomes (LOs): where
5- “strongly agree”;
4 - “agree”;
3 – “neither agrees nor disagrees”;
2 – “disagree” and
1 – “strongly disagree”.

In your opinion, Technology LOs are:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | Teachable | 1 | 2 | 3 | 4 | 5 | Not teachable | 23 |
| 2 | Discouraging participation | 1 | 2 | 3 | 4 | 5 | Encouraging participation | 24 |
| 3 | Understandable | 1 | 2 | 3 | 4 | 5 | Not clear | 25 |
| 4 | Easy to follow | 1 | 2 | 3 | 4 | 5 | Difficult to follow | 26 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 | Theoretical | 1 | 2 | 3 | 4 | 5 | Practical | 27 |
| 6 | Context (policy) based | 1 | 2 | 3 | 4 | 5 | Content (textbook) based | 28 |
| 7 | Tests/exam driven | 1 | 2 | 3 | 4 | 5 | Project driven | 29 |
| 8 | Clustered | 1 | 2 | 3 | 4 | 5 | Well structured | 30 |

# APPENDIX 4.1
# SAMPLE OF THE INVITATION TO CONTACT SESSION

***To:*** *Technology teachers as research participants teaching Technology at senior phase level from the following schools:* RMR sec; WHW sec; KMK sec; VMV sec; and BMB *secondary.*

You are cordially invited to attend some Technology contact sessions scheduled as follows:-

Dates: $18^{th}$, $19^{th}$, $20^{th}$ and $21^{st}$ April 2011
Venue: WHW secondary school
Time: 11H30 till 14H00
PAR facilitators: Mr. TA Mapotse from Unisa and UL lecturer

Attached please find the daily programme. Just take note a theme from system and control will be handled daily. The sessions are meant to emancipate you to present Technology pedagogic content knowledge with confidence and every chance of success. The group dynamics in sharing their experience will capacitate you to face you Technology teaching with rigour.

Please bring along the following items (if you have them):-

- Policy document;
- CAPS documents;
- Your Technology personal file;
- Sample of Technology Lesson Plan, Work Schedule and Learning Programme
- Technology textbook(s) that you are using;
- Assessment Guide document;
- Any document you deem relevant.

Thanks and see you there!

07 April 2011

TA Mapotse
Technology Lecturer

Date

# APPENDIX 4.2
# PARTICIPANTS WORK SCHEDULE FOR 2011
# TERM 2: GRADE 8 AND 9 ONLY

## 2. GRADE 8 WORK SCHEDULE

## 2.2 SAMPLE OF GRADE 8 WORK SCHEDULE FOR TERM 2

| Week | LO | Assessment Standards | Knowledge and Concepts | Context | Forms of Assessment | Suggested Resources |
|---|---|---|---|---|---|---|
| 1-6 | L01<br><br>LO2<br><br>LO3 | Investigate<br>Design<br>Make<br>Evaluate<br>Communicate<br><br>Structures<br>Processing<br><br>Indigenous Technology and culture<br>Impact of Technology | How different cultures have solved problem of containerization (canning, bottling)<br><br>How containerization impacted on people's lives and their environment | Containerization | Case Study<br><br>Research<br><br>Assignment | Cans<br><br>Bottles<br><br>Box |
| 7-11 | LO1<br><br>LO2<br><br>LO3 | IDMEC<br><br>Structures<br>Processing<br><br>Indigenous Technology and culture<br>Impact of Technology<br>Bias in Technology | | | COMMON TEST DATE 09/6/2011 | |

**NB:** The last two columns are for both date completed and comments respectively, not included.

**2. GRADE 9 WORK SCHEDULE**

**2.2 SAMPLE OF GRADE 9 WORK SCHEDULE FOR TERM 2**

| Week | LO | Assessment Standards | Knowledge and Concepts | Context | Forms of Assessment | Suggested Resources |
|---|---|---|---|---|---|---|
| 1-3 | L01<br><br>LO2<br><br>LO3 | AS 1-3 AS 5<br><br>AS 2<br><br>AS 2 | Preservation through galvanizing and electroplating of metals | Manufacturing | Assignment | Textbooks Steel product e.g. pots, cutlery, pipes |
| 4-6 | LO1<br>LO2<br>LO3 | AS 1-5<br>AS 2<br>AS 2 | Vanishing and painting of textile and wood products to improve or change properties | Furniture Clothing | Assignment | Textbooks Fabrics Wooden product |
| 7-9 | LO1<br>LO2<br>LO3 | AS 1-5<br>AS 2<br>AS 2 | Recycling of plastics and metals for remanufacturing into products | Health Environment | Research (FORMAL) | Textbooks Plastic and metal product |
| 10-11 | LO1<br>LO2<br>LO3 | AS 1-5<br>AS 2<br>AS 1-2 | Preservation through freezing and drying of food to increase life span | Food | COMMON TEST DATE 09/6/2011 | Textbooks Magazines Food |

**NB:** The last two columns are for both date completed and comments respectively, not included.

**APPENDIX 4.3**

**[A]. GRADE 8 & 9 MARKING RUBRIC FOR THE PROJECT**

**AND**

**[B]. ASSESSMENT STRATEGIES IN TECHNOLOGY (FORMS OF ASSESSMENTS PER TASK)**

**SCHOOL NAME:……………………………………………………………………**
**GROUP NAME:……………………………………………………………………**
**GRADE:……………………………………**
**PROJECT NAME:…………………………………………………………………**
**OVERALL PERCENTAGE FOR THE GROUP:……………………**

The learners were given the project based on the following:

- o Objectives
- o Design
- o Making
- o Evaluate

Assessment Rubric will be is used to mark their project

| | Not achieved | Partially achieved | Achieved | Excellent | Total |
|---|---|---|---|---|---|
| Criteria | 1` | 2 | 3 | 4 | |
| Investigation | | | | | |
| Design | | | | | |
| Making | | | | | |
| Evaluation | | | | | |
| Communication | | | | | |

Teacher's comments:…………………………………………………………………………
…………………………………………………………………………………………

………………………… ……………………………
Signature Date

## B. ASSESSMENT STRATEGIES IN TECHNOLOGY (FORMS OF ASSESSMENTS PER TASK)

| Strategy or form of assessment | Type of task or activity | Example |
|---|---|---|
| **Investigation tasks** | Short, independent research or investigation work of any kind. These can usually form part of the Investigations stages of a Project.<br><br>Ideal for LO1 (**investigate**) LO2 or LO3. | **Poster Presentations about Research.**<br><br>Use to assess Investigation and Communication skills.<br><br>**Case Study**<br><br>Learners explore how a specific existing product works.<br>**Practical investigations**<br>Learners do practical experiments or tests to learn about technology knowledge content. |
| **Design tasks** | Learners generate ideas by discussion, sketching and 3D modelling and present them in some way. Ideal for LO1 (**design**). | Done during designing stages of as project or as short specific challenges to develop brainstorming and creativity skills. Also ideal for linking with communication tasks. (e.g. design an advert for a space age cell phone) |
| **Making tasks** | Making or practical skills are central to the technology learning area. Learners will usually spend more time making than on any other stage. Ideal for LO1 (**make**). | e.g. Learners make the structure for a water tower.<br>**Short making tasks:**<br>Can be done during investigations.<br>e.g. Learners make a model of a basketball hoop that stands up on its own. |
| **Evaluating tasks** | The analytical skill needed to objectively judge a product and seek improvement. Ideal for LO1 (**evaluate**). | **Short evaluations** can be linked to existing product investigations.<br>**Within design process projects**<br>Mostly learners will evaluate products they themselves have designed and made. |

| Strategy or form of assessment | Type of task or activity | Example |
|---|---|---|
| | | |
| **Communication tasks** | Focus on learners' ability to present ideas in different ways (sketching, drawing, writing and using ICT). | Sketching, drawing formal working drawings and presenting a project portfolio are all ways that learners can be assessed on this skill. |
| **Test** | Written tests used to assess mainly LO2: Knowledge and Understanding. | End of project knowledge test or end of year exam. |

# APPENDIX 4.4

# AR SAMPLE PROGRAMME FOR CYCLE 3

## CYCLE 3: PAR PROGRAMME

## DAILY PARTICIPATORY ACTION RESEARCH (PAR) PROGRAMME RUN BY MYSELF AND THE INVITED UL TECHNOLOGY LECTURER

Day 1: Monday the 18th April 2011

By Mr. TA Mapotse from University of South Africa (Unisa) Muckleneuk campus

- Opening and welcome. Outlining the purpose of these sessions
- Curriculum transformation from NATED/REPORT 550 through NCS to CAPS was unpacked. The questions that follow were asked to the participants for target population discrimination around curriculum transformation: Are we are aware about the curriculum transition? Are we ready for the changes? Let's share our experiences around this transformation.

University of Limpopo (UL) North campus technology lecturer addresses the topics below:

- Facilitate the session on challenges technology teachers are facing in class
- Empowering technology teachers on how they can explore and interpret Technology Curriculum Policy

Theme of the day: Systems and Control: **ELECTRICAL -** *(Ohms Law; resistor colour coding; calculating resistance; and logic gates).*

Day 2: Tuesday the 19th April 2011

By TA Mapotse

- Opening, welcome and reflection on Day 1 activities

- Teachers' Professional Development in technology around:

  - Technology Learning Programme (TLP)
  - Technology Work schedule (TWS)

  Do you have both TLP and TWS documents for your school? Let's do them together for the remaining terms of 2011!

By UL technology lecturer

- Let us together draft a Technology Lesson Plan
- Assessment in Technology: "Which assessments do you incorporate in your lesson presentations and why? Which ones can we all accept to use as a team?

Theme of the day: Systems and Control: **MECHANICAL –** *(mechanism; classes of levers; gears; and mechanical advantage).*

Day 3: Wednesday the 20th April 2011

- Opening, welcome and reflection on Day 2 activities

Both facilitators will handle the following challenges with technology teachers:

- Resources; PCK; Support; Technological skills; Barriers to learning; etc

  Content and context are the determining factor in dealing with the above challenges. How do you go about resolving the above listed challenges?

Themes of the day: **STRUCTURES**– *(types of structures, classification of structures, stability of structures and structural members)*and **PROCESSING –** *(material, food & textile processing; changing properties of a structure through processing).*

Day 5: Friday the 22nd April 2011

- Opening, welcome and reflection on Day 3 activities

All team members will address the following:

- Learning Outcome three with its three assessment standards

Theme of the day: **DRAWING –** *(Graphic Communication, Design, Drawing instruments, Orthographic drawing).*

# APPENDIX 5.1

# ONE OF THE EXERCISES DONE WITH THE PARTICIPANTS DURING CONTACT SESSION

**THIS SENIOR PHASE SCIENCE EXERCISE WAS GIVEN TO PARTICIPANTS SO AS TO CHECK HOW FAR MUCH DO THEY KNOW AROUND THE THEME SYSTEM AND CONTROL – IN THE TOPIC ELECTRICAL TECHNOLOGY.**

*This is the exercise I used to give to teachers enrolled for ACE – Natural Science senior phase, Department of Mathematics Science Technology Education (DMSTE) at University of the Limpopo (UL) Turfloop Campus.*

**5.1 Alternative Conceptions Questionnaire**

Please answer the following questions. Please explain your answers, so that we can understand what you were thinking. You will not receive a mark. You will not be punished for wrong answers. This questionnaire is only meant to identify any problems you may have so that the lecturer can assist you. It is important that you answer honestly and as well as you can. Thank you for your assistance.

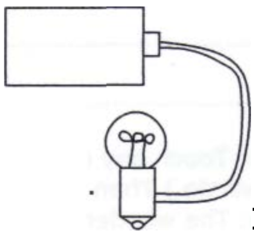


**Figure 1**

1. Figure 1 show a bulb connected to a battery by *a* wire. Will the bulb light?

a. Yes

b.. No.

c. I don't know.

Explain:

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
……………

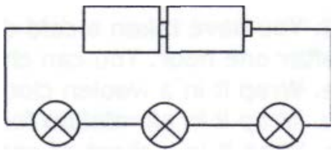


**Figure 2**

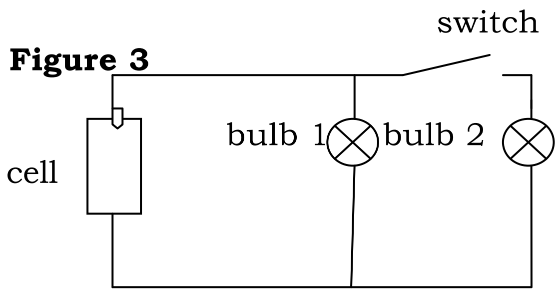
2. Figure 2 shows a diagram of an electric circuit. Which of the following are present in the circuit?
a. Electrical wires
b. Batteries
c. Bulbs
d. All of the above
e. None of these.

Explain (indicate how many of each item is present):
……………………………………………………………………………………………
……………………………………………………………………………………………
…………………………………………………………………………

3. In Figure 2, which bulb will be the brightest?
a. The one on the left.
b. The one in the middle.
c. The one on the right.
d. All will be equally bright.

Explain:…………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………
……………………………………………

**Figure 3**




4. In Figure 3, bulb 1 is bright but bulb 2 is dark. If we close the switch bulb 2 will light. What will happen to bulb 1?
a. Bulb 1 will remain equally bright.
b. Bulb 1 will become slightly less bright.
c. Bulb 1 will become only half as bright.
d. Bulb 1 will become totally dark.

Explain:…………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

5. Touch any metal object that is near you. (Any metal part of a chair or table will do.) Then touch any wooden (or plastic) object near you.
What do you feel?

a. The wooden object feels warmer than the metal object.
b. The metal object feels warmer than the wooden object.
c. Both objects feel equally warm.

Explain:
……………………………………………………………………………………………………
……………………………………………………………………………………………………
………………………………………………………………………………………

6. You have taken a cold drink from the fridge. You are only allowed to drink it after one hour. You can choose one of the following to keep it cool:

a. Wrap it in a woollen cloth.
b. Wrap it in aluminium foil.
c. Wrap it in a sheet of paper.
d. Nothing at all, just leaves it standing.

Which will you choose? Explain why:
……………………………………………………………………………………………………
……………………………………………………………………………………………………
…………………………………………………………………………………………

7. On a cold day, it is best to keep the doors and windows closed. Why is that?

a. To keep the cold out of the house.
b. To keep the heat inside the house.
c. Both a. and b.
d. Other reasons.

Explain:
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………

**5.2 Traditional beliefs about lightning**

In the Limpopo many different cultures are represented, each with their own traditional and cultural beliefs. This traditional knowledge is not always in agreement with science, but is nevertheless relevant and valuable. On the other hand, it can provide problems for learners who are trying to learn science. In this exercise you are requested to explore some aspects of that knowledge. The topic is 'lightning' and relates to our science topic of electricity. During the Block, these beliefs will be identified. We will explore the relevance of these beliefs in the teaching of science. In all activities, it will be very important to maintain respect and appreciation for this knowledge that has been built from experience and thought over the millennia.

**- *Your personal awareness of beliefs related to lightning***

Answer the following questions in detail. Use a separate sheet of paper to write your answers.

1. Many people in Limpopo believe that there are several types of lightning. In Northern Sotho one recognizes, for example, ‘tladi' and 'legadima'. How many types of lightning are you aware of? Describe all types of lightning that you know of in as much detail as you can.

2 If there is a thunderstorm, what are the things people should do? For each of the things one must do, also describe *why* one should do that.

3 What are the dangers of lightning? What happens to a person who is struck by lightning? Do different kinds of lightning have different dangers?

4 How can a person protect himself/herself from being struck? Are there
different ways to protect against different kinds of lightning?

5 Many people associate a bird or lizard with lightning. These creatures are said to do certain things. Are you aware of these and/or other beliefs related to lightning? Please describe in as much detail as you can.

## 5.3 Interview with two well-informed sources

Identify two authorities in your community who are well informed about traditional and cultural beliefs related to lightning. Find out whether they share your beliefs about lightning. Determine whether they have beliefs that you were unaware of. Report in writing (1-2 pages) about what you learned.

# APPENDIX 5.2

# OBSERVATION ASSESSMENT SCHEDULE FOR AR TECHNOLOGY LESSON PRESENTATION

**AR TECHNOLOGY LESSON PRESENTATION ASSESSMENT**

<table>
<tr><td>Name:</td><td colspan="2">School:</td></tr>
<tr><td>Grade:</td><td colspan="2">Theme:</td></tr>
<tr><td>Starting Time:</td><td colspan="2">Ending Time:</td></tr>
<tr><td>Context:</td><td colspan="2">Core Knowledge:</td></tr>
<tr><td>Category and Criteria</td><td colspan="2">Observer’s Comment</td></tr>
<tr><td>1. Technology Didactic<br>- Clear link between lesson and assessment standards.<br>- Clear link between lesson and context.<br>- Lesson effectively planned using set format<br>- Activities relate to outcomes/assessment standards.<br>- Is there any integration within or across LA?</td><td></td><td>(15)</td></tr>
<tr><td>2. Technology Process:<br>- Did it build on learner interest and understanding/previous work?<br>- Was it communicative and supportive? i.e. were there activities to support learning?<br>- Did it include higher order thinking?<br>- Did the teacher develop the relationship between this topic and other knowledge?</td><td></td><td>(15)</td></tr>
<tr><td>3. Technology Classroom Management<br>- Was the teacher's classroom management (of learners, furniture, LSM) effective?<br>- Was the learner - educator's approach to discipline appropriate?<br>- Was the lesson purposeful and orderly?</td><td></td><td>(10)</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

| | | |
|---|---|---|
| **4. Assessment in Technology:**<br>- Is the assessment tasks related to LO, assessment standards?<br>- Was the teacher's assessment strategy appropriate?<br>- Did the teacher make use of the information gathered? | | (10) |
| **5. Resources in Technology:**<br>- Did the teacher offer/ show information and insights beyond what is available in<br>- Did the teacher offer/ show information and insights beyond what is available in class?<br>- LSM and other resources available.<br>- Was the teacher available to take suggestions from the learners or adapt methods to accommodate contingencies? | | (5) |
| **6.Technology Policy Implementation:**<br>- Did the teacher demonstrate sufficient grasp of the LA? - Were the methods and content adapted to be suitable for the learner's age and grade? | | (20) |
| **7. Support in Technology:**<br>- Was the teacher's approach to the learners supportive and caring?<br>- Did the teacher motivate the learners?<br>- Was the learning barriers identified and how it was addressed?<br>- Was expanded of opportunities provided relevant and realistically applied? | | (5) |
| **8. Teacher's Presentation Reflection (Continue on the next page) :**<br>- Are assessment standards met or not,<br>- The learner's ability to complete the activities,<br>- How learners delivered proof of learning i.e. written, oral task, hands-on, etc.<br>.- Remediation required by needy learners to achieve the same assessment standards with the rest of the class, the strength (high points) and weaknesses (low points) of the lesson, and<br>- The general lesson presentation and suggest improvements in the next lesson? | | (20) |

Results (circle one):

N.B. National codes: 1. Leaner-educator not satisfied the requirement of LO= 0-39; 2. Has partially satisfied =40-49; 3.

Has satisfied =50-74; 4. Has exceed =75 and above.

**ENCIRCLE THE CORRECT ONE: 1; 2; 3; 4.**

Teacher's signature: ____________ Observer's name: __________

Signature:_________

Date: ______________________

____________________________ Date:____________________________

**PARTICIPANTS LESSON PRESENTATION PERSONAL REFLECTION QUESTIONS**

**(a) What can you do differently and why, if you have to present the same lesson next week?**

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**(b) How do you use to teach the same topic before AR Cycles?**

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**(c) What has changed in a way of approaching and presenting the same topic?**

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**(d) Mention the gaps that still has to be covered within the topic in question as well as Technology in general**

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# STUDY ANNEXTURES 1.1
# ADDITIONAL INFORMATION ABOUT THE STUDY

## 1.1.1 PHOTO PICTURE OF YOUR TECHNOLOGY EDUCATION ACTION RESEARCHER – TOMÉ AWSHAR, MAPOTSE

- **Contacts**

Email: mapotta@unisa.ac.za or tamapotse@gmail.com
Tel: +2712 429 4480 (B) or +27(0)799 7007(H)
Fax: +27(0)866 528 036 or +27(0)12 429 4922
Cell: SA 073 9244 750

- **Mini Profile**

Once a Technical Education Teacher; Departmental Head of Mathematics, Science and Technology Education; School Principal and now Technology Education lecturer.

Secondary Teachers Diploma (Technical); National Higher Diploma (Electrical Engineering); Bachelor of Technology (Technology Education); Masters of Technology (MTech.Ed). This is my Doctorate in Education (DEd: Curriculum Studies focuses on Technology Education).

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## 1.1.2 THE STUDY'S FIRST PUBLISHED PAPER CAN BE ACCESSED FROM:

| Full text | 0.33 MB | PDF (requires Acrobat Reader) |
|---|---|---|

**Authors:** Tomé Awshar Mapotse: Department of Science & Technology, College of Education. University of South Africa (Unisa), South Africa

Mishack Thiza Gumbo: Department of Science & Technology, College of Education. University of South Africa (Unisa), South Africa

**Publication Title:** Action Research study with Technology teachers in Limpopo Province of South Africa: an Emancipation recipe for Technology teachers

**Conference:** PATT 26 Conference, Technology Education in the 21st Century, Stockholm, Sweden, 26-30 June, 2012

**Publication type:** Abstract and Full text

**Issue:** 073

**Article No.:** 035

**Abstract:** The extent of South Africa's (SA) un- and under- qualified teachers amongst technology senior phase teachers has intensified and reinforced that action research (AR) be regarded as a tool for emancipation in the teaching of technology as is apparent from this study. The purpose of the paper is to report DEd inquiry findings from the action research activities that took place in selected schools of Limpopo Province. For technology education – a foreign concept to many teachers and a new learning area in the school curriculum both nationally and internationally – has found its way into the school environment successfully and effectively through engaging informants with the action research approach. In all the spiral activities of planning, observation, action and reflection during the AR cycle contact sessions with participants, the main goal was to address the following research question: *How can an action research intervention be used to improve the teaching practice of senior phase technology teachers who are under qualified?* The presenters argue that inadequate training of technology teachers impacts negatively on their teaching practice. The study did identify the gaps and an appropriate progressive intervention was embarked on.

The research was designed from both a critical theory perspective and a participatory paradigm. The following instruments were used as a means to gather data: observations, interviews, questionnaires, field notes, video recording of lesson plans and logs of meetings. The research findings reveal that most technology teachers were not trained or qualified to teach

technology with confidence and every chance of success until an intervention in the form of action research was introduced which has successfully change their situation.

**Language:** English

**Keywords:** Technology education, technology teachers, action research, reconnaissance study, curriculum transformation/reform, emancipation/empowerment

**Year:** 2012

**No. of pages:** 8

**Pages:** 301-308

**ISBN:** 978-91-7519-849-1

**Series:** **Linköping Electronic Conference Proceedings**

**ISSN (print):** 1650-3686

**ISSN (online):** 1650-3740

**File:** http://www.ep.liu.se/ecp/073/035/ecp12073035.pdf

**Available:** 2012-06-18

**Publisher:** Linköping University Electronic Press, Linköpings universitet

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**REFERENCE TO THIS PAGE**

Awshar Mapotse, Tomé; Mishack Thiza Gumbo (2012). Action Research study with Technology teachers in Limpopo Province of South Africa: an Emancipation recipe for Technology teachers, PATT 26 Conference, Technology Education in the 21st Century, Stockholm, Sweden, 26-30 June, 2012 **http://www.ep.liu.se/ecp_article/index.en.aspx?issue=073;article=035** (accessed 8/21/2012)

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## 1.1.3 THE STUDY HAS THE FOLLOWING POTENTIAL PROMISES:

**From:** McKay, Veronica
**Sent:** 16 September 2012 08:01
**To:** Nieman, Marietha; Gumbo, Mishack; Mapotse, Tome'
**Subject:** Re: Congratulations: Mr. (Dr) Mapotse and Dr Gumbo

Well done and congratulations to both of you and thank you Marietha for sharing the good news.

Regards Veronica
Unisa
College of Education
Deputy Executive Dean

On 14 Sep 2012, at 2:49 PM, "Nieman, Marietha" <Niemamm@unisa.ac.za> wrote:
Dear Colleagues

We are very proud of Mr. Mapotse who will be receiving his doctorate on 8 October!

One of the external examiners was so impressed with Mr. Mapotse's research, that he has invited him and his supervisor, Dr Gumbo, to do a presentation at a seminar organized by the *Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE)*!

Congratulations Mr. Mapotse and good luck with your presentation at the seminar.
Kind regards

Prof MM Nieman
Head: Office of Research and Graduate Studies
College of Education
AJH 6-18
Tel: 012 429-4587

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## 1.1.4 OFFICIAL INVITATION, PRESENTATION RECAP AND THANK YOU NOTE

### (a) INVITATION TO A TWO-DAY MST EDUCATION SEMINAR

SOUTHERN AFRICAN ASSOCIATION FOR RESEARCH IN MATHEMATICS, SCIENCE AND TECHNOLOGY EDUCATION

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

education and training
Lefapha la Thuto le Katiso
Departement van Onderwys en Opleiding
Department of Education and Training
NORTH WEST PROVINCE

Enquiries: Dr. J.A.T. Tholo
Tel: (+27)18-397 3015/3000
Fax: (+27) 862620534
Mobile No.: (+27) 795156296

Date: 21 September 2012

Mr. T.A. Mapotse and Dr M.T. Gumbo
University of South Africa
Pretoria
001

**Invitation to be a programme speaker for the Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE) North West Chapter seminar: 04-05 October 2012, North West University, Mafikeng**

The SAARMSTE North West seminar will be held at the North West University, Mafikeng Campus from October 4th to 5th, 2012. It is the first event of a series of events planned by the North West chapter executive committee. This event is planned in conjunction with North West University (Mafikeng Campus) and North West Department of Education and Training.

I have been requested by the organizing committee to write to you in my capacity as the secretary for SAARMSTE NW chapter to inquire if you could be a programme speaker at this seminar.

You will be required to present a topic on: "Action Research Enquiry into senior phase Technology teachers' practice in selected schools in Limpopo Province".

Please let me know at your earliest convenience if you would be able to accept our invitation. If you are willing to come, we would be grateful if you could send us your presentation on resolutions/recommendations by Friday, 28 September 2012.

Kind regards

Dr Thabo Tholo: Secretary
JTholo@nwpg.gov.za: (+27) 832074169

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**(b) PRESENTATION RECAP OF MST EDUCATION SEMINAR – Day 2: 05 October 2012**

**Day 1(04 October 2012) Extract and Recap by Ms MD Motsepe**

- **Opening Prayer and Devotion**

Mr Khutsoane opened the seminar with a prayer. He gave support to the objectives of the seminar which included: (i) Plans to develop and adopt strategies and approaches that could produce good results. (ii) Plans to explore and establish new partnerships for the benefit of the teaching and learning of Mathematics, Science, and Technology. (iii) Plans to ensure that the adopted plans are fully implemented. But the key message of caution was that planning devoid of God might not work. So plan and involve God in the implementation of these plans. Commit your plans to the Lord, Ask the LORD to bless your plans, and you will be successful in carrying them out (Proverbs 16:3).

- **Mr Mapotse and his supervisor presentation**

**Mr Mapotse** presented his Action Research findings that were confirmed by his Supervisor as conclusive after two years of research on teachers in the Limpopo Province. The findings indicated that the teachers were "emancipated" at the end of a two year multi-phased research design. Change occurred after "diagnoses" and "action" where the researcher had become an insider (welcomed) and the group members were co-researchers that later became a team. The study has been successfully conducted and he will soon graduate as Doctor. The study is accessible through the website. Dr Tholo commended the researcher on the work well done

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## (c) THANKS YOU NOTE FROM THE SENIOR MANAGER WITHIN NORTH WEST DEPARTMENT OF EDUCATION

**SAARMSTE seminar: Vote of thanks**
**By: Mr. M.S. Malindi, Senior Manager: Whole-School and Systemic Evaluation Services**
**At: North West University on 05 October2012**
Program director; Senior Managers from the Department of Education, SAARMSTE North West Chapter Executive committee and seminar Local Organizing Committee, seminar participants , social partners and stakeholders; ladies and gentlemen. I wish to say Happy Friday and thank you for bestowing this honour upon me to officially close this seminar and say thank you to all of you. Let me thank Messrs Malindi and Khutsoane for making money available to ensure that all participants have registered for this seminar. Without them there could have been no seminar. A big thank you goes to Mr. Chuenyane, Ms Lanna Quinn and Mr. Alexandre Hannie of the Communication Directorate in the North West Department of education for printing the programs for this auspicious occasion. Thank you and may the good Lord bless you.

I wish to thank my colleagues for helping in the registration desk. Thank you very much. Your commitment has not gone by unnoticed. Let me thank Mr. Khutsoane and Ms Keebine for opening this seminar with the word of God and Prayer. The scripture say Heaven and Earth will pass away but the word of God will never. We sow in tears and will reap with joy in the morning.

Let me also take this opportunity to heartily thank Prof Mashudu Davhana Maselesele for welcoming and introducing SAARMSTE guests and participants. Surely your question on how to increase the enrollment in the Faculty of Agriculture, Science and Technology has been answered.

Let me thank Mr. Mutsvangwa, the acting chairperson and now a newly elected SAARMSTE North West chapter chairperson for giving the background and purpose of this seminar.

Let me heartily thank Dr I.S. Molale, the Acting Education Head of Department for officially opening this seminar on behalf of the MEC for Education, Honourable Louisa Mabe Your interest in the development of Mathematics, Science and Technology Education is quite evident.

Let me take this opportunity once more to thank all program directors for the sterling work performed. (Dr Kwayisi; Mr. Ncoane; Mr. Mbizeni; Prof Drummond and Mr. Swaratlhe).

Ms Sophy Mangope you are heartily thanked for raising funds and introducing Prof Moses Makgato, our Key note speaker. A big thank you also goes to Prof Makgato for delivering the keynote address. You have brought dynamism to this seminar.

We also wish to thank the following presenters for enlightening us with the latest developments in MST Education: Prof Drummond; **Mr. (Dr) Mapotse**; Dr Gumbo; Mr. Ntsime; Ms Walaza; Mr. Baughan; Mr. Mazibuko; Prof Mamiala; Mr. Makgamathe and Dr Tholo. Let me take this opportunity to thank Ms Nomsa Mhlongo of Via Afrika on behalf of sponsors and PASA (Publishers Association of South Africa) for making a presentation. We know that time was not on our side but we believe that God will create another opportunity in the future for you to present again. Ms Motsepe your efforts are recognized and we thank you for reflecting on the previous day's activities.
Thank you for electing the new SAARMSTE executive committee which will I believe, organize the coming seminars on an annual basis.

I would like to finish by congratulating most warmly the organizers of this auspicious occasion. It is interesting to note that this is the first SAARMSTE seminar in our province. The number of participants should growth significantly on an annual basis. We should never be satisfied until every Mathematics, Science and Technology teacher in every school attends the SAARMSTE seminar as part of the 80 hour professional development.

Thank you and God bless you

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## STUDY ANNEXTURES 1.2
## ADDITIONAL INFORMATION ABOUT TECHNOLOGY

### 1.2.1 TECHNOLOGY SUBJECT GLOSARY: FROM NATIONAL CURRICULUM AND ASSESSMENT POLICY STATEMENT FOR TECHNOLOGY GRADES 7-9 (2011: 54 – 57)

**aesthetics** – characteristics of a product or system that make it look beautiful

**artifact** – a manufactured object

**anthropometrics** – measurements of people's shapes and sizes. Such measurements are usually taken when products are designed for human use (e.g. furniture, eating utensils, hairdryers, sporting equipment, cars, clothing).

**biases** – people's preconceived ideas or prejudices about some things or people before they actually meet ordeal with them (e.g. in areas like gender, race, ethics, religion, disability)

**biophysical environment** – the land, air and water around us; the space in which we find

**compression** – a squeezing force

**constraints** – aspects that limit conditions within which the work or solution must be developed (e.g. time, materials, tools, human resources, cost)

**control** – the means by which systems are regulated; an adjustment of the process which makes the actual result conform more closely to the desired result

**conventions** – ways of showing information on designs or working drawings that are understood and recognized to have specific meaning

**criteria** – statements of a particular standard or requirement that a solution must satisfy

**data** – facts and figures (e.g. population statistics, rainfall figures, temperature readings). Data may be processed into information.

**design (noun**) – the plan, sketch, model, drawing, etc., that outlines or shows the intention of the proposed solution

**design brief** – a short and clear statement that gives the general outline of the problem to be solved as well as the purpose of the proposed solutions

**design process** – a creative and interactive approach used to develop solutions to identified problems or human needs. This is one of the technological processes. Its associated skills are investigate, design (development of initial ideas), make, evaluate and communicate

**ergonomics** – features of a product or system that makes it user-friendly.

**findings** – things that have been discovered after a process of investigation or research

**forming** – changing a material's shape without cutting it

**information** – data that has been processed (e.g. recorded, classified, calculated, stored). Knowledge is gained when different kinds of information are compared and conclusions are drawn.

**input** – the command or information entered into a system

**isometric** – a three-dimensional drawing where the lines of sight are set at 30 degrees

**machine** – a device made up of a combination of simple mechanisms linked so as to form a system for the purpose of doing work

**materials** – physical substances used in technology (e.g. wood, textiles, fabric, plastic, food) mechanical advantage – a concept that describes how much easier mechanisms or machines can make a particular task

**mechanism** – parts that can turn one kind of force into another and give mechanical advantage. Mechanisms can be combined to form a machine. The basic mechanisms are the lever, wedge/screw, cams/cranks and pulleys/gears

**mode** – the way or manner in which a thing is done

**modeling** – the testing of a solution (product or system). This could include using small replicas (scale models) and intangible representations of the solution (e.g. mathematical models, computer models).

**need** – a necessity for basic function (e.g. food)

**oblique** – a three-dimensional drawing where the lines of sight are set at 45 degrees

**opportunity** – the chance to do something about a need or a want

**orthographic** – a type of two-dimensional drawing, usually showing three separate views of the same object (e.g. front, top, left)

**output** – the actual result obtained from a system

**perspective** – a three-dimensional drawing in which the lines of sight converge on the horizon

**product** – the physical or tangible artifact that results from a process (e.g. model, poster, chart)

**preserving** – a process that prolongs the natural life of a product

**problem** – something that leads to a need or want and that can give rise to an opportunity

**process** – the part of a system that combines resources to produce an output in response to input

**project portfolio** – a systematic and organized collection of a learner's work. It includes findings, successful and unsuccessful ideas, notes on the process that was followed in developing solutions, data, pictures, drawings, and so on.

**pulley** – a wheel with a groove on its circumference, is used to transmit movement and used with a belt recycle – reuse all or part of a substance

**recyclable** – a material that can be recycled

**safety** – the way that a person works with tools, materials and equipment that causes no physical harm

**shaping** – a process used to change the shape or contour of materials; involves the removal or addition of material

**specification** – an organized, detailed description of the requirements or criteria that the solution or product must meet (e.g. safety, size, material, function, human rights, environment)

**structure** – something that has been built, made or put together in a particular way

**system** – something that is made up of interlinked parts that function together as a whole to accomplish a goal (e.g. a 'mechanical system' has a combination of mechanisms that make it function as a whole; an 'electrical system' has interrelated electrical parts that work together to make the system do what it was designed to do)

**Technology** - the use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration.

**technological actions** - require the use of many types of resources including: People, Information/Knowledge, Materials, Tools (devices & systems), Energy, Capital, and Time.

**technological capability** – the ability to use a combination of skills, knowledge and resources in a variety of contexts to solve a technological problem. Technological capability leads to technological literacy.

**Technology Education** - is applying math, science, and technology; solving practical problems, using knowledge, tools and skills. It's action based, it's exploring careers, it's increasing ones potential and it's fun.

**technology's mission** - is to answer the "How" questions using the technological design and problem solving method to enhance the world; the mission of science is to answer the "Why" questions using the scientific method of inquiry.

**technological solution** – a plan that arises by using a systematic problem-solving process (e.g. ideas, flowcharts, models)

**technological literacy** – the ability to use, understand, manage, and assess technology

**technological processes** – creative human activities of developing technological solutions in order to satisfy human needs and wants (e.g. manufacturing, design, repair, restoration). The processes followed are: Investigate; Design; Make; Evaluate and Communicate.

**tension** – a force that stretches an object or material; a pulling force

**want** – something that people would like but do not actually need (a convenience)

==========================================================================================

## 1.2.2 EXPLANATION OF THE *DESIGN PROCESS* FROM NATIONAL CURRICULUM AND ASSESSMENT POLICY STATEMENT FOR TECHNOLOGY GRADES 7-9 (2011: 54 & 55)

It is a creative and interactive approach used to develop solutions to identified problems or human needs. This is one of the technological processes. Its associated skills are investigation, design (development of initial ideas), make, evaluation and communication (acronym IDMEC). The Design Process can be explained as follows:

- **Investigate**

Investigating a situation to gain information is an important starting point for Technology. Research or finding of information mainly takes place here. Learners gather data and information, grasp concepts and gain insight, find out about new techniques, etc. Some skills needed for investigating are information accessing and processing skills, recording, identifying, predicting, comparing, observing, classifying, interpreting, collating, etc.

- **Design** (verb)

Once a problem is fully understood, the design brief needs to be written. Possible solutions should then be generated. These ideas may be drawn on paper. The first idea may not necessarily be the best; so several different solutions are desirable. This part of the design process requires awareness and the knowledge and skills associated with graphics, such as the use of colour, rendering techniques, 2D and 3D drawings, etc. These in essence include abilities in planning, sketching, drawing, calculating, modelling, and managing resources. Once possible solutions are available, a decision must be made. The chosen solution will be the one that best satisfies the specifications. It is expected that learners justify choices made. At this point final drawings/sketches (working drawings) of the chosen solution should be prepared. They should contain all the details needed for making the product or system. These include instructions, dimensions, annotated notes, etc. Testing, simulating or modelling the solutions before final manufacture is done here. **2D – two-dimensional** – a flat drawing, in which only two principle dimensions (measurements) are visible (e.g. length and height,). **3D- three-dimensional** – a pictorial drawing. A drawing in which the three principle dimensions are visible, also the three principle faces are visible in the one drawing.

- **Make (verb)**

This aspect provides opportunities for learners to use tools, equipment and materials to develop a solution to the identified problem, need or opportunity. It involves building, testing and modifying the product or system to satisfy the specifications of the solution (design specification). Learners will cut, join, shape, finish, form, combine, assemble, measure, mark, separate, mix, etc. should be according to the design although modifications are also desirable. Making must always be undertaken in a safe and healthy atmosphere and manner.

- **Evaluate**

Learners need to evaluate their actions, decisions and results through the technological processes. Learners need to evaluate the solutions and the process followed to arrive at the solutions. They should be able to suggest changes or improvements where necessary. Some evaluation should be done against criteria (e.g. constraints) that may be given or self-generated. This stage requires the use of probing questions, fair test, analysis, etc.

- **Communicate**

In this aspect the assessment evidence of the processes follow any given project, i.e. the ability to analyse, investigate, plan, design, draw, evaluate and communicate. This could be done in various modes like oral, written, graphic or electronic presentation. A record of the processes from conception to realization of the solution (i.e. investigating to communicating solutions) should be kept in the form of a project portfolio.