

STRENGTHENING THE TEACHING OF MINI-PRACTICAL ASSESSMENT TASK
IN A SENIOR PHASE TECHNOLOGY CLASS

by

PRETTY KUBHEKA

STD (Technical) (Indumiso College of Education); B-Tech (TUT); BEd Hons (UP)

A dissertation submitted in partial fulfilment of the requirements for the degree

MAGISTER EDUCATIONIS

(Curriculum Studies)

in the

SCHOOL OF EDUCATION STUDIES

FACULTY OF EDUCATION

CURRICULUM STUDIES

at the

UNIVERSITY OF THE FREE STATE

BLOEMFONTEIN

Supervisor: Prof M.M. Nkoane

Co-supervisor: Prof M.G. Mahlomaholo

DECLARATION

I, Pretty Kubheka, declare that the dissertation, "Strengthen the teaching of mini-practical assessment task in a senior phase technology class", handed in for the degree Magister Educationis at the University of the Free State is my own independent work and has not been previously submitted by me at another university.

I also declare that I have not used the work of other scholars without proper citation and that all the sources used or quoted have been indicated and acknowledged by means of complete references.

PRETTY KUBHEKA

Signed.....

Date.....

ACKNOWLEDGEMENTS

My sincere gratitude to the following:

- The almighty God for granting me strength, determination and courage to embark on this productive academic journey. I truly concur that “nothing is impossible with God”.
- I express my heartfelt gratitude to my supervisor, Prof M.M. Nkoane, and my co-supervisor, Prof S.G. Mahlomaholo, for their support throughout this journey. They have been a source of encouragement. Thank you so much for having faith in me.
- My wonderful husband, Vusi Kubheka. Thank you, Khathide, for your support and understanding. Ngyabonga Masobode Swazi.
- My children, for their support and understanding when I had no time to spend with them.
- A special thank you to my friend and colleague Nonhlanhla Shozi, for always being an inspiration, even during trying times. Your contribution in this journey has not gone unnoticed, Mnganga.
- To my study mate and colleague Sbongile Tlou, thank you, my sister, for your contribution throughout this period.
- To all my study mates in Newcastle, thank you very much for your advice and the strategies we shared during our writing sessions.
- My co-researchers, thank you for your dedication and commitment. May the almighty God bless you. I wouldn't have done it without you. You really demonstrated passion for technology and the teaching profession.
- To my colleagues at Amajuba District TLS-GET, Siphon Vilakazi, Siphon Manyoni, Mpume Mlotshwa, Zinhle Khanyile, Sbo Sibisi and Zodwa Msezane, thank you for your support and making me believe that I can do this.
- SuLE/SuRLEC family. Thank you for your encouragement, constructive criticism, sharing and positive inputs.
- To my colleague and friend Gail Stroebel. Thank you, my friend, for assisting with proofreading and editing my work.

DEDICATION

I dedicate this study to my children for their support during the period of my study. I wish they could see the value of education through my dedication to education and follow suit.

To my husband, Vusi Kubheka, this is your degree too. If it weren't for your encouragement and support when I felt depressed, I wouldn't have gone this far.

To my late parents, Theresa Thokozile Mncwabe (maMkhize) and Samuel Mfana Mncwabe, thank you for instilling discipline in me and constantly reminding me that education is the key to every door.

ABSTRACT

The study aims at strengthening the teaching of the mini-Practical Assessment Task in a senior phase technology class. The challenge that teachers confront, is the learners' failure to execute this task. This task aims to develop the learners' skills and creative thinking. The theoretical framework that informs this research is constructionism. This theoretical framework has been adopted because it is a theory that examines the development of a jointly constructed understanding of the world, which forms the basis of shared assumptions about reality. This study embraces participatory action research as a research approach. Participatory action research is a philosophical approach to research that recognises the need for persons being studied to participate in the design. Participatory action research practitioners integrate three basic aspects of their work, namely participation, action and research.

Teachers need content knowledge to be able to understand the possible challenges that their learners may encounter in a specific topic. The mini-Practical Assessment Task requires critical and creative thinking, as well as decision-making and problem-solving skills. Team teaching between schools should be encouraged to enable learners to receive proper technology content knowledge reports. This study envisages having a successful implementation of the strategy that might assist in improving the practical skills of teachers and learners through the appropriate usage of the mini-Practical Assessment Task.

Meetings and discussions with co-researchers have been used for data generation. The generated data have been analysed through a means that would enable the researcher and co-researchers to have a deeper understanding of the phenomenon by interpreting the generated data and reflecting on their interpretations. Critical discourse analysis has been adopted to analyse the data. Critical discourse analysis acknowledges the need to examine, in practical terms, how one goes about doing critical analysis of text and talk. A team of eight technology teachers, one from each circuit of the Amajuba District in the KwaZulu-Natal Province, plus fellow technology subject advisors have worked together as equals in devising ways to strengthen the teaching of the mini-Practical Assessment Task in a technology class.

Keywords: *Strengthening teaching, mini-Practical Assessment Task, technology.*

OPSOMMING

Die studie het die bevordering van die onderrig van die mini-Praktiese Assesseringstaak in 'n senior fase-tegnologieklas ten doel. Onderwysers word gekonfronteer deur die uitdaging van leerders se onvermoë om hierdie taak uit te voer. Die doel van hierdie taak is om leerders se vaardighede en kreatiewe denke te ontwikkel. Konstruksionisme is as die teoretiese raamwerk van hierdie studie aangeneem aangesien die teorie die ontwikkeling van gesamentlike gekonstrueerde begrip van die wêreld, wat die grondslag van gedeelde aannames oor die werklikheid vorm, ondersoek. Hierdie studie gebruik deelnemende aksienavorsing as 'n navorsingsbenadering. Deelnemende aksienavorsing is 'n filosofiese benadering tot navorsing wat die behoefte van persone wat bestudeer word om deel te neem in die ontwerp, erken. Deelnemende aksienavorsingpraktisyns integreer drie basiese aspekte van hul werk, naamlik deelname, aksie en navorsing.

Onderwysers benodig inhoudskennis om die moontlike uitdagings wat hul leerders in 'n spesifieke onderwerp mag teëkom, te verstaan. Die mini-Praktiese Assesseringstaak vereis kritiese en kreatiewe denke, sowel as besluitneming- en probleemoplossingsvaardighede. Spanonderrig tussen skole moet aangemoedig word sodat leerders 'n behoorlike weergawe van tegnologie-inhoudskennis kan ontvang. Hierdie studie beoog die suksesvolle implementering van 'n strategie wat kan help met die verbetering van praktiese vaardighede van onderwysers en leerders deur die toepaslike gebruik van die mini-Praktiese Assesseringstaak.

Vergaderings en besprekings met medenavorsers sal gebruik word vir data-insameling. Die gegenereerde data sal ontleed word deur middel van 'n metode wat die navorser en medenavorsers in staat sal stel om 'n dieper begrip te hê van die fenomeen deur die gegenereerde data te interpreteer en daaroor te reflekteer. Kritiese diskoersanalise is gebruik om die data te ontleed. Kritiese diskoersanalise erken die behoefte om prakties te ondersoek wat dit sou behels om teks en diskoers krities te ontleed. 'n Span van agt tegnologie-onderwysers, een uit elke kring van die Amajuba-distrik in die provinsie van KwaZulu-Natal, tesame met tegnologie-vakadviseurs sal as gelykes saamwerk om vorendag te kom met maniere om die onderrig van die mini-Praktiese Assesseringstaak in 'n tegnologie-klas te verbeter.

Sleutelwoorde: *Bevordering van onderrig, mini-Praktiese Assesseringstaak, tegnologie.*

LIST OF FIGURES AND TABLES

Figure 3.1: Self-reflective cycles	71
Table 3.1: Plan of action	82

LIST OF ABBREVIATIONS AND ACRONYMS

ACE	Advanced Certificate in Education
AR	Action Research
ATP	Annual Teaching Plan
CAPS	Curriculum and Assessment Policy Statement
CDA	Critical Discourse Analysis
CM	Circuit Management
DBE	Department of Basic Education
DoE	Department of Education
FET	Further Education and Training
GET	General Education and Training
IDMEC	Investigate, Design, Make, Evaluate and Communicate
HoD	Head of Department
HRM	Human Resource Management
ICT	Information and Communication Technology
LTSM	Learning and Teaching Support Material
Mini-PAT	Mini-Practical Assessment Task
MST	Mathematics, Science and Technology
NCS	National Curriculum Statement
NPDE	National Professional Diploma in Education
PAR	Participatory Action Research
PCK	Pedagogical Content Knowledge
RNCS	Revised National Curriculum Statement
SMT	School Management Team
TP	Transformative Paradigm

TABLE OF CONTENTS

CHAPTER 1: STRENGTHENING THE TEACHING OF THE MINI-PRACTICAL ASSESSMENT TASK IN A SENIOR PHASE TECHNOLOGY CLASS	1
1.1 INTRODUCTION.....	1
1.2 BACKGROUND TO THE STUDY.....	1
1.3 THE CHALLENGES OF TEACHING THE MINI-PAT.....	2
1.4 PROPOSED SOLUTIONS TO THE CHALLENGES OF TEACHING THE MINI-PAT.....	2
1.5 CONDITIONS NECESSARY FOR STRENGTHENING THE TEACHING OF THE MINI-PAT.....	3
1.6 ANTICIPATED THREATS TO TEACHING THE MINI-PAT.....	3
1.7 ANTICIPATED SUCCESS FOR IMPLEMENTATION OF THE STRATEGY.....	4
1.8 STATEMENT OF THE PROBLEM.....	5
1.8.1 Research question.....	5
1.8.2 Research aim and objectives.....	5
1.8.3 Objectives of the study.....	5
1.9 THEORETICAL FRAMEWORK.....	6
1.10 RESEARCH DESIGN AND METHODOLOGY.....	7
1.11 SELECTION OF CO-RESEARCHERS.....	8
1.12 DATA ANALYSIS.....	8
1.13 VALUE OF THE RESEARCH.....	9
1.14 ETHICAL CONSIDERATIONS.....	9
1.15 LAYOUT OF CHAPTERS.....	10
CHAPTER 2: THEORETICAL FRAMEWORK AND LITERATURE REVIEW	12
2.1 INTRODUCTION.....	12
2.2 THEORETICAL FRAMEWORK – CONSTRUCTIONISM.....	12
2.2.1 Definition of constructionism.....	12
2.2.2 Origin of the constructionism theory.....	14
2.2.3 Claims of constructionism.....	15
2.3 JUSTIFICATION FOR THE CHOICE OF CONSTRUCTIONISM IN THIS STUDY.....	16
2.4 PRINCIPLES OF THE CONSTRUCTIONISM THEORY.....	17
2.4.1 Promotion of collaborative learning.....	17
2.4.2 Hands-on learning.....	18

2.4.3	Sharing of knowledge	19
2.5	POSITION OF THE RESEARCHER AND THE CO-RESEARCHERS	19
2.6	EPISTEMOLOGY AND CONSTRUCTIONISM.....	21
2.7	ONTOLOGY OF CONSTRUCTIONISM.....	22
2.8	TRANSFORMATIVE PARADIGM AND CONSTRUCTIONISM	23
2.9	REFLECTION ON THE USE OF CONSTRUCTIONISM	24
2.9.1	Strengths of constructionism	24
2.9.2	Challenges of constructionism.....	25
2.10	DEFINITION OF OPERATIONAL CONCEPTS	25
2.10.1	Technology.....	26
2.10.2	Assessment.....	27
2.10.3	Mini-PAT	28
2.11	REVIEW OF RELATED LITERATURE ON TEACHING THE MINI-PAT.....	29
2.11.1	Justifying the need to strengthen the teaching of the mini-PAT	29
2.11.2	Challenges in the teaching of the mini-PAT	31
2.11.2.1	Pedagogical content knowledge	32
2.11.2.2	Educational resources in the teaching of the mini-PAT.....	34
2.11.2.3	Learner-teacher ratio.....	36
2.11.2.4	Professional development.....	37
2.11.3	Possible solutions.....	39
2.11.3.1	Pedagogical content knowledge	39
2.11.3.2	Educational resources.....	40
2.11.3.3	Learner-teacher ratio.....	42
2.11.3.4	Professional development.....	43
2.11.4	Conditions conducive to strengthening the teaching of the mini-PAT.....	44
2.11.4.1	Conditions that enhance teamwork.....	44
2.11.4.2	Good communication skills and positive attitude.....	45
2.11.4.3	Availability of educational resources	45
2.11.5	Threats that could hinder the success of the strategy	46
2.11.5.1	Nominal collaboration can be a threat to others	46
2.11.5.2	Absence of educational resources	47
2.11.5.3	Pedagogical approaches.....	47
2.11.5.4	Unavailability of time and financial constraints.....	49
2.11.6	Indicators of success.....	50
2.11.6.1	Improved pedagogical content knowledge	50

2.11.6.2	Collaboration between all stakeholders.....	51
2.11.6.3	More learners pursuing technical subjects in the FET phase.....	51
2.11.6.4	More focus given to learning and teaching support material	52
2.11.6.5	Improved learner performance and content coverage.....	53
2.11.7	Summary of the chapter	54
CHAPTER 3:	RESEARCH DESIGN AND METHODOLOGY	56
3.1	INTRODUCTION	56
3.2	INTERROGATING RESEARCH DESIGN AND METHODOLOGY	56
3.2.1	Participatory action research	57
3.2.2	Origin of participatory action research	58
3.2.3	Objectives of participatory action research	60
3.2.3.1	Empowerment.....	60
3.2.3.2	Democratisation	60
3.2.3.3	Equity	61
3.2.3.4	Liberation	61
3.2.4	Features of participatory action research.....	62
3.2.4.1	Participatory action research as a social process	62
3.2.4.2	Participatory action research is participatory.....	63
3.2.4.3	Participatory action research is practical and collaborative.....	63
3.2.4.4	Participatory action research as emancipatory	64
3.2.4.5	The critical nature of PAR	65
3.2.4.6	PAR is reflective.....	65
3.3	FORMATS OF PARTICIPATORY ACTION RESEARCH	66
3.3.1	Giving a voice to others	66
3.3.2	Learning from one another	66
3.3.3	Empowerment	67
3.3.4	Social change.....	68
3.4	STAGES IN PARTICIPATORY ACTION RESEARCH.....	68
3.5	STEPS IN PARTICIPATORY ACTION RESEARCH	70
3.5.1	Initial planning stage	71
3.5.2	Implementation stage participatory action research	73
3.5.4	Reflection stage of participatory action research.....	73
3.6	EPISTEMOLOGY OF PARTICIPATORY ACTION RESEARCH	73
3.7	ONTOLOGY OF PARTICIPATORY ACTION RESEARCH.....	75
3.8	THE ROLE OF THE RESEARCHER	76
3.9	ETHICAL CONSIDERATIONS.....	76

3.10	DESCRIPTION OF THE RESEARCH SITE.....	78
3.11	SELECTION OF CO-RESEARCHERS.....	78
3.11.1	Credentials of the team	79
3.11.1.1	The researcher.....	79
3.11.1.2	Teachers as co-researchers	79
3.11.1.3	Subject advisors.....	81
3.12	SPIRAL OF PARTICIPATORY ACTION RESEARCH	81
3.12.1	The plan of action.....	82
3.13.1	Critical discourse analysis	85
3.13.2	Definition of critical discourse analysis	85
3.13.3	Levels of analysis	87
3.13.3.1	Analysis at textual level.....	87
3.13.3.2	Discursive level of analysis	87
3.13.3.3	Discourse as a social practice.....	88
3.13.4	Origin of critical discourse analysis	89
3.14	SUMMARY OF THE CHAPTER	89

CHAPTER 4: PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA.....	91
4.1 INTRODUCTION	91
4.2 CHALLENGES TO THE TEACHING OF THE MINI-PAT IN A TECHNOLOGY CLASS.....	91
4.2.1 Pedagogical content knowledge	91
4.2.2 Educational resources	94
4.2.3 Learner-teacher ratio	96
4.2.4 Professional development	99
4.3 SOLUTIONS FOR SUCCESSFUL TEACHING OF THE MINI-PAT IN A TECHNOLOGY CLASS.....	101
4.3.1 Pedagogical content knowledge	101
4.3.2 Educational resources in the teaching of the mini-PAT	103
4.3.3 Learner-teacher ratio	105
4.3.4 Solution to professional development.....	107
4.4 CONDITIONS CONDUCIVE TO SUCCESSFUL IMPLEMENTATION OF THE STRATEGY TO STRENGTHEN THE TEACHING OF THE MINI-PAT.....	109
4.4.1 Enhancing teamwork	109
4.4.2 Good communication skills	111
4.4.3 Availability of educational resources.....	112

4.5	THREATS THAT COULD HINDER THE SUCCESS OF THE STRATEGY TO STRENGTHEN THE TEACHING OF THE MINI-PAT	113
4.5.1	Nominal collaboration	113
4.5.2	Absence of educational resources.....	115
4.5.3	Pedagogic approaches	116
4.5.4	Time and financial constraints	117
4.6	INDICATORS OF SUCCESS IN STRENGTHENING THE TEACHING OF THE MINI-PAT	119
4.6.1	Improved pedagogical content knowledge.....	119
4.6.2	Teacher collaboration	120
4.6.3	Educational resources	120
4.6.4	Improved learner performance	120
4.7	SUMMARY OF THE CHAPTER	121

CHAPTER 5: SYNTHESIS OF FINDINGS, RECOMMENDATIONS, DISCUSSIONS AND THE CONCLUSION TOWARDS STRENGTHENING THE TEACHING OF THE MINI-PAT IN A SENIOR PHASE TECHNOLOGY CLASS 122

5.1	INTRODUCTION	122
5.2	BACKGROUND OF THE STUDY	122
5.2.1	Problem statement	122
5.2.2	Research question.....	123
5.2.3	Research aim	123
5.2.4	The objectives that informed the study	123
5.3	FINDINGS AND RECOMMENDATIONS	123
5.3.1	Findings on educational resources	124
5.3.1.1	Recommended components of lack of educational resources	124
5.3.1.2	Threats in educational resources	125
5.3.1.3	Recommended conditions for educational resources.....	125
5.3.2	Findings on pedagogical content knowledge	126
5.3.2.1	Recommended components of pedagogical content knowledge	126
5.3.2.2	Threats in pedagogical content knowledge	127
5.3.2.3	Conditions conducive to teamwork.....	127
5.3.3	Findings on learner-teacher ratio.....	128
5.3.3.1	Recommended components of learner-teacher ratio	128
5.3.3.2	Threats in learner-teacher ratio	129
5.3.3.3	Conditions conducive to learner-teacher ratio.....	129

5.3.4	Findings on teacher development.....	129
5.3.4.1	Recommended solution to teacher development	130
5.3.4.2	Threats to teacher development	130
5.3.4.3	Conditions conducive to teacher development.....	131
5.4	CONCLUSION AND SUMMARY	131
BIBLIOGRAPHY		135
APPENDICES		164

CHAPTER 1

STRENGTHENING THE TEACHING OF THE MINI-PRACTICAL ASSESSMENT TASK IN A SENIOR PHASE TECHNOLOGY CLASS

1.1 INTRODUCTION

This study aimed to strengthen the execution of the mini-Practical Assessment Task (mini-PAT) in a senior phase technology class. The concept “mini-PAT” is defined by the Department of Education (DoE) in the curriculum assessment policy statement (Curriculum and Assessment Policy Statement [CAPS], 2011a:41) as a formal assessment task, which is made up of a collection of small practical activities. It assesses learners’ ability to apply knowledge during each term. A mini-PAT may be an assignment covering facets of the technological process (i.e. investigation, design, make, evaluate and communication). It comprises an assortment of forms of assessment suitable for the mini-PAT.

The word “technology” is frequently used, but not well understood. This causes uncertainty in terms of what it means. The majority of people associate it with technological devices, such as computers (Laufenberg, 2009:1). Technology is defined by the Department of Basic Education (DBE) as the use of skills, knowledge and resources to rally people’s desires and wishes by constructing practical solutions to problems considering social and environmental factors (DBE, 2011a:6; DoE RNCS, 2002:4). The Ohio Department of Education (2007:7) defines technology as a study of technology that presents an opportunity for students or learners to learn about the processes and knowledge interrelated to technology that are needed to decipher problems and extend human capabilities.

1.2 BACKGROUND TO THE STUDY

As a technology senior education specialist, I conduct on-site visits to all schools in the Amajuba District with the intention of monitoring and rendering support to the

technology teachers. I frequently discover that the teachers seem to experience challenges in terms of the execution of the mini-PAT. Consequently, this study sought to strengthen the teaching of the mini-PAT in the senior phase technology classroom.

1.3 THE CHALLENGES OF TEACHING THE MINI-PAT

The implementation of the mini-PAT in schools has been approached prematurely for most of the teachers as they have not been well acquainted with the necessities or fundamentals of technology as a subject. Numerous challenges may influence the teaching of the mini-PAT. The challenges that seem to hinder the teaching of the mini-PAT include inadequate pedagogical content knowledge (PCK), a lack of educational resources, inadequate training of teachers and the high learner-teacher ratio (De Jager, 2011:148). This is confirmed by Kansanen (2009:6), who declares that the mastering of content is the basis of effective teaching. Mapotse and Gumbo (2012:139) stress that the number of learners attached to one teacher obstructs the practical character of technology as classes are congested. Omorogbe (2013:181) further explains that access to educational resources is problematic in Nigerian schools.

1.4 PROPOSED SOLUTIONS TO THE CHALLENGES OF TEACHING THE MINI-PAT

As a solution to the above challenges Ziyambi (2009:77) reports that team teaching between schools has been established as a resolution in the improvement of PCK and that it should be encouraged to enable learners to receive relevant and proper technology content knowledge. Team teaching includes clustering teachers to plan together and assist one another in terms of the subject content and effective methodology to teach that particular subject. The DBE (2011a:14-21) introduced a detailed annual teaching plan (ATP), and publishers have been tasked to develop textbooks which are CAPS-compliant and strictly aligned to the ATP. This was to address the issue of textbooks that had been found to be incongruent with the policy document (Mapotse, 2012:09). Furthermore, the ATP was trying to solve the issue of the shortage of educational resources. Working in small groups, changing the

classroom desk arrangement and establishing simple rules proved to be effective when dealing with large classes. Observing notional time was another important aspect in the teaching of the mini-PAT to avoid incomplete tasks. According to the abovementioned sources it was evident that appropriate knowledge, skills and attitudes of teachers result in effective teaching of the mini-PAT.

1.5 CONDITIONS NECESSARY FOR STRENGTHENING THE TEACHING OF THE MINI-PAT

The conditions for successful teaching of the mini-PAT include the availability of educational resources and collaboratively working with others (teamwork). This has been confirmed by Hong, Yu and Chan (2008:286), who state that working collaboratively is the best method for solving problems. Full participation (commitment) from both the teachers and facilitators, where everyone is allowed to contribute towards a common goal, is another condition that would assist in strengthening the teaching of the mini-PAT.

It has also been claimed that technology teachers should possess good communication skills and a genuine interest in learners' learning through the use of real-life problems (Coffin, 2013:204). For instance, when the learners have to design and make a bridge, the teacher has to use real-life problems that are relevant to the learners' environment. The scenario depends on the place where the school is located, such as whether the school is situated in a rural area, where the design brief could be to design and make a bridge that would assist in alleviating the problem of learners being swept away by the river when it has rained. However, in a township school or an ex-Model C school, the scenario could relate to learners being involved in road accidents due to the high volume of cars travelling at different speeds; hence the design brief could be to design and make a pedestrian bridge.

1.6 ANTICIPATED THREATS TO TEACHING THE MINI-PAT

Imminent threats that could impede the accomplishment of strengthening the teaching of the mini-PAT, include, among other things, inadequate educational resources and changing from traditional to learner-centred approaches. Another

aspect that may threaten the teaching of the mini-PAT is the availability of time. When devising plans to strengthen the teaching of the mini-PAT, time was of the essence for the workshops to be conducted. The workshops took the form of a “hands-on” approach, which is usually time-consuming, and as time is a resource most teachers do not have, the unavailability of enough time poses a threat to the implementation of the strategy. This has been confirmed by the KwaZulu-Natal DoE, which gives a directive that no teacher should leave class for workshops during teaching time (Human Resource Management [HRM] 9 of 20). As a result, workshops commence at 13:00. However, from my experience as a facilitator, teachers usually have commitments after school hours. To circumvent these limitations, Mahlomaholo (2013:80) suggests that an advocacy programme should be put in place to cultivate a buy-in from all stakeholders, which, by implication, may influence the prioritisation of resources. On the other hand, in terms of educational resources, the DBE Mathematics, Science and Technology (MST) sub-directorate, sponsored as a continuing initiative by the Sasol Inzalo Foundation in a joint venture with the Ukuqonda Institute, has successfully developed Grades 7 to 9 technology workbooks (learners’ books and teachers’ guides). The MST sub-directorate has also distributed toolkits in all districts in KwaZulu-Natal. These tools include consumables and non-consumables.

1.7 ANTICIPATED SUCCESS FOR IMPLEMENTATION OF THE STRATEGY

The success of teaching the mini-PAT could be evaluated through the improved practical skills of learners because these skills enable learners to engage effectively with the technological process. Improvement in learner performance in the mini-PAT and technology, as a subject, would also prevail. Karaman (2012:59) declares that teachers require content knowledge to be able to comprehend the possible barriers their learners may encounter in a specific focus; hence the teachers’ content knowledge would also be improved. Van Rensburg (2008:49) indicates that the mini-PAT requires crucial and innovative thinking, problem-solving strategies and decision-making skills. Learners and teachers who possess all the above-mentioned skills will serve as evidence of the success of the plan to strengthen the teaching of the mini-PAT.

1.8 STATEMENT OF THE PROBLEM

The problem was that there seemed to be a challenge in the execution of the mini-PAT at some schools in the Amajuba District. Some teachers endeavour to do the mini-PAT, but often many gaps are discovered. The mini-PAT contributes 70% towards the learners' technology term mark. Additionally, South Africa seems to encounter a scarcity in terms of the number of its engineers, technicians and artisans, who are essential in the present society. The mini-PAT could assist in exposing learners to multiple career choices in the engineering field at tertiary level because it develops the learners' skills in different trades. This challenge does not only occur in the Amajuba District but is also evident in other districts and provinces, as well as in other countries. The reason that has been advanced for the challenge of executing the practical part of the technology mini-PAT is that technology is a comparatively new subject, internationally and nationally (Khumalo, 2004:15; Mapotse, 2012:4; Rauscher, 2010:219-305; Ziyambi, 2009:1). The CAPS document (DBE, 2011a:8) also attests to the shortage of engineers, artisans and technicians in South Africa.

1.8.1 Research question

The main research question central to this study was: **How can the teaching of the mini-PAT be strengthened in a senior phase technology class?**

1.8.2 Research aim and objectives

The aim of the study was to strengthen the teaching of the mini-PAT in a senior phase technology class.

1.8.3 Objectives of the study

The objectives that informed this study are as follows:

- To identify and justify the need to strengthen the teaching of the mini-PAT in a senior phase technology class.

- To identify the components for strengthening the teaching of the mini-PAT in a senior phase technology class.
- To determine the conditions conducive to strengthening the teaching of the mini-PAT in a senior phase technology class.
- To identify and circumvent the threats to strengthening the teaching of the mini-PAT in a senior phase technology class.
- To find and test best practices to strengthen the mini-PAT in a senior phase technology class.

1.9 THEORETICAL FRAMEWORK

Constructionism was used as a theoretical framework in strengthening the teaching of the mini-PAT in technology classes. Constructionism emphasises that everything is comprehended by being constructed. Constructionism scrutinises the development of cooperatively constructed understandings of the world, given that it is a theory of knowledge in sociology as well as a communication theory. It delineates the derivations of a shared hypothesis on truth. The focal point of the theory is the belief that people rationalise their knowledge by creating models of the social world and share and reify these models through language. The main focus of constructionism is on unearthing the strategies that have been utilised by groups and individuals in the making of social reality.

It has been a quarter of a century since the idea of constructionism has been initiated by Papert and Harel (1991:1) – the “n-word” rather than the “v-word” (Papert & Harel, 1991:1). Constructionism is based on four characteristics. The first is modelling, which promotes the learning of great ideas through practically engaging on them, in contradiction to the conservative method of much teaching. The second is accessibility, where learners develop an awareness of the existence of models and how they shape actions. Layering is the third characteristic of constructionism, through which learners can decide how deep they should dig into the why of the problem. The last characteristic is collaboration, which confirms that effective learning is promoted through long-term engagement in collaborative projects.

The principles of constructionism are as follows:

- Learning transpires by creating relevant projects and sharing them among one another.
- Objects are used to support real thinking about abstract phenomena.
- Best ideas crop up from a variety of areas of knowledge.
- Reflecting on practices and discussions with others are of vital importance.

This framework has been adopted because it speaks to the issue of collaborative learning, learner-centeredness and modelling. In executing the mini-PAT, the learners are expected to design and make artefacts depending on the area of knowledge being taught during a particular term. Therefore, constructionism was the appropriate lens through which to view this study.

1.10 RESEARCH DESIGN AND METHODOLOGY

The study adopted participatory action research (PAR) as a research approach to strengthen the teaching of the mini-PAT in technology. According to Chevalier and Buckles (2013:10), PAR practitioners amalgamate three basic facets of their work, namely participation (life in society and democracy), action (engagement with experience and history) and research (soundness in thought and the growth of knowledge). Developing trusting relationships with salient stakeholders is the major facet of the research process needing mediation and reciprocity.

1.10 DATA COLLECTION

The research team engaged in a cyclical rather than a linear process of planning, acting, observing and evaluating, as the study is devoted to ensuring that both the researcher and the co-researchers remain partners throughout the research process and that the co-researchers are genuinely involved (Khan & Chovanec 2010:35; McDonald, 2012:37). Meetings and conversations with co-researchers were used for data generation (Gills & Jackson, 2002; Greenwood & Levin, 1998; McNiff & Whitehead, 2006; Stringer, 1999; Stringer & Genat, 2004). The role of the co-researchers was to engage in the discussions with the researcher around the issue

of strengthening the teaching of the mini-PAT. Minutes of meetings, video recordings and voice recordings were used as instruments for gathering data. During our initial gathering, issues of ethics were discussed. The co-researchers were furnished with consent forms. I clarified that there was no remuneration involved and should any co-researcher aspire to withdraw his or her participation from the study, he or she was at liberty to do so. The ultimate objective of this study was the thorough transformation of social reality and the betterment of the lives of technology teachers.

1.11 SELECTION OF CO-RESEARCHERS

The participants in this study understood that as co-researchers they had been randomly selected on the basis of their availability and expertise. A team of eight technology teachers, one from each circuit in the Amajuba District in KwaZulu-Natal, plus fellow technology subject advisors worked together as equals in strengthening the teaching of the mini-PAT in a technology class.

1.12 DATA ANALYSIS

The generated data were analysed in a manner that was meant to enable the co-researchers and me to have a profound understanding of the phenomena under study by explaining the generated data running over their interpretations. Critical discourse analysis (CDA) was adopted to analyse the data. CDA recognises the necessity to scrutinise how a critical analysis of text and talk is done (Van Dijk, 2011:89). CDA provides a higher consciousness of the hidden motivation in others and ourselves and, hence, enables us to resolve real problems, not by providing unambiguous answers, but by making us ask ontological and epistemological questions (Van Dijk, 2012:20). Data can be analysed through textual analyses, discursive practice and various sociological parameters. Textual analysis refers to the approaches to discourse that focus on understanding how text is structured beyond the level of the sentence. Fairclough (2012:210) proposes a number of tools for text analysis. These tools include interactional control, metaphors, ethos, wording and grammar. The central point of the analysis of discourse practice is on how the text is generated and how it is consumed; for example, the inter textual chain of text,

where the same text can be seen in a range of different versions. Much work in CDA deals with discursively endorsed or justifiable strategies of authority and resistance in social relationships of ethnicity, class, race, gender, age, sexual orientation, language, religion, nationality or the world (Govender & Muthukrishna, 2012:29; Van Dijk, 2011:93).

1.13 VALUE OF THE RESEARCH

This study envisaged contributing towards the attempts of the DBE to enhance and strengthen the teaching of the mini-PAT in technology and consequently, improving learner performance, so that the learners may produce inventive and innovative ideas and work collaboratively in converting their ideas into actions. This also allowed learners to explore entrepreneurial initiatives and various opportunities for further education and future careers, which would enable them to contribute to the social and economic development of South Africa. The study also sought to motivate and capacitate teachers in terms of teaching the mini-PAT and technology as a subject in the senior phase. It contemplates encouraging teachers to improve themselves to strengthen and elevate their technology methodology, planning and content knowledge. The focus groups that will benefit from this study are teachers, learners and fellow subject advisors.

1.14 ETHICAL CONSIDERATIONS

“Ethics” is an idealistic term, originating from the Greek word *ethos*, meaning character or custom, which denotes a social code that expresses moral integrity and unswerving values (Partington, 2003:22). All researchers are subjected to ethical considerations (Gratton & Jones, 2010:121). Ethical considerations in research are significant. Ethics are the norms or standards for conduct that makes a distinction between right and wrong (Dick, Mckee & Porter, 2013). This study first and foremost sought permission from the DBE. The findings and the results of the study were to be disseminated to all technology teachers. However, the co-researchers’ identities would be reserved and not revealed in any way. The purpose and the benefits of the study were communicated to the co-researchers, and I made them aware of their liberty to withdraw their participation, should they wish to do so. The co-researchers

were apprised on the data interpretation, which would be made available to them. Ethical considerations could include obtaining letters of consent and permission to be interviewed, as well as undertaking to destroy audio tapes (Marie, 2007:42)

1.15 LAYOUT OF CHAPTERS

Chapter 1: This chapter provides the outline of the study and draws the reader's attention to what has driven me to conduct the study. This is referred to as the problem statement. It presents vivid details of the challenges encountered by technology teachers in the teaching of the mini-PAT. The research question, research aim and objectives of the study are described. This chapter continues to briefly highlight the theoretical framework that has been utilised as the lens through which this study would be viewed. The research design and methodology adopted in this study are also brought to light. The manner in which the data were collected and analysed is touched upon. The selection of the co-researchers, who were working closely together with me as the researcher, is clarified. Issues of ethics are observed as well.

Chapter 2: This chapter has been divided into two sections. The first part focuses on the theoretical framework underpinning this study. Constructionism was found to be ideal for this study, thus the definition and origin of constructionism are explored. The selection of constructionism as the theoretical framework guiding this study is justified. The transformative paradigm (TP) and how it relates to constructionism are looked into. Operational concepts are discussed in detail. The second section deals with reviewing literature relating to strengthening the teaching of the mini-PAT in a senior phase technology class. This aims at responding to the objectives of the study.

Chapter 3: The focal point of this chapter is PAR, which has been used as the data generation method for this study. PAR is discussed by looking at its definition and origin, which could be drawn back to the work of Kurt Lewin. PAR has been found to be ideal for this study because of its participative and collaborative nature. This chapter also discusses CDA, which has been used for analysing the data. CDA is discussed, focusing on its origin and how it has been used on three different levels,

namely textual analysis, discursive practice and social structure analysis.

Chapter 4: This chapter presents, discusses, interprets and analyses the data generated in Chapter 3. The generated data are analysed on three levels, namely analyses on the textual, discursive and social levels. The data for all five objectives of the study are presented, analysed and interpreted.

Chapter 5: The final chapter presents the findings of the study, which have been established during the deliberations among the researcher and the co-researchers, as well as the findings which have been found in related literature. Recommendations on the findings, which have been drawn from both the literature and the discussions held by the team of co-researchers, are discussed. The conditions of the implementation of the strategy and the threats that may hinder its implementation are considered as well. The summary and the conclusion of the study include the strategy that the team has agreed upon.

CHAPTER 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discusses constructionism as a theoretical framework used throughout this study and the review of related literature. Constructionism is defined, and the origin of this framework is discussed. Furthermore, the objectives, steps and formats of constructionism are considered. Some operational concepts are defined, and the ontological and epistemological perspectives of the study are discussed. The relationship between the researcher and the co-researchers, as well as the role of the researcher is dealt with. The review of related literature on the challenges, solutions, threats, conditions and anticipated successes of the strategy is discussed as well.

A discussion on constructionism as a theoretical base for this study follows.

2.2 THEORETICAL FRAMEWORK – CONSTRUCTIONISM

2.2.1 Definition of constructionism

In this study, the term “constructionism” is used as an umbrella term for other variations technical literature refers to, such as the constructionism learning theory, social constructionism and strict constructionism. However, the strict measures of and a focus on constructionism are observed in this study. Constructionism is a theory of learning and an educational viewpoint developed by Papert and Harel (1991:1). Social constructionism, in contrast, is a theory of how social occurrences or objects of awareness develop in a social setting, while strict constructionism refers to a traditional type of legal or constitutional elucidation. This study adopts the constructionism learning theory as a theoretical framework. Constructionism is the “n-word” as opposed to the “v-word” – it possesses the perspective of constructivism

of learning as building knowledge structures through the continuous internalisation of actions. (The n-word refers to constructionism [“n” in “-nism”], whereas the v-word refers to constructivism [“v” in “-vism”].) It also includes the idea that this happening is especially favourable when the learner is purposefully involved in making a public body, whether it is a sandcastle on the beach or a theory of the world.

Various definitions of constructionism are found in literature, but the straightforward definition has been delineated by Papert and Harel (1991:2), explicating that constructionism, in essence, requires that everything should be comprehended by being constructed. Practical learning, learning by making projects or artefacts and learning through practical play are essential in constructionism. Learning by doing or constructing objects demonstrates the application of constructionism. These present the basis for using constructionism in this study. Working collaboratively to construct artefacts is highly encouraged in constructionism as it centres on the prototypes that are made through discussions and collaborations in a group. The constructionist focuses on revealing the manner in which people participate in the construction of their perceived social reality, which involves examining ways social phenomena are created, established, recognised and made into custom by beings. The focal point of constructionism is learning through making or creating things, rather than the demonstration of cognitive potential.

Crotty (2003:42) also asserts that constructionism is “the view that all knowledge and therefore all meaningful reality as such is contingent upon human practices being constructed in and out of interaction between human beings and their world and developed and transmitted within essentially social context”. This connotation is not discovered, but created.

The above discussion demonstrates that constructionism is ideal and links with this study in the sense that its principles are similar to the objectives of the mini-PAT, which are to encourage learning by doing because the learners design and make the prototypes as per the requirement of the CAPS curriculum.

2.2.2 Origin of the constructionism theory

Constructionism is a theory of learning established by Papert (1991:1), which is grounded on the premise that knowledge is co-constructed. Papert's constructionism centres on the art of learning or learning to learn and on the significance of building things in learning. Papert's interest is on the manner in which learners participate in discussions with (their own or other people's) artefacts and how these deliberations enhance self-directed learning and eventually ensure that there is a smooth construction of new knowledge.

Constructionism emerged some 30 years ago. It has its derivations in sociology and has been connected to qualitative research. Papert's crucial work on constructionism was introduced in 1967. Constructionism gained prominence in the United States of America with the book *The Social Construction of Reality* (1966) by Peter Berger and Thomas Luckmann. It has been more than a quarter of a century since Seymour Papert initiated the idea of constructionism. During the 1970s and 1980s, the constructionist theory was transformed as constructionists and sociologists engaged with the work of Michel Foucault. In the 1970s, Seymour Papert began to expand the psychological insights of Piaget's constructivism into pedagogical principles. Papert's book was published in the 1980s and the term "constructionism" was coined. In this book, he advanced a theory of learning, teaching and design (Crotty, 2003:41).

Constructionism was unpopular and not accepted until the early 1990s. Some reasons why constructionism failed to gain acceptance in the past are explained by Hannafin, Land and Oliver (1999). Three reasons have been put forward for the unpopularity of constructionism. Firstly, an enabling context is cited as one of the reasons. This means that learners require a relevant context for them to learn; simply put, one cannot be taught to play football in a china shop. The second reason refers to resources, which is self-explanatory in that everything one does, resources are required; these resources could be infrastructure, human resources and so forth. The third reason refers to a set of tools, which could be any tool of knowledge. The focal point of constructionism is the creation of knowledge which is said to be produced through interaction among people.

Berger and Luckmann (1991:65) are concerned with nature and construction. Apart from Papert and Harel (1991), other scholars, such as Berger and Luckman (1991:65), trace constructionism to Piaget's constructivism. Constructionism is a theory of learning based upon Piaget's constructivism. These two theories can be compared to identify the similarities and the dissimilarities between them. The focus of Piaget's constructivism is on what learners are interested in and on their ability to achieve at different stages of development, whereas Papert's constructionism pays more attention to "learning to learn" or the art of learning and on the importance of learning by making things. According to constructivists, learning is perceived as the process of building knowledge structures inside one's head. Constructionists, on the other hand, suggest that the best technique to make certain that such cognitive structures emerge is through active participation in the creation of concrete and sharable things outside one's mind.

2.2.3 Claims of constructionism

In the learning situation, constructionism is the idea that successful learning occurs when people engage in making things. Ackerman (2001:20) declares that constructionism focuses on the "how" part of learning and on the significance of producing models throughout the learning activity. Ackerman, Gauntlett and Wechstrom (2009:56) further elaborate that constructionism is a theory of learning and instruction that declares that the creation of knowledge transpires at its best through making concrete and participative objects. In constructionism, education is structured and organised in a manner that enhances "flow", "creative thought", group effort and action competence (Anderson, 2005:13-14). Furthermore, Anderson (2005:13) asserts that constructionists support innovative means of reasoning and learning by involving the player in the design and making of constructive artefacts.

Constructionists stress that in a constructionist setting, the learning environment should be characterised by crafting, making, building and doing projects; this is what has led to the development of the theory of constructionism. It increments on what constructivist theories advocate, namely that knowledge is not conveyed from teacher to learner, but is actively constructed in the learners' mind. Constructionists

emphasise that truth and knowledge are not discovered by the mind, but instead, are created (Schwandt, 2003:293).

2.3 JUSTIFICATION FOR THE CHOICE OF CONSTRUCTIONISM IN THIS STUDY

In view of the above definitions of constructionism, I concluded that constructionism as a theoretical framework was ideal for this study for the reason that in teaching the mini-PAT, I would work collaboratively with the co-researchers to ensure that the teaching of the mini-PAT was strengthened. Additionally, constructionism supports new ways of thinking, which the mini-PAT aims to present in our curriculum where teachers have to engage learners in developing different skills. When focusing on the challenges that teachers encounter during the teaching of the mini-PAT, inadequate PCK is the major challenge facing technology teachers in the Amajuba District. Consequently, the use of constructionism would assist these teachers in teaching the mini-PAT.

According to Brennan and Resnick (2013:285), constructionism is perceived as a pedagogical theory. In the theory of constructionism, prototype creation and reflective discussion on the prototype is the root of new knowledge construction. Likewise, the mini-PAT presents a structure where teachers are required to equip learners with skills allowing them to construct artefacts in the area of knowledge they are engaged in during a particular term. I selected constructionism as it emphasises hands-on learning and learning by doing; it enhances creative thinking, ensuring that there is an end product in the form of a model or prototype. In the teaching of the mini-PAT, the co-researchers and I would engage in a hands-on approach.

The selection of constructionism in this study is based on the fact that undertaking the mini-PAT, teachers are expected to facilitate the process, and not to lecture or teach the learners. This implies that a learner-centred approach, not a teacher-centred approach, should be employed. On the other hand, the learners are supposed to engage in the activities and eventually produce a prototype or artefact. I also chose constructionism because through it, the teachers and learners could collaborate in a developmental process to the end.

2.4 PRINCIPLES OF THE CONSTRUCTIONISM THEORY

This section intends to draw the reader's attention to the principles of constructionism. It also displays how these principles inform the research and why I have chosen constructionism as a theoretical framework for this study. Environments where new ways of thinking and learning, such as designing and making prototypes, are implemented support the four principles of constructionism as a learning theory. These principles were discovered by Viera, Bers, Ponte, Juelich and Schenker (2002:132) and can be summarised as follows:

- Learning transpires by designing significant projects and using them jointly with others (collaborative learning).
- Manoeuvring objects assists in concrete thinking about abstract phenomena (learning by doing or hands-on learning).
- Great views come from diverse areas of knowledge (the sharing of knowledge among one another).

2.4.1 Promotion of collaborative learning

Constructionism aims at improving collaborative learning (Lei, 2016:1-3; Noss & Clayson, 2015:1-3). Collaborative learning happens in any kind of learning; however, in the context of learning by construction, collaboration has three strengths, namely optional collaboration, flexible partnership and collaboration through the air. Optional collaboration refers to a scenario where people are at liberty to work individually in a project or they are allowed to work in groups, should they prefer to do so. Flexible collaboration is when people are afforded an opportunity to select whom they want to work with, without being compelled to work with people they do not desire to work with. Collaboration through the air involves sharing of knowledge and ideas. Sharing is a very important aspect in most of the things we as human beings do. Sharing a design cannot end in the modification of that design, but it can result in attaining a profound understanding of other people's points of view. In the constructionist environment, people can know one another's design plans, difficulties and solutions.

The constructionist principle of the promotion of collaborative learning is related to this study because for the mini-PAT to be effectively executed, collaboration among all stakeholders is of paramount importance. This is confirmed by Wilson and Harris (2003:233), who point out the three essential characteristics of teaching and learning technology that are significant in the development of technological capability. These characteristics are as follows: creating an effective learning process that allows learners to construct their understanding of the world, learning with social context and learning through making.

2.4.2 Hands-on learning

Constructionists proclaim that learners learn better if they are intellectually engaged in meaningful and relevant activities and projects. The constructionist setting is seen in the deep involvement of all members of the group. Thus, the researcher and the co-researchers work together in yielding the desired outcome. Situated learning means that constructionists believe that no piece of knowledge grows by itself. They encourage working in a context that mobilises innovation and self-knowledge, and stress the importance of shifting away from focusing on getting the outcome but putting more emphasis on the process of reaching the outcome. In learning through communication, constructionists believe that one learns better by practically engaging in making projects, and best by reasoning and discussing what has to be done.

The fundamental principles to take cognisance of during the learning and teaching of technology are as follows: ensuring the smooth running of the learning process in class, ensuring that learning is focused on learners since they are the people who are learning (learner-centeredness), allowing the learners to take charge of their learning by participating actively in their learning, and allowing them to display their creativity and their problem-solving skills. These principles agree with the methods regarded as suitable for the successful learning of instruction in technology (De Swart et al., 2003:27-28). Tooley (2010:94-95) adds that technology is a “hands-on” subject and that the result thereof should be something tangible, such as a model, an artefact or an ornament.

2.4.3 Sharing of knowledge

Sharing is another principle of constructionism. Sharing a creation can result not only in its modification but also in the learner obtaining more insight into other people's views on the object and ideas to which it is related (Evard, as cited in Lei, 2016:3). In the constructionism environment, learners can know one another's design plans, difficulties and solutions. They can share disparate viewpoints or problem-solving strategies. Their expertise in particular areas can also be shared, followed by gaining a measure of appreciation in the community.

In this study, constructionism was found to be ideal and related to the nature of technology since it can assist in learning areas of knowledge such as structures and processing, electrical and mechanical systems. The design process can be mastered as well because the context of construction puts learners in a mode of thinking like planners, problem solvers or designers. Most people believe that no problem is too difficult to solve if people are working collaboratively in trying to resolve it. That is what would happen in strengthening the teaching of the mini-PAT in senior phase technology classrooms. The co-researchers and I would share knowledge, leading to solutions to the problems confronting technology teachers. Mokoena (2009:50) explains that technology emphasises the process of learning how to learn, rather than the end product. Technology has the following features that are related to constructionism: in technology, learners learn by solving problems in creative ways, creating a positive attitude towards technology-based careers and combining abstract concepts to obtain a concrete understanding thereof.

2.5 POSITION OF THE RESEARCHER AND THE CO-RESEARCHERS

This study is aligned with the principles of constructionism and takes cognisance of the transformative paradigm (TP) as it aims to transform the teaching methodologies in schools. Constructionism values the contribution of co-researchers, and as such, the research becomes transformational as no one is regarded as superior to another. This implies that the researcher will not be the leader, but both the researcher and the co-researchers will work together as equal partners. In constructionism-oriented studies, the people involved in the study are respected and the co-researchers are

viewed as equally knowledgeable partners of the researcher. In a study where the co-researchers and the researcher work together as equals, the researcher learns from the co-researchers and the co-researchers can arrive at the best possible solutions. This is confirmed by Byler (as cited in Dube, 2016:41), who elucidates that in this type of relationship, the researcher is not the main actor and in charge of everything; he or she no longer is the sole authority of what is regarded as knowledge. Alternatively, the information is produced through a consensual relationship between the researcher and the co-researchers. Dube (2016:42) further explains that the participation of co-researchers makes such a study a precious experience towards social transformation.

In this study, the people who might have been referred to as “subjects”, “respondents” or “participants”, are referred to as “co-researchers”. I entered into a joint partnership with the co-researchers to gather and analyse the data. It was of paramount importance that I was sensitive and faithful to the co-researchers. Constructionism is a theoretical framework that promotes the idea of the researcher working together with co-researchers as equals, and that they think, interpret and create meanings jointly in the direction of realising the aspirations set under the objectives of the study (Kemmis, 2013:271).

Constructionism encourages creative thinking. As a result of this, the co-researchers and I would work together, sharing our ideas to collaboratively derive ways that could be employed to assist in strengthening the teaching of the mini-PAT. I would not be superior or above the co-researchers. We would contribute equally towards achieving a common goal, which was to find a solution to the problem of teaching the mini-PAT confronted by technology teachers in the Amajuba District.

Both the researcher and the co-researchers create observations in constructionism. These observations and results emerge from interactions between the researcher and the co-researchers called “transactional epistemology”. Constructionists also believe that constructions can be uncovered through interactions between the researcher and the co-researchers; they then embrace dialectical discussions. This describes my relationship with the co-researchers in this study. The researcher allows the co-researchers an equal opportunity to voice their views on the research

topic, while making them feel that they are a part of the research and are equal to the researcher. The researcher also needs to ensure that the data generated during the discussions are kept safe. In this study, these included audio tapes, WhatsApp conversations, voice notes and scripts that had been used to record the discussions in the form of minutes. The researcher would also analyse, categorise and interpret the generated data. Moreover, the researcher would be the one who should organise the meetings with the co-researchers.

2.6 EPISTEMOLOGY AND CONSTRUCTIONISM

Epistemology pays attention to the nature of knowledge and different techniques of acquiring knowledge (Lewis & Thorndale, 2003:85). It studies knowledge by attempting to make a distinction between true (sufficient) knowledge and false (insufficient) knowledge (Erickson & Kovalainen, 2008:14). Constructionism is the epistemology that qualitative researchers tend to bring into play. It rejects the objectivist observation of human knowledge, thus stating that there is no unbiased truth expecting to be discovered. The constructionist nature of knowledge depicts that the knower and the known are interactively linked and the answers are constructed as the research advances (Lewis & Thorndale, 2008:85). The constructionist epistemological position accepts that human beings build the object, grant it a name and assign the attributes connected to it to the object. The epistemological assumption of constructionism is interdependence and subjectivity.

In constructionism, knowledge comprises the constructions that have reached some consensus and progress in knowledge; it is not generalised but arises when juxtaposing construction through logical discussions (Guba & Lincoln, 2004:17-38). Furthermore, Guba and Lincoln (2004:17-38) elucidate that knowledge is realistic; it represents the subjective experiences of the co-researchers. Moreover, it is transferable, confirmable and dependable, rather than being unstable. Schwandt (2003:196-197) elaborates on the epistemological stance of constructionism as one that, in opposition to objectivism, posits that knowledge is not out there waiting to be found but is created or made up (i.e. co-created through the interaction of subject and object, or researcher and researched) against a backdrop of shared

understanding, practices, languages and other historical, cultural, ideological and political aspects of social experience.

The epistemological view of constructionism relates to what is required of teachers teaching technology. When learners engage in the design and making of the mini-PAT, they work together in designing the model that would solve the problem they confront. During this process, they debate with one another in terms of how some aspects should be done or designed, but ultimately, they all produce an artefact. While the learners are engaged in this process, the teacher takes on a meditational, rather than an instructional role (Papert & Harel, 1991:193-206).

2.7 ONTOLOGY OF CONSTRUCTIONISM

Ontology is described as the “science or study of being”, which is concerned with the nature of reality (Blaikie, 2010:119). Ontology is a structure of belief that demonstrates an explanation of a person about what comprises reality. Constructionists’ research structure is more distinctive and fluid, which makes it open to recording meanings in human interactions and making sense of what is viewed as reality (Black, 2006:319-324). The ontological view of constructionism observes that social occurrences are generated from the views and deeds of those community members concerned with their being. Subsequently, constructionism is an “ontological position which states that social phenomenon and their meanings are continually being accomplished by social actors” (Bryman, 2012:19; 2012:119).

Researchers’ view of the nature of reality or being is that it is socially made, subjective and not fixed, but it may change and is inclusive of all social players (Frey, Botan & Kreps, 2000:18; Grossberg, Wartella, Whitney & McGregor, 2006:205). When a constructionist perspective is adopted, knowledge is not viewed as an insight into some objective truth, but instead, it is constructed by humans, partly through communication. Constructionists assess whether constructions are true or false and endeavour to aid, giving a well-versed and complicated viewpoint on ontology (Moss, 2016:3). In this study, the co-researchers worked together, and everyone’s input was considered as vital towards strengthening the teaching of the mini-PAT.

2.8 TRANSFORMATIVE PARADIGM AND CONSTRUCTIONISM

There are many paradigms or worldviews of research, such as transformative paradigm (TP), pragmatism, post-positivism and positivism, to mention a few. A paradigm refers to a set of basic beliefs or the manner in which the world is viewed. It consists of certain theoretical beliefs that channel and direct reasoning and actions. In this section, I discuss the TP because constructionism falls within this paradigm. The TP is an abstract framework that “directly connects difficulties faced by researchers and assessors in multi-cultural communities when their work is centred on escalating social fairness” (Mertens, 2009:10). The main focus of this paradigm is on the strains that occur when irregular power relationships filter through a research situation that deals with firm social issues (Greene, 2008:13).

The focal point of TP is the powers that live in societies that encounter bias and maltreatment because of their cultural beliefs and experiences. The following research principles, which were previously linked with respecting change and driving closer to more equitable social relationships, are incorporated in the TP: the neo-Marxist theory, the feminists’ critical race theory, PAR, critical theory and emancipation, and disability theories (Guba & Lincoln, 2005:201; Lather, 1992:6; Mertens, 2010:10).

Politics in research is dealt with, in the TP, by confronting social domination at whatever point it occurs (Oliver, 1992:111; Reason, 1994:21). Researchers in the TP purposely and openly place themselves alongside with the vulnerable in an attempt to bring about social change. The aim of TP education and research practice is to construct the knowledge and comprehension that people require to restore dignity in the world by disassembling dominant structures that hamper such knowledge (King, 2005:5).

Recognising power inequalities that prevail in our community and establishing their impact on the outcome of the programme is the basis of the transformative theory. The heart of TP is ensuring that the lives and experiences of marginalised groups, such as women, ethnic or racial minorities, the disabled and the poor, are taken into cognisance. Working within TP, the researcher intentionally analyses unbalanced

power relationships, looks for strategies to connect the outcomes of social enquiry to action and links the results of the enquiry to wider questions of social inequity and social justice (Mertens, Farley, Madison & Singleton, 1994:125).

TP is ideal for this study in the sense that the main aim of this paradigm is to deal with politics in research by facing social oppression at whatever level it transpires. Transformative researchers mindfully and openly place themselves alongside the powerless in a joint effort to bring about social change. TP focuses on people who have been marginalised due to race or ethnic group. Technology has been introduced with the intention of addressing the issues of a curriculum that has been too academic and has not encouraged skills development. The approaches used during teaching in class will be transformed to suit the nature of the subject. There will be a shift from the traditional methodologies that have previously been employed to learner-centred approaches. Transformative approaches encourage participation; hence the new, learner-centred approaches that came with outcomes-based education will be utilised.

2.9 REFLECTION ON THE USE OF CONSTRUCTIONISM

In this section, I reflect on the use of constructionism in the study. The strengths or positive aspects associated with this type of research as well as the weaknesses of constructionism are highlighted.

2.9.1 Strengths of constructionism

Constructionism is apposite or relevant to this research in the sense that it focuses on uncovering the mechanisms used by groups and individuals who participate in the building of social reality. It includes examining the ways by which social occurrences are crafted, institutionalised, recognised and made into traditions by beings. Constructionism is the ideal framing for such research in the sense that it enhances collaboration throughout the research process. Moss (2016:1) declares that constructionism is imperative in the sense that knowledge is not viewed as an insight into some objective reality; instead, it is made by humans through social interactions to some extent.

Papert and Harel (2002:3-4) suggest that constructionism is ideal for all when compared to the widespread “instructionist” approaches followed in schools. They further state that constructionism is the only framework that has been proposed that allows a full range of intellectual styles and preferences to each, finding a point of equilibrium. In the execution of the mini-PAT and in teaching technology as a subject, teachers are advised to shy away from the traditional way of teaching, which mainly focuses on teachers, to a more learner-centred approach. This affords learners an opportunity to display their creativity and demonstrate their skills. The reason for choosing constructionism in this study was because using constructionism as a lens in the study would assist technology teachers in becoming better in their technology subject knowledge, make them good problem-solvers, boost their confidence and increase their ability to cooperate, communicate and share with others.

2.9.2 Challenges of constructionism

Every theory has weaknesses associated with it. This section draws the reader’s attention to the challenges associated with constructionism. Lei (2016:7) highlights that constructionism is time-consuming, while Hoban, Nielsen and Carceller (2014:434) purport that constructionism does not go further than highlighting the importance of the interaction of personal and social influences on learning as it is not clear on how this happens. This implies that in constructionism, interrelationships are not explicit. Constructionism has argued that there are both individual and social influences on learning when designing an artefact for sharing. According to Papert and Harel (2002:3-4), the weak claim of constructionism is that it suits some people better than the other modes of learning that are currently being used. Constructionism is said to be time-consuming. The administration of the mini-PAT takes some hours; hence most teachers see it as time-consuming.

2.10 DEFINITION OF OPERATIONAL CONCEPTS

In this section, I draw the reader’s attention to the operational concepts that inform this study. It is important to start by defining technology as a subject. This might raise questions in the sense that researchers have conducted subject-based research

studies, but the name of the subject is usually not defined. In an attempt to elucidate the above statement, Laufenberg (2009:1) states that the term “technology” has been excessively used without clearly understanding what it means. This has led to uncertainty about its meaning. Many people connect it to electronic devices, such as computers, laptops, tablets and so forth.

2.10.1 Technology

The Oxford Advanced learners Dictionary (2010) defines technology as the utilisation of scientific knowledge to construct technological models, particularly in different trades. The term “technology” has been derived from the Greek word “techno logia” where “techno” means art, skill, craft or the manner in which things are gained, and “logia” means words or the utterances by which inwards thought are expressed. The DoE (1997:28) defined technology as the utilisation of knowledge, skills and resources to satisfy the needs and wants of people so that they are able to identify and find solutions to the problems they encounter. This can be done by following the design process, which is investigating, designing, making, evaluating and communicating products and systems. This definition was later reconsidered by the DoE, and technology was later on defined as the utilisation of knowledge, skills and resources to ensure that people’s needs and wants are met. For this to be accomplished, developing practical solutions (artefacts/models/prototypes) to problems, taking social and environmental factors into consideration, was ideal (DBE *Curriculum News*, 2010:6; DoE RNCS, 2002:4).

The Ohio Department of Education (2007:7) describes technology as a study which affords learners an opportunity to explore the processes to be followed and the knowledge required to solve technological problems. The International Technology and Engineering Educators Association (2011) define technology as the manner in which people reform the natural world to complement their own purpose. Typically technology is concerned with the collection of knowledge used by people to showcase their abilities and fulfil their needs and wants. In this study, technology should be understood as a practical subject that seeks to develop learners’ technological literacy by exposing them to the basics of different technical subjects. Furthermore, it affords learners an opportunity to develop skills that can be employed

in solving technological problems. Moreover, technology helps learners to understand the concepts and knowledge used in technology education and teaches them to use these responsibly and purposefully and to appreciate the interaction between people.

2.10.2 Assessment

The concept “assessment”, as defined by the Oxford advanced Learners Dictionary (2010), refers to an opinion or judgement about something that has been thought about very carefully. The DBE (2011a:38) refers to assessment as an exercise of analysing, accumulating and interpreting data to help the teacher make decisions about the progression of the learner. The motive behind assessing learners is to strengthen their growth and development, to ensure that learners are indeed learning and to observe and check learner progress (DoE RNCS, 2002:54). The literature reveals that assessment is the process of gathering, evaluating and analysing information about learner attainment to be able to make informed decisions about learner performance.

Dunn, Mehrotra and Halonel (2004:12) confirm the above assertion by articulating that assessment is an essential instrument that assists schools and other educational institutions in ascertaining that they are grooming learners to be successful in tomorrow’s marketplace and society and if they are meeting the learners’ educational needs. Assessment is conducted so that information can be gathered; this process is usually driven by teachers as they are regarded as the leading role players in the implementation process. Mansell, James and the Assessment Reform Group (2009:25) add that assessment is essential since it allows people to acquire the required educational support. Furthermore, assessment is used to check if the different methods used during teaching and learning are effective and if educational budgets are being spent effectively.

Learners are assessed formally and informally. In both instances, learners and parents should be presented with regular feedback to improve the learning experience (DBE, 2011a:38). Informal, daily or learning assessment tasks are prepared by the teacher and administered to learners in an informal setting during

class periods or given as homework. Informal activities, as the name suggests, need not be recorded as they are used as a measuring instrument used to measure learners' understanding of different concepts. Informal activities can be assessed by learners or their peers (self and peer assessment), and the teacher is expected to control them. The marks of informal work are not formally recorded and are not taken into account in the promotion and progression of learners (DBE, 2011a:39).

An annual programme of assessment is planned at the beginning of the year and all formal tasks and projected dates for the administration of tasks are completed. The programme of assessment is then distributed to the parents (NPA, 2011:5). Formal assessment tasks are strictly marked and formally recorded by the teacher. This is imperative because these assessments are used for progression and certification purposes. In this study, assessment is defined as a measuring tool used to measure learners' level of grasping concepts in any subject. This is done in a formal setting where learners are assessed formally, and the marks are recorded and contribute towards the promotion and progression of the learner.

2.10.3 Mini-PAT

The mini-PAT is composed of a number of short practical assessment tasks which make up the main formal assessment task (DBE, 2011a:41). It assesses the learners' ability to go through the technological process skills and their ability to apply the knowledge acquired during each term. The composition of the mini-PAT is based on an assortment of forms of assessment suited to the range of activities that make up a mini-PAT. It may be an assignment covering aspects of the design process. This assignment can be to design and make an object. This does not necessarily cover all the aspects of the design process. Alternatively, it may be a full capability task covering all aspects of the design process IDMEC. IDMEC is an acronym for investigate, design, make, evaluate and communicate.

The design process (a set of steps followed when doing the mini-PAT) can be seen as the key pedagogic principle of the subject and helps to distinguish it from other subjects in the curriculum (De Jager, 2012:16). Johnsey (as cited in Gumbo & Makgato, 2008:23) clearly and precisely defines the design process as a way of

going about achieving an end and separate parts of a process. The senior phase comprises Grades 7 to 9, which fall under the general education and training (GET) band in the CAPS curriculum.

Within the technology curriculum, the design process (IDMEC) is the main aspect of technology and is defined as an innovative and interactive approach used to find solutions to identified problems of human needs. In this study, the mini-PAT is defined as a formal assessment task that can take a form of an assignment wherein some design process skills are addressed, or it can be a full capability task where all the design process skills are addressed. The mini-PAT contributes 70% towards the learners' term mark. All learners in the senior phase (Grades 7-9) are expected to complete this task. During this task, the learners engage in the design process IDMEC, which is non-linear. The teachers facilitate this process, and the task is completed under their supervision as it is allocated time in the ATP. This task develops the learners' skills that assist them to be problem solvers and critical and creative thinkers.

2.11 REVIEW OF RELATED LITERATURE ON TEACHING THE MINI-PAT

This section reviews related literature from the best practices in South Africa, SADEC countries and internationally. The reason for reviewing related literature is to find ways that can be used to enhance the current technology teachings in South Africa.

2.11.1 Justifying the need to strengthen the teaching of the mini-PAT

Technology is one of the eight subjects taught in Grades 7 to 9 (senior phase) in South Africa. It was introduced to Grades 4 to 9 in 1998 and reviewed in 2002. It later amalgamated with natural sciences in the intermediate phase (Grades 4-6). Most teachers are still struggling with its execution, especially in rural schools (Makgato, 2013:1). It has been brought to light that South Africa confronts an acute shortage of engineers, artisans and technicians (DBE, 2011a:8). This is a result of the failure to expose our learners to technology, particularly the practical aspect thereof, which is the mini-PAT. Technology was introduced into the South African

curriculum in acknowledgement of the need to produce engineers, artisans and technicians needed in modern society.

Technology as a subject in the senior phase (Grades 7-9) intends to equip learners with the foundation they require to pursue technical subjects in the Further Education and Training (FET) phase. These technical subjects are civil technology (which has three specialisations – civil services, construction and woodworking), electrical technology (with three specialisations – digital electrons, electronics and power systems) and mechanical technology (with three specialisations – automotive, fitting and machining, and welding). However, equipping learners with the necessary foundation is impossible if teachers are not well capacitated in teaching the mini-PAT, which is the most important aspect of technology because it is where the learners are introduced to the basics of the abovementioned technical subjects. The CAPS document (DBE, 2011a:8) justifies the inception of technology in the South African curriculum by stating that for a country to have people who are technologically inclined to the modern world, subjects such as technology are essential. This has also been substantiated by Mapotse (2014:2), who elucidates that industries are concerned with the calibre of learners being produced in our schools – they wonder whether these learners are ready to pursue the engineering field. Mapotse (2014:2) further emphasises that learners should be exposed to technology early in their schooling so that they would appropriate a clear understanding of what technology entails and be able to produce relevant artefacts, models or prototypes. Technology is structured in a manner that allows for theory and practical work. It is a subject that requires skilled teachers since it is a theory-practice subject. It has four areas of knowledge, namely processing, mechanical systems and control, electrical systems, and control and structures (DBE, 2011a:10). Learners engage in enabling tasks in preparation for the practical task, which is formally assessed and contributes 70% towards the learners' term mark.

During the teaching of technology, three specific aims are approached. These specific aims contribute towards learners' technological literacy by affording them a chance to develop and employ relevant design skills to find and resolve technological problems. Moreover, these aims assist learners in understanding the concepts and knowledge used in technology. The learners are encouraged to use

these responsibly and purposefully and value the interaction between peoples' values and attitudes, technology, society and the environment (DBE, 2011a:8).

Specific aim number one is the technological process, which is the pillar of technology as a subject and the main focus of this study. This is a non-linear process, which includes investigation, design, making, evaluation and communication, as Chikasanda (2014:69) asserts that in Malawi, the technological process – which is also referred to as the design process – is vital to the technological activity and requires communication of hand and brain. It is a journey that learners should explore in search of a solution to a problem. The focal point of this study is the technological process, which is followed in a non-linear fashion. Learners engage in the technological process when they complete the mini-PAT. Before the strengthening of the NCS, which was done by developing the CAPS curriculum, the mini-PAT was referred to as the technological or design process.

Technology kindles inventive learners and enhances their innovative and analytical reasoning skills. It guides learners on how time and material resources can be effectively managed. It also presents the chance for collaborative learning and promotes teamwork. Papert and Harel (1991:3) assert that learners learn best when they research, design and build prototypes or models as a way of demonstrating their knowledge.

With the above being indicated, teachers in rural schools, such as those in the Amajuba District, are still grappling with the execution of the mini-PAT, which is the practical aspect of technology. It is on this premise that I resolved to conduct a research study on strengthening the teaching of the mini-PAT.

2.11.2 Challenges in the teaching of the mini-PAT

Technology, as it is called in South Africa, has different names in different countries. In Malawi and Bangladesh it is called “science and technology”, in the United Kingdom and Botswana “design and technology”, and in the United States of America and New Zealand, it is called “technology education” (Mapotse, 2011:48). Internationally and nationally, technology is a new subject. In South Africa it has

been introduced as a new subject in outcomes-based education. This curriculum has been referred to as “Curriculum 2005” and has been reviewed twice.

Many challenges have been identified as stumbling blocks towards achieving our goal in South Africa to produce learners that will be critical thinkers and problem solvers by introducing them to the practical part of technology, which is called the mini-PAT. Introducing learners to the mini-PAT will not only assist in developing learners’ different technological skills but also assist the country in developing economically and producing engineers, technicians and artisans, as it has been articulated that South Africa has an acute shortage of these professionals. These challenges, which are evident in other countries as well, are inadequate PCK, the inadequate training of teachers, the high learner-teacher ratio and the shortage of resources.

In this section, I review literature in South Africa and other countries in the world regarding these challenges.

2.11.2.1 Pedagogical content knowledge

Technology is a relatively new subject globally (International Technology and Engineering Educators Association, 2011; Mawson, 2007). It has been introduced in South Africa as a result of many educational changes that have taken place after the democratic election in 1994. Consequently, a new curriculum, which has been known as “Curriculum 2005”, has been introduced. Technology was one of the new subjects that came with the introduction of Curriculum 2005. Curriculum 2005, being confronted by many challenges and much criticism, was reviewed, leading to the twice-revised National Curriculum Statement (RNCS) and the National Curriculum Statement (NCS), which have led to the development and introduction of the CAPS curriculum from 2011. The NCS remains policy; however, it has been repackaged to be more user-friendly to teachers, while the CAPS curriculum attempts to provide unambiguous directives on carrying out the NCS. The CAPS curriculum, on the other hand, has been introduced to strengthen the NCS and to give clear indications on what has to be taught and assessed per subject in each grade (DBE *Curriculum News*, 2010:2; De Jager, 2011:143).

The abovementioned changes have affected technology teachers and have led to their encountering challenges on the subject content and pedagogical knowledge of technology. Pedagogical content knowledge (PCK) refers to the process of learning to teach. Shulman (1986:9) defines PCK as teachers' interpretations and transformations of subject matter knowledge in the context of facilitating learners' learning. Shulman further proposes several key elements of PCK: (1) knowledge representations of the subject matter (content knowledge); (2) understanding of the learners' conceptions of subjects and the learning and teaching implications that were associated with the specific subject matter; and (3) general pedagogical knowledge (or teaching strategies). To complete what he called the "knowledge base for teaching", Shulman (1986:9) included other elements, namely (4) curriculum knowledge, (5) knowledge of educational context and (6) knowledge of the purposes of education. Shulman speaks of transformation in his definition of PCK. Transformation is a process whereby teachers' subject-matter knowledge is converted into a form appropriate for teaching, a form he calls PCK.

PCK entails teachers' ability to help learners comprehend the content of a subject (Peng, 2013:84). Inadequate PCK has been found to be a challenge in the teaching of technology. This has been confirmed by Makgato (2013:3689), who affirms that studies have revealed that teachers meet with real challenges in teaching technology content, knowledge and skills. The ministry of education substantiates this by articulating that while most South African teachers are being trained to teach a number of subjects, most technology teachers are not comfortable with the pedagogy of technology (Mapotse, 2014:2). This is confirmed by Omorogbe (2013:181), stating that in Nigeria, technology teachers are still grappling with technology content knowledge and pedagogical skills. These are recognised as factors that influence learner performance.

Khumalo (2004:15) asserts that teachers have demonstrated that they lack adequate technology content knowledge, which has a negative impact on learning as learners are being exposed to inadequate information. This means that learners usually progress to another grade or class with content deficits from the previous grade. Spady (2003:9) states that in conventional educational practice across the world, "content is king", which means that the education system is arranged around the

content the teacher wants the learner to remember and understand. Kansanen (2009:6) concurs with Spady that the mastering of content is the basis for effective teaching and for the relationship between learners and teachers. This is in addition to the pedagogical relationship. It is presumed that facilitating a subject means that the teacher has enough of what Kansanen (2009:6) refers to as “curricular knowledge” and “pedagogical knowledge”. Okafor (2007:184) further elucidates that quality teaching lies in the teachers’ ability to convert written knowledge into forms that are pedagogically powerful and yet adaptive to the learners’ abilities and backgrounds.

In a study conducted by Chikasanda, Mtemeng’Ombe, Nyirenda and Kopangule (2014:71), observations on teaching practices in science and technology (“technology” as referred to in Malawi and Bangladesh) classrooms revealed the actual teachers’ understanding of the subject matter and pedagogical practices to teach the content. It has been observed that changing content into suitable representation and instruction seemed to focus mainly on teachers’ activities and was less concerned with the learners’ interactions and the associated learning outcomes. The observation above demonstrates that inadequate PCK is a challenge not only in South Africa but also in other countries, and PCK is imperative not only in technology but in all subjects to be effectively implemented.

2.11.2.2 Educational resources in the teaching of the mini-PAT

Resources are central to the practical nature of technology. These involve both physical and human resources. Bolick, Berson, Coutts and Heinecke (2003:23) define teaching resources as tools used by teachers to intensify the teaching and learning process. They further elaborate that teaching resources are a fundamental element of the learning and teaching situation. Teaching resources are not meant for augmenting learning but assist in ensuring that teaching and learning are improved. Teaching resources also assist in making teaching and learning uncomplicated and less strenuous. These are paramount catalysts of social transformation and intellectual development of learners. Orakwe (2000:62) further states that teaching resources are not items used during the teaching-learning process but are used to make teaching more real and hands-on to the learners.

Technology is a subject that requires learners to engage in practical activities with the aim to produce artefacts. This requires physical resources. Dugger (as cited in Ziyambi, 2009:37) states that physical resources play an important role in producing learners who perform well in technology. This has also been deduced by Omorogbe (2013:186), who states that the unavailability of ideal teaching and learning resources in Nigerian schools has been found to be a huge challenge in the teaching of technology. He adds that adequate teaching and learning resources contribute immensely to ensuring that teaching is successful and effective.

The importance of resources is confirmed by observing a few lesson presentations by technology teachers in senior phase classes. The shortage of resources delays the process of teaching and learning, and as a result, some learners fail to complete their tasks on time (February, Ogunniyi, Langenhoven & Olufunmilayo, 2012:515). Insufficient resources or a lack thereof is also prevalent in Botswana. This is authenticated by Moalosi and Molwane (2008:7), explaining that teachers who teach design and technology in Botswana complain about the lack of resources in their schools. They further elaborate that there is a lack of proper technology laboratories and teaching resources, such as textbooks, worksheets, tools, material and equipment.

In a research study conducted by Mapotse (2014:3), the findings revealed that technology teachers reported that they had no workshop or laboratory designated for technology learning, teaching and practicals. The effective teaching of technology, especially the practical part, requires that each school has an equipped laboratory or workshop that is dedicated to doing projects. The unavailability of resources is a huge challenge that technology teachers face, particularly in rural schools and township schools in the Amajuba District. This has also been confirmed by Ampofu (2009:96), stating that the availability of learning material, including textbooks and practical material, has been found to be a challenge in teaching technology.

In a study conducted by Mapotse (2012:28), observations confirmed the lack of textbooks for both teachers and learners, who have been found sharing one textbook in certain schools. According to Smith (2007:52), physical resources, such as hand

tools, including screwdrivers, a hacksaw, glue gun, pliers and so forth, are essential for teaching technology effectively in the GET phase.

A lack of resources has a negative impact on the classroom situation as these resources are essential to improve classroom learning and support, and thus engage learners and create avenues for participation. The availability of resources is of the essence in teaching the mini-PAT because these resources assist in improving the teaching experience and create authentic connections that foster creativity, collaboration and meaningful learning. In Malawi, it has been reported that the lack of resources is a general problem that affects not only the teaching of science and technology but all other subjects as well. In Nigeria, the inadequate supply of instructional materials and the lack of well-equipped workshops or science and technology labs, tools and machines have been reported to be rife (Nigerian Educational Survey and Digest Statistics Report, 2010:3).

2.11.2.3 Learner-teacher ratio

The learner-teacher ratio compares the number of learners to the number of teachers in a school or an educational institution. The number of learners to a class might influence the performance of both the teachers and the learners. It can also affect the amount of work covered per day, week, month or year (curriculum coverage). This may occur in different ways; for example, the learner-teacher ratio could affect how learners relate with one another and the level of social engagement. This may result in more or less noise and disruptive behaviour, which in turn, could affect the types of activities the teacher is able to promote. It could also affect the amount of time the teacher provides to individual learners (individual attention). Furthermore, the teacher could find it difficult to identify learners' specific needs since more attention is dedicated to the group as a whole (Ehrenberg, Brewer, Gamoran & Williams, 2001:1).

High learner numbers make it difficult for the teacher to teach, assess and give feedback to learners immediately after an activity has been executed. Providing immediate feedback to learners can greatly enhance learning and improve learner performance. In the case of classes with 60 or more learners, this becomes

impossible, which has a negative impact on teaching and learning. Reeves (2010:227) confirmed this by asserting as follows:

Effective feedback does not only tell students how they performed, but how to improve the next time they engage the task. Effective feedback is provided in such a timely manner that the next opportunity to perform the task is measured in seconds, not weeks or months.

The South African Schools Act of 1996 gives vivid guidelines on the number of learners for which one teacher should be responsible. In a high school, it states, one teacher should be allocated 35 learners (1:35) and in primary schools, one teacher should have a maximum of 40 learners per class (1:40).

The high learner-teacher ratio in schools in the Amajuba District has a negative impact on the execution of the mini-PAT. Mapotse and Gumbo (2012:139) and Mapotse (2012:29) stress that large numbers of learners per class hamper the “practical nature” of technology since classes are overcrowded. Mapotse (2012:29) further states that unmanageable numbers in a technology class render the teaching of technology ineffective, while depriving the learners of the opportunity to participate actively in the allocated tasks. This also restricts learners from exposing their cognitive skills. Classroom management also becomes a challenge. Mapotse (2014:508) states that in most schools, especially township schools, each teacher has to teach a minimum of 60 to 90 learners, which has a negative impact on the execution of practical activities.

Glewe (2013:31) states that increase in class size usually have a negative impact on learners’ learning. International research also shows that high-quality teaching has a greater impact on learner performance than a reduction in class size, but there is evidence that smaller classes (of 18 or fewer learners) improve learners’ learning, especially for low-income and poverty level learners (Centre for Public Education, 2005:2).

2.11.2.4 Professional development.

Reimers (2003:1) defines professional development as “the development of a person in his or her professional role”. Teacher development is described as “the

professional growth which a teacher achieves as a result of gaining increased experience and examining his or her own teaching systematically” (Reimers, 2003:1). When technology was introduced in the GET phase, qualified technology teachers were not available in schools (Ampofu, 2009:15). This resulted in many teachers teaching technology without any formal training in technology (Marumo, 2013:38). The introduction of this newcomer (technology) prompted a pressing need for in-service teacher training as part of teachers’ professional development.

Although most South African teachers are experienced in teaching more than one subject, they are not qualified to teach technology. The modifications in the South African schooling system created an urgent need for the retraining of teachers (Khumalo, 2004:101). Few teachers in South Africa have received formal pre-service training in this field, which makes the implementation of technology in this country difficult. This has also been experienced in Australia (Chapman & Macgregor, 2002). The DoE supplied insufficient training for one week, which was not sufficient to master everything about technology content knowledge. The training was not sufficient for the promotion of technology or the implementation of technology (Stevens, 2004). This is also evident in American schools, as Kent (2004:6) explains that most districts in America usually allocate a very limited time for professional development.

Short workshops have been conducted, but they were not enough to sustain a long-term impact on teaching practices. According to Pithouse (as cited in Mapotse, 2012:39), facilitators of outcomes-based education were trained for a limited time of about one week and were expected to cascade the information to teachers. They did not possess adequate technology content knowledge and skills; hence teachers received insufficient and poor-quality training in technology. Teacher development plays a very important role in the accomplishment of curriculum transformation (Brown, Sithole & Hofmeyer, 2000:32). In my view, if teachers are not capacitated in a particular subject, it leads to their being demotivated and poses a challenge in terms of meeting the objectives and outcomes of the subject.

2.11.3 Possible solutions

The following are the possible solutions that have been found in literature, which have been proven to assist in dealing with the challenges that are seen to be impeding the execution of the mini-PAT.

2.11.3.1 Pedagogical content knowledge

Team teaching has been found to be a solution that can aid in boosting teachers' PCK. Team teaching is delineated by Davis (1995:8) as an instance where two or more teachers collaborate to plan, present and assess learning activities for the same group of learners. According to Quinn and Kanter (1984), team teaching is defined as the straightforward collaboration that occurs between two or more qualified teachers. They, together, present lesson presentations to the same group of learners. They further give the two broad categories of team teaching: the first category is when a group of teachers present the same lesson to the same learners at the same time; the second category is when a group of teachers plan a lesson together, but they neither present the lesson to the same group of learners nor teach at the same time.

According to the *Fall Newsletter* (2006:1) of the Centre for Teaching and Learning, team teaching advances many pedagogical and intellectual advantages. It can help to create a vibrant and interactive learning environment. Team teaching also allows for a high level of intellectual debate among colleagues. Wadkins, Miller and Wozniak (2006:78) further explain that team teaching encourages teachers to pre-plan before they meet for planning because they discuss the concepts that are to be covered within a specific timeframe. Engaging in group discussions among colleagues is a strategy to coerce all the members of the team to engage with the content of the subject before meeting with other team members.

Team teaching benefits not only teachers but also the learners. It improves learner performance as it encourages teachers and learners to engage in discussions about a particular concept. Furthermore, it offers a multidimensional approach to the subject matter. This is confirmed by Armitage (2010:4), articulating that team

teaching is not only beneficial to teachers but also assists learners as they are being exposed to the views and skills of more than one teacher. It further guides learners towards clearly understanding knowledge. He further states that teams also afford teachers an opportunity to enter into conversations as they debate, disagree with conclusions, raise new questions and point out consequences.

Qhosola (2016:69) elucidates that it is through reflection that the team in collaboration may influence results. If a team reflect on their teaching and how different parts of what they do, work well, as well as which aspects of their teaching can be improved, and how problems that arise could be solved, this could assist them to advance their collaborative efforts in the teaching and learning of the mini-PAT. Working together can play a pivotal role in ensuring the strengthening of the teaching of the mini-PAT as teachers will be working as a collective and sharing their knowledge. Another solution to boosting PCK is changing from traditional teaching methods to learner-centred approaches, such as activity-based learning and project-based learning, which can be employed by teachers.

2.11.3.2 Educational resources

Technology teachers need to submit a list of required material to the head of department (HoD) timeously. The HoD who sits in the meetings of the school management team (SMT) should then forward this list to the SMT. Section 34(1) of the South African Schools Act states that the government must fund public schools from public revenue on an equitable basis to ensure the proper exercise of the rights of learners to education and redress the past inequalities in the provision of education. Each school is allocated funds for learning and teaching support material (LTSM). In this allocation, 60% of the total is allocated to LTSM, of which 40% of the 60% is allocated to textbooks, 30% of the 60% is allocated to learner stationery and the remaining 30% of the 60% is allocated to other LTSM. The remaining 40% is allocated to non-LTSM. Schools can utilise the 30% allocated to other LTSM or tap into the 40% allocated to non-LTSM for purchasing toolkits for technology (KwaZulu-Natal Circular No. 61 of 2016).

The MST sub-directorate has provided technology kits for district officials to use during training workshops. The technology kits are now included in the catalogue used to purchase textbooks. This would make it easier for principals to request the kits when they are requesting textbooks. The Sasol Inzalo Foundation has developed technology workbooks for Grades 7 to 9 (teachers' guides and learners' books). These workbooks are also available electronically on the internet. This is the endeavour of the DoE to provide a resource that can be useful to both the teacher and the learner. Another approach to addressing the issue of limited resources is pairing up learners or dividing learners into small groups. This is confirmed by Ziyambi (2009:75), who asserts that grouping learners to share the inadequate resources that schools possess, is recommended.

Ziyambi (2009:75) further explains that although the demonstration of lessons is problematic in technology, considering that it is a practical subject, the issue of sharing the limited resources is seen as a possible solution to this challenge. One other aspect that might be a solution to the shortage of resources is for schools to ask for donations from local companies. The companies referred to in this study are those that employ people with different skills that are developed in technology, such as mechanics, electricians, boilermakers and so forth. I suggest that because technology seeks to produce learners that will pursue the abovementioned careers, such companies might be keen to assist in resolving the issue of inadequate resources. Schools can also request for sponsorship in local stores, such as a store where all the learners purchase their school uniforms. Assistance can be solicited from such stores to provide certain teaching resources.

Teachers need to involve learners in their learning process. Involving learners in their learning process and timeously informing them of what will be required for the execution of the mini-PAT in a particular term can be helpful because learners can collect the required resources needed as the use of recycled material is encouraged in technology. In dealing with the PCK, team teaching is recommended; teachers can use the same platform to source resources from colleagues, which can be a trend. They can then support one another in terms of the resources, because what one teacher has, another might not have. Subsequently, they can borrow from one another.

2.11.3.3 Learner-teacher ratio

In trying to deal with overcrowded classrooms, the following are recommended: working in small groups, changing desk arrangement, establishing simple rules and allocating designated roles to the members of the group. These strategies might assist shy learners, as they might be more comfortable to speak to a small group of peers rather than the whole class. Through such strategies, learners would also be given more time to engage because they would be engaging in small groups. The designated roles can be determined by the teacher or established by the groups themselves (Barkley, Cross & Major, 2005:10). In evidence of the benefits of this strategy, Mulryane-Kyne (2010:21) asserts that using small groups has been found to be one of the solutions to deal with large numbers of learners in classrooms.

Small groups allow a safe place where learners can work through their ideas with their peers. Such a setting also assists learners in teaching one another, as well as identifying and addressing misconceptions. Small groups also assist teachers in dealing with the issue of large classes when teaching the mini-PAT. Creating policies that give clear guidelines in terms of how things should be done in class is also important as it ensures that all classroom activities are performed appropriately. This includes the manner in which the learners conduct themselves, for example distractive behaviour, such as coming late, leaving early, having side conversations and doing other activities (Mulryane-Kyne, 2010:20).

Peer assessment for informal in-class learning activities allows the learners to receive immediate feedback and provides an opportunity for learners to be the teacher by giving helpful feedback to their peers (Deslauriers, Chelew & Wieman, 2011:35). Working in pairs and groups also assists learners who are passive in class in the sense that these learners are free to speak with their peers because they are communicating in small groups rather than talking to the whole class. The utilisation of small groups can, therefore, help to deal with large numbers of learners in class.

2.11.3.4 Professional development

To strengthen the teaching of the mini-PAT, I concur with De Jager (2011:145), who suggests that institutions of higher education should not only develop their course programmes around knowledge but also focus on teaching methodology. Teaching, in general, is often portrayed as a passive and knowledge-oriented process. This is not the case with technology as it includes practical skills. This is confirmed by Darling-Hammond (2006:80), stating that in attempting to remedy the above challenges, the training of teachers has to include the practical skills needed for making products to solve problems. Darling-Hammond (2006:80) further states that teacher training should not only give the teacher what they have to learn (content and preparation) but also “how” they need to learn it. The “how to learn it” involves the process of developing useful knowledge to respond to the complexity of the classroom. This would assist developing teachers’ abilities as reflective decision-makers and enhance their understanding of the subject content within the subject pedagogy.

Makgato (2013:1) asserts that teacher education and training in tertiary institutions should be intensified to produce teachers with proper pedagogy in teaching and learning technology. Rollnick (2009:26-27) explains that universities have introduced the Advanced Certificate of Education (ACE) programmes in an attempt to improve teachers’ content knowledge in technology and other subjects. Govender (2002:125) adds that in trying to address the issue of the insufficient training of teachers, the University of KwaZulu-Natal has also introduced National Professional Diploma in Education (NPDE) programmes in 2001.

Mapotse (2014:8) suggests that more contact workshops should be conducted on a regular basis. He further states that certificates of attendance should be issued at the end of the training sessions to encourage teachers to attend the workshops. The DoE has developed a system whereby each time teachers attend a professional development workshop, they are awarded points that contribute towards the teachers’ Integrated Quality Management System.

Mishra and Koehler (2006:1034) suggest that the training of teachers should take the form of design-based activities. This would develop teachers' practical skills. The DoE also endeavours to assist GET technology subject advisors by including them in the training of FET teachers for technical subjects that have been resuscitated in schools. In these workshops, teachers of technical subjects and GET advisors engage in practical activities in different specialisations.

2.11.4 Conditions conducive to strengthening the teaching of the mini-PAT

Various conditions are appropriate for ensuring that the strategy to teach the mini-PAT in a senior phase technology class is successful.

2.11.4.1 Conditions that enhance teamwork

Full commitment in a team by all team members is essential. Wenger (2000:230) describes commitment as the most important condition in a team. According to Pearce (2004:297), commitment is a long-term promise made by an individual to oneself and to others. Being committed in the context of this study means remaining true to the promise made against all odds. It starts with being committed to one another, to the team and its success and, finally, to the mission and vision of the school (Bishop, Scott & Burroughs, 2000:1114). In a team, there are people from diverse environments and diverse viewpoints. This bringing people together to share their knowledge with one another, creates an empowering experience (Kurtzberg & Amabile, 2000:286) and an atmosphere conducive for the team to accommodate and create different perspectives (Labonte & Laverack, 2001:130).

I concur with the aforesaid statements in the sense that for teamwork to be effective, it is vital that the team members are first and foremost committed to the team. Being committed means being on time when meetings have been scheduled, contributing fully to the team when a point of discussion is put forth and so forth. Communication among the group members ensures that the skills and knowledge necessary for the successful completion of tasks are shared among the team members. Depending on the manner in which the team is managed, diverse teams tend to be more creative and achieve goals more efficiently.

2.11.4.2 Good communication skills and positive attitude

An open line of communication and good communication skills are required in teams to function properly. Communication is paramount in a group because it gives the group members a chance to share their best practices openly (Bhohkour, 2006:350). Consequently, communication is an important condition for a dedicated team, and it is essential for teachers in their teaching. The members of the team should possess good communication skills because when working in a team, they interact with one another. Hence if one cannot communicate or is reserved, the team will not be beneficial to that team member and he or she will not contribute to the group. Others may lack the correct manner of approach in a group setting, consequently leading to conflict because of the manner in which one might have spoken to another group member. It is in this premise that good communication skills are fundamental in any group.

Research has displayed that positivity can make a difference to people's victory and welfare. The attitude of a person can make a huge contribution towards the realisation of one's aspirations. If the members of a team have a positive attitude, it becomes easy to achieve the set objectives of the team. According to Hamm (2010:2), a positive attitude widens one's sense of opportunities and opens one's mind – as a result, affording one the opportunity to build new skills. In addition, goals are accomplished with ease. A positive attitude is one condition that is vital for the accomplishment of the intended goal, which is to strengthen the teaching of the mini-PAT. Being positive makes one willing to learn and to admit when one needs assistance. A positive attitude also makes individuals understand that not knowing something does not mean that one is incompetent but simply requires one to seek assistance from another person.

2.11.4.3 Availability of educational resources

One of the core resources in technology is textbooks. Mapotse (2012:09) reports that textbooks that are congruent with the ATP, as prescribed by the DBE, have been developed. These technology textbooks have been screened by the departmental officials before their approval. In these textbooks, the mini-PATs for all the terms are

prescribed (DBE, 2011a:14-21). Teachers' guides are also provided. This solves the problem of textbooks that had been incongruent with the work schedule. The DoE, the MST sub-directorate and the Sasol Inzalo Foundation have developed workbooks for technology (learners' books and teachers' guides) in their endeavour to provide resources for technology teachers and learners. These workbooks are made available for each learner to take home.

The MST sub-directorate have also supplied the districts with technology kits to be used during workshops and to assist teachers in terms of knowing which resources are required. Unfortunately, these kits are not sufficient for all schools; hence the district is planning to distribute them to education centres for teachers to be able to borrow them or take the learners to the education centre so that they can use the resources but leave them there for other schools to use as well.

2.11.5 Threats that could hinder the success of the strategy

In 2.11.4 above, the conditions favourable for the successful implementation of the strategy to teach the mini-PAT in a senior phase technology class have been discussed. In this section, the threats to the successful implementation of the strategy are explored in detail.

2.11.5.1 Nominal collaboration can be a threat to others

Teachers may feel threatened by the presence of other people while they are teaching. As a result, they might think that they are incompetent teachers (Dearman & Alber, 2005:636). Dearman and Alber (2005:636) further elucidate that teachers should be made aware that working in a team is beneficial to all team members in the sense that the team is there for the empowerment of all the members of the team, hence the necessity of a platform for open discussion. I concur with Dearman and Alber because sometimes working as a team can pose a problem to other members in the sense that some people may tend to dominate the group and other people's views may not be acknowledged. This can threaten the effectiveness of the group because some members may end up pulling out of the team.

2.11.5.2 Absence of educational resources

Inadequate physical resources might threaten the success of the strategy in the following manner. In the Amajuba District, resource centres are in geographic locations that are not accessed and utilised by most teachers and officials. Many teachers do not even know what these resource centres are equipped with. The district officials use them as venues to conduct workshops and cluster meetings. Peacock (2009:250) and Chisholm (2005:94) describe the shortage of resources as the main factor that makes curriculum reform have an unintended impact on teaching and learning. The availability of teaching and learning resources enhances the effectiveness of teachers and schools as they are the basic resources that bring about good academic performance.

Momoh (2010) explains that material resources have a significant effect on learners' achievement since they facilitate the learning abstract concepts and ideas and discourage rote learning. When teaching and learning resources are inadequate, education is compromised, and this inevitably is reflected in poor learner performance, high dropout rates, problematic behaviour, poor teacher motivation and unmet educational goals. If teachers are demotivated, the facilitation of the mini-PAT will not be successful. I can, therefore, conclude that inadequate resources can threaten the success and effectiveness of the implementation of the strategy to strengthen the teaching of the mini-PAT in a senior phase technology class.

2.11.5.3 Pedagogical approaches

Ayodele (as cited in Omorogbe, 2013:184) identifies the use of inappropriate, non-effective teaching methodologies as a major factor hindering learners' understanding and achievement in technology. The teacher who strives to meet the need for active participation of the learner engages the learner in reflective and critical thinking exercises on the subject content (Vakalisa & Gawe, 2011:2). Teachers prefer to use lecturing as an instruction strategy as most teachers are committed to the teacher-centred approach. This emanates from the schooling system the teachers have been exposed to. Currently, teachers are the product of a schooling and training system that has been characterised by teacher-centred instruction strategies and rote

learning. This has contributed immensely to the reinforcement of their own belief to follow the instructional approach in their classrooms. This particularly applies in the South African context where the vast majority of teachers received their education during the apartheid era when limited exposure was given to learner-centred instruction. Instead, the curriculum then focused on content, rote learning, memorisation and summative assessment practices (Spren & Valley, 2010:42, 48).

Teachers' misconceptions about learner-centred instruction can also threaten the success of the strategy. This factor can be explained as follows: teachers believe in the assumption that learner-centred instruction is too time-consuming (which will not leave enough time to complete the curriculum) and requires too many resources and teaching experience, both of which are lacking (Isikoglu, Basturk & Karaca, 2009:350; Lombard & Grosser, 2004:213; Spren & Valley, 2010:51). Spren and Valley (2010:51) further purport that teachers may also be of the opinion that learner-centred instruction undermines the teacher's authority and class discipline; hence they prefer to distance themselves from this type of instruction. Dicamillo and Gradwell (2012:2) state that some teachers' beliefs are grounded in views that the curriculum is purely an examination-driven practice, which leads to their coaching learners to obtain good examination results.

The above discussion displays that transposing from the teacher-centred to the learner-centred approach would threaten the success of the strategy because change has often been a threat to people. According to Bertels (2003:478), change can be described as the process of analysing the past to elicit present actions required for the future. Kobola (2007:204-208) indicates that people resist change, and this is caused by different factors at different levels. I therefore conclude that changing from the teacher-centred to the learner-centred approach can threaten the implementation of the strategy to strengthen the teaching of the mini-PAT in a senior phase technology class because for the teacher to be able to facilitate the mini-PAT, he or she has to employ learner-centred approach strategies. The methodology used by the teacher during teaching and learning has a significant impact on the success of the lesson delivered. The use of different teaching approaches, particularly learner-centred approaches, also corroborates with constructionism as it advocates

the use of a problem-based learning approach and a project-based approach (Alesandrini & Larson, 2002:119-121).

2.11.5.4 Unavailability of time and financial constraints

Time is seen to be one of the aspects that threaten teachers and deter them from achieving what they should achieve. The DoE has given a directive that no teachers should leave class for workshops during teaching time (HRM 4 of 2009). This implies that workshops have to be conducted after school or during weekends and school holidays. This is a threat because attendance at workshops is often poor, and if workshops are held after lunch or commence at 13:00, teachers usually request to be excused because of commitments ranging from doctors' appointments to picking up children from school.

During weekends, teachers are usually attending to personal matters, such as funerals. Time not only threatens the running of workshops but also prevents teachers from registering for formal in-service courses, such as NPDE, ACE or BEd (Honours). The Personnel Administrative Measures document (2003:c-63) stipulates that all educators may be required by the employer to attend programmes for ongoing professional development, up to a maximum of 80 hours per annum. These programmes are to be conducted outside the formal school day or during vacations. The employer should give at least one term's notice of programmes to be conducted during school vacations (Personnel Administrative Measures, 2003:c-63). This poses a challenge as such programmes are not conducted by the district but provincially. Another factor is, when teachers are called to attend workshops during school holidays, the attendance thereof is very poor. Teachers give different reasons for not being able to attend such workshops, such as attending to their families, so that this exercise proves to be unsuccessful.

2.11.6 Indicators of success

2.11.6.1 Improved pedagogical content knowledge

This section discusses the indicators of success for this study in strengthening the teaching of the mini-PAT in a senior phase technology class. In terms of teaching the mini-PAT, the technology teachers' PCK would improve drastically. The teachers would benefit from the presence of a dedicated team because they would be exposed to the views of more than one teacher. This would enhance the learners' understanding of the mini-PAT because the teachers will be clear in terms of the mini-PAT and how the different stages of the mini-PAT should be approached. Being involved in a team would drastically improve the content knowledge of the teachers because they would discuss their weaknesses, and those who are strong on certain aspects of the technology content knowledge would share with those who are challenged by the content.

It has been reported that ACE certificates with technology specialisations have been introduced to a number of higher educational institutions (Rollnick, 2009:26-27). In Zambia, Kenya, Malawi and Ghana, teacher professional development has begun, which aims at strengthening a decentralised network for supporting school-based teacher training (Mattson, 2006). Akinbode (as cited in Udofia & Ikpe, 2012:310) adds that more teacher in-service training and workshops have been conducted for teachers to approach the issue of content knowledge and pedagogy for teaching technology. Several certificates, diplomas and degree programmes are offered at parish, district and provincial level. Teachers meet as clusters on a regular basis, where they plan for their lessons and assessment together. This assists to a considerable extent in the improvement of the teachers' PCK. Workshops, where teachers engage in practical activities on different mini-PATs, are conducted. Winter classes and spring classes funded by the DBE are conducted, where problematic content areas in different subjects are dealt with. This has a very positive impact on the teachers' PCK.

2.11.6.2 Collaboration between all stakeholders

Collaboration between stakeholders, including the community, especially the parents, becomes a powerful contribution towards the process of learning and teaching (Spaull, 2013:4). The inclusion of all stakeholders ensures that everyone concerned strives towards the success of the project at hand. In this case, the parents, teachers and learners seem to be working together. This has proven to be effective regarding strengthening the teaching of the mini-PAT in the sense that most learners cooperate with their teachers whenever they are requested to bring resources for a particular project. Sherman (2008:5) adds that collaboration creates a network where knowledge literacy is positioned. Education resembles a three-legged pot, namely the teacher, the learner and the parents. Subsequently, the successful implementation of the strategy depends on whether the parties mentioned above are committed to making the strategy work.

2.11.6.3 More learners pursuing technical subjects in the FET phase

The number of learners who will select a technical stream at the FET band will increase. This will be as a result of their exposure to the different knowledge strands in technology in the senior phase and their passion for these subjects increasing as a result. Teachers will be more confident in their teaching as they will be more knowledgeable in terms of content knowledge and pedagogy.

This will also assist with the non-linear procedure that should be followed with the entire mini-PAT. The DoE has resuscitated a number of technical high schools. Workshops have been conducted for all FET teachers, GET subject advisors, as well as some GET teachers. The workshops for technical subjects commenced in 2015 for implementation in Grade 10 in 2016. They continued for another two consecutive years for implementation in Grades 11 and 12. The inclusion of GET teachers and subject advisors have exposed them to different technical subjects and strengthened their knowledge of technology content. Furthermore, it will put technology teachers in a better position to advise the learners in terms of subject choices, which will channel the learners to pursue the technical stream in the FET phase (KwaZulu-Natal

Circular No. 65 of 2016: Training for teachers of technical subjects). This has been done in all South African provinces.

2.11.6.4 More focus given to learning and teaching support material

The issue of teaching resources or LTSM is taken seriously in South African schools as the South African Schools Act No. 84 of 1996 stipulates that the responsibility of ensuring the availability of such resources lies within the government. Additional resources or shortages of resources should be attended by the school governing bodies as it is their duty to ensure that teaching resources are provided. This is confirmed in a study conducted by Seido (2013:64), who asserts that some of the material or textbooks used in the school where the observation of lessons have taken place, have been provided by the DoE, although learners have been sharing due to the large numbers of learners in the classes.

The schools will strategise in terms of the allocation of other LTSM to purchase the technology toolkits. This will indicate that the study has been successful because there will be a mind shift from people's perceptions on technology and schools' SMTs will understand that providing educational resources is crucial. It is evident that the government has attempted to provide technology resources. Previously, teachers did not have any idea of what to purchase for technology; however, the CAPS document (DBE, 2011a:56) provides a list of cheap and affordable materials that schools can purchase for technology.

Technology and science toolkits have been added to the catalogue used for requesting textbooks (Circular No. 28 of 2016). This implies that schools can now order these toolkits. According to Seido (2013:64), schools in the Free State possess the electricity and electronics toolkits, and learners use them to build electrical circuits and make their mini-PATs. Some sell these technology and science toolkits for schools to purchase. Although not all schools have a full complement of textbooks for each learner to have his or her own textbook to take home, as recommended in the DBE *Curriculum News* (2010:25), the numbers of textbooks have improved drastically in schools. This also applies to Nigerian schools. Either learners share in pairs or the teacher carries textbooks to class and moves them

from one class to another, which is perceived to be an improvement on having only one teacher copy. The DoE has also taken it upon itself to ensure that textbooks are delivered timeously to schools. Most schools have retrieval policies to ensure that textbooks are returned to schools by the learners.

Workbooks are available on the internet (KwaZulu-Natal DoE E-Learning Solution), and they have no copyright, which means they are downloadable and printable. Banks of items are also available on the internet, where teachers can get enabling tasks for learners. These are obtainable from the Thutong website and others. Seido (2013:64) confirms that open internet resources are used by teachers to teach learners in Nigerian schools, and learners are also allowed to use the internet for schoolwork purposes.

According to Nwazor (2012:53), teachers have been trained in information and communication technology (ICT), with the intention of developing their skills in the utilisation of electronic devices. This serves to assist teachers in using electronic resources such as the internet. At some schools, there are classrooms designated for technology (technology laboratories), and learners move to these for technology periods (Seido, 2013:64). This provides evidence that the issue of teaching resources is being addressed, which is an indication of success in terms of strengthening the teaching of the mini-PAT and technology as a subject taught in the senior phase.

2.11.6.5 Improved learner performance and content coverage

Having a teacher who is knowledgeable in terms of content knowledge and an effective teaching methodology and approach at one's disposal may contribute towards improved learner performance. Improved learner performance will be an indication of success in this study in the sense that it will display that the plans to improve teaching have been instrumental in strengthening the teaching of the mini-PAT in a technology class. Furthermore, teachers will cover more content because they will have received training in workshops on different concepts of technology, and they will be more comfortable to teach all the topics prescribed in the ATP.

The DoE has introduced pacesetters, which seek to ensure that teachers are on track with the content to be covered each term. This gives a clear indication of the dates and content to be covered within a particular week. In the pacesetter, teachers are required to indicate the date of completion after exhausting a topic. This helps the teachers to see if they are on track with curriculum coverage or not. This will eventually assist in improving learner performance in the sense that they will have thoroughly covered all topics. This assertion has been confirmed by technology teachers in a study conducted in the Limpopo Province (Mapotse, 2011:131). These teachers highlighted that they were no longer confronted by the challenge of not knowing what needs to be taught since they had been provided with an ATP. They further indicated that their confidence had increased since they understood what should be taught in technology. This strategy was also implemented to improve teachers' content knowledge, which would eventually have a positive impact on learner performance. Evaluations by the Pakistan Education Sector Reform Assistance (2005) indicated an improvement in teachers' skills and learner achievement in technology. This improvement was as a result of covering all topics as prescribed in CAPS.

2.11.7 Summary of the chapter

The focal point of this chapter was the theoretical framework informing the study, namely constructionism. Constructionism was defined, and its principles were discussed in detail. The origin of constructionism pointing to Seymour Papert, who believes that knowledge is co-constructed, was considered. The claims and transformative nature of constructionism were outlined as well. This chapter further justified why constructionism was considered suitable for the study. As with any other theory, constructionism involves certain challenges and strengths, which were examined in this chapter.

Related literature on strengthening the teaching of the mini-PAT in a senior phase technology class was reviewed, drawing from South African as well as international literature. During the literature review, the primary focus was on the five objectives of the study, which were as follows: to explore the challenges confronted by technology teachers during the execution of the mini-PAT, the possible solutions to the

highlighted challenges, the conditions conducive to the success of the strategy, the imminent threats that could hinder the implementation of the strategy and the indicators of success in strengthening the teaching of the mini-PAT in a senior phase technology class. The next chapter focuses on PAR, the approach used for empirical data generation in this study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The study aimed to strengthen the teaching of the mini-PAT in a senior phase technology class. Chapter 2 dealt with the constructionism learning theory as the lens that would be used in this study. Related literature drawn from different countries was reviewed. The research design and methodology are discussed in detail in this chapter. Chapter 3 has two sections; the first part of the chapter is the theoretical section, and the second is the empirical section. Both sections elaborate on the research design and approach used to reach the objectives of the study. The first section, which is about the research methodology, covers theoretical arguments to provide a clear understanding of PAR. A PAR approach has been used for the data generation and analysis in this study. The practical section describes the research design.

3.2 INTERROGATING RESEARCH DESIGN AND METHODOLOGY

The research design and research methodology are used to describe and justify what researchers do to understand and solve problems. Furthermore, the research design and methodology are used to give details of the concepts that may be complicated to comprehend (Myende, 2014:67). Myende (2014:67) further elucidates that the research design and research methodology are utilised to validate and explicate what researchers do to understand, and at times, resolve the research problems. Babbie and Mouton (2001:74) explain that researchers frequently confuse these two terms or use them interchangeably as a result of uncertainty regarding what constitutes the former and the latter.

Marie (2007:70) defines research design as a blueprint, which moves from primary theoretical assumptions to specifying the selection of co researchers, the data generation procedures to be used and the data analysis to be done. Research

design is also defined as a mechanism used to describe the manner in which the study is conducted (Burns & Groove, 2003:195; Diggins, 2009:33; Malhotra, 2010:102; McMillan & Schumacher, 2014:28; Parahoo, 1997:142). The procedure followed when a study is conducted, includes questions such as under what conditions the data would be attained as well as when and who from. In other words, the research design specifies how the research is set up, what happens to the co-researchers and what methods of data generation are used. The impetus of the research design is to identify clearly the plan for producing empirical evidence that will be used to respond to the research question (Mouton, 1996:107).

The process used to attain the set goals in a study is called the research methodology. This process includes the modus operandi and the type of tools to be used in the study (Leedy & Ormrod, 2010:12; Mouton, 2001:56). Its genesis is the point of departure required to execute the research design, which the researcher can decide to follow (Babbie & Mouton, 2001:75). In this study, research methodology is defined as the process followed during the research project, including the instruments and the methods that will assist with achieving the ultimate goal of the study.

3.2.1 Participatory action research

PAR is the acronym for participatory action research. PAR is used to recall the process of planning for transformation, acting and scrutinising the procedure and product of transformation and reflecting on these processes and consequences. The process then starts again from re-planning to acting, observing, reflecting and so on (Kemmis & McTaggart, 2000:595). Different definitions of PAR demonstrate that the focus of PAR is on the participation and involvement of all role players in a particular research study. The researcher and the co-researchers are equally involved in the process. Levin and Greenwood (2011:28) define PAR as a multidisciplinary perspective of cogeneration of knowledge, which includes different disciplines. PAR is able to integrate and foreground the importance of social science teaching in an environment where teaching is valued less than research. PAR could be viewed as a learning opportunity built on real-life problems where theory and methods are challenged and used to broaden understanding. It also considers methodological

diversity and challenges the traditional division between qualitative and quantitative methods, which has proved unhelpful in clarifying understanding (Levin & Greenwood, 2011:31).

McTaggart (1991:24) defines PAR as an organised and joint project between the scholarly and marginalised members in putting together evidence on which to base group reflection and planning change. McTaggart (1991:24) further elucidates that PAR researchers are advised to link theory and practice, use everyday language and avoid academic imperialism. PAR is labelled as “a philosophical approach to research that recognises the need for persons being studied to participate in the design and conduct of all phases (e.g. design, execution, and dissemination of any research that affects them)” (Vollman, Anderson & McFarlane, 2004:129).

3.2.2 Origin of participatory action research

According to Jordan (2003:187), PAR originated from countries that have been colonised in the early 1960s. It was stirred by the anticolonial school to focus on how to change and better people’s lives. It was introduced in view of the fact that people were discontented with the social, political and economic structures that were in existence at the time. They seemed not to address the lived realities of people, especially those considered as underprivileged by the plans and technologies of the privileged members of the community (Dube, 2016:102). Jordan (2003:187) further states that the fundamental aim of PAR was to find research procedures for people who are facing a challenge to bring forth a practical solution thereto. PAR is frequently erroneously seen as action research (AR), and in several instances, it supports forms of participatory research and well-liked educational programmes (Jordan, 2003:187).

PAR can be traced back to Kurt Lewin’s theory of social action, developed in the 1940s, which emphasises a strong link between theory and practice (Campbell, 2008:248; Given, 2008:60; Khan & Chovenec, 2010:35; Reason & McArdle, 2004:1; Schein 1995:7). Lewin is believed to be the originator of AR, by which emphasis is placed on matters of workplace and equality. AR and PAR are explanative and qualitative methods that integrate social investigation, educational work and action

(Brydon-Miller, 2001:77). Kurt Lewin was a “Jew who grew up in the United States of America and his interest was more on conflict resolution where he argued that peace and democracy should be core of social existence” (Maksimovic, 2010:120). His theoretical and metaphysical stand is grounded on the understanding that people can be inspired to perform duties to the best of their abilities if they are part and parcel of the decision-making process in the functioning of their place of work (McNiff, 1998:22; McNiff & Whirehead, 2006:36).

McDonald (2012:37) asserts that Lewin’s type of AR attends to matters of separation, inequity and assimilation. It also supports the process of resolving these issues and starting modifications while investigating the effects of these modifications. In addition, AR permits researchers to work in close association with the problems of the community, especially those of the voiceless and the marginalised (Qhosola, 2016:91).

PAR re-emerged in the 1970s in the work of Swantz in Tanzania, Fals-Borda in Columbia and Tandon in India (Brydon-Miller, 2001:102). PAR is committed to Freire’s (1974) suggestion that discourse and “conscientisation” is the key to social transformation. PAR occurs when marginalised people embark on critical analysis, putting together strategies to enhance their situation. Furthermore, in PAR, researchers commit themselves to a form of research that defy unfair and inequitable economic, social and political systems and practices. The research process intends to be a liberating and transformative experience (Khan & Chovanec, 2010:36).

Freire’s PAR perspective is concerned with emancipating the underprivileged and the oppressed, motivating them to act against the unjust elements of reality and liberate maltreated people (McDonald, 2012:37). McDonald (2012:37) further elucidates that the development of PAR aimed to enhance and inform economic, social and cultural practice whereby persons with incompatible authority, influence and position collaborate in relation to a particular concern. This confirms the theoretical framework of this study, which is grounded on working together or collaboratively, sharing ideas and learning by doing. PAR is suitable for this study because it encourages working together as equals and sharing ideas with the intention of solving a problem. In this case, teachers would work collaboratively in

devising a strategy to be used to execute the mini-PAT effectively. This would, in return, bring about emancipation since technology was previously treated as if it had been developed or designed for a chosen few. PAR has key features that the researcher, in collaboration with the co-researchers, needs to be cognisant of when using PAR as an approach for data generation. The next section, therefore, unpacks the seven key features of PAR.

3.2.3 Objectives of participatory action research

3.2.3.1 Empowerment

The aspiration of PAR is to empower the oppressed to join forces in social transformation, which persuades capacity development and capacity building of all who join in the effort (McTaggart, 1997:585). PAR is committed to Freire's (1974) submission that the solution to social transformation is through discourse and "conscientisation". It occurs when marginalised people embark on a critical analysis, organising strategies to enhance their situation. The ultimate goal of PAR is to empower people, which would lead to their being knowledgeable about the issue at hand.

3.2.3.2 Democratisation

PAR researchers argue that the study process must be democratic and empowering (McDonald, 2012:39). PAR is democratic, thus allowing all people to participate and work against unbearable circumstances; it is also life enhancing, which enables the expression of people's full human potential (Stringer, 1996:92). Reason and Bradbury (2006:1) concur with Stringer in his definition of PAR as a democratic process concerned with developing practical knowing in the pursuit of meaningful human purposes. The democratic nature of PAR is evident in that all people involved in PAR are offered an equal chance to have a say in the deliberations. All contributions are taken seriously, and no input is regarded as insignificant. The principle of democracy is required in a technology classroom as learners mainly work in small groups. This principle enables all the members of the team to contribute freely and without fear. In this study, all teachers would be able to participate in the

conversations with the ultimate goal of strengthening the teaching of the mini-PAT in a senior phase technology class.

3.2.3.3 Equity

The PAR process should be equitable (McDonald, 2012:39). PAR breaks away from traditional research and forms alliances with individuals with the least social, cultural and economic power. PAR is unbiased since it recognises that all people are equal and valuable (Sherman, 2008:5). Equity refers to the relationship between the researcher and co-researchers. This relationship is that of equal partners in research where the contributions of all team members are valued, and none are looked down upon because of socio-economic position or level of education (Armitage, 2010:10; McPhail, 2001:474). PAR encourages that co-researchers should be actively involved in the process of generating information (Chapman & Dold, 2009:1).

3.2.3.4 Liberation

PAR is emancipating and liberating because it sets one free from oppression; hence PAR intends to promote community development, empowerment, access, social justice and involvement (Vollman et al., 2004:129). PAR requires people to test their ideas, practices and assumptions about institutions. Local situations can be enhanced using PAR processes and valuing discussions from a broad range of intellectual origins. It is embedded in an “especially strong concern for social justice and equality” (Pant & Odame, 2009:160-172). With this in mind, PAR goes further than identifying and assessing complications and theorising on these by observing the process of teaching and learning and engaging with solutions to accomplish what the study entails (Levitt, 2008:49).

The next section unpacks the seven key features of PAR.

3.2.4 Features of participatory action research

3.2.4.1 Participatory action research as a social process

According to Kemmis and McTaggart (2007:280), PAR intentionally explores the connection between the individual and the social realms. It recognises that “no individualisation is possible without socialisation and no socialisation is possible without individualisation” (Habermas, 1992:26). It also recognises that the process of individualisation and socialisation continue to shape individuals and social relationships in all settings in which one finds oneself. A positive change within organisations, individuals, societies and communities becomes visible when PAR processes are implemented (Juujaarvi& Lund, 2015:3).

PAR tries to understand the nature of people’s lives and how they are formed and reformed as individuals and through interaction with one another, such as the learner-teacher relationship (Kemmis & McTaggart, 2007:281). From the social process perspective, PAR involves strong research engrossment and tenure by people in societies who have a vision of working collaboratively towards solving a certain problem (Dube, 2016:108). Eruera (2010:1) states that in PAR, the researcher works with co-researchers and the co-researchers are energetically involved in all the stages of the research to concretise PAR from the social process. Miller and Maguire (2008:81) note that this perspective openly challenges existing structures of power and creates opportunities for the development of innovative and effective solutions to the problems confronting our schools.

In response to PAR as a social process, the research team consisted of teachers from different schools in the Amajuba District. Some of these schools were farm schools situated in deep rural areas, most of which were multigrade schools. The other schools were either ex-Model C schools or township schools. Although the team comprised teachers from different schools with different backgrounds, the team had a common goal of attempting to devise a strategy that would assist them in the execution of the mini-PAT in a senior phase technology class, regardless of background.

3.2.4.2 Participatory action research is participatory

PAR is not conducted “on” others; it is participatory because people can only conduct AR “on” themselves, either alone or jointly. It focuses on “people changing their own practices and behaviours, not those of others” (Stringer, 2004:5). In PAR, all individuals in a group endeavour to comprehend “strategies in which knowledge shapes their sense of identity and agency recognition” (Kemmis & McTaggart, 2007:282; Wadsworth, 2001:48). I concur that in PAR, co-researchers are not passive participants who are treated as objects but are fully engaged in the research process, which demonstrates the participatory nature of PAR. This feature is confirmed by Dube (2016:109) in his assertion that in PAR, co-researchers are not subjects for satisfying a research plan but have the status of “researcher” as they have an equal role in the research and involve one another in a journey. In this case, the journey was to strengthen the execution of the mini-PAT in a technology class.

3.2.4.3 Participatory action research is practical and collaborative

PAR creates circumstances where people can jointly search for more genuine, inclusive, ethically true and suitable means of understanding and acting in the world (Watters & Comeau, 2014:10). It dismisses the conventional boundaries put between the researcher and the co-researchers (Fletcher, McPhee & Dickson, 2015:2; Schroeder, 2013:106). These restrictions are completely removed by emphasising the importance of equal participation between the researcher and the researched (Given, 2008:601). In PAR, the co-researchers examine the manner in which they communicate with others, while examining strategies that can be used to enhance their interaction in the community (Kemmis & McTaggart, 2007:282). PAR often engages partnerships between colleagues who share a specific set of skills and knowledge (Pain, Finn, Bouveng & Ngobe, 2013:29).

Leykim, Pugh, Lanham, Harmon and McDaniel (2009:8) state that apart from being practical and collaborative, PAR endeavours to address issues in specific systems and pays attention to problem solving. Moreover, it sheds light on work practices and appreciates the research process as an alternative to life solutions. In acknowledging PAR, the co-researchers in this study, who are actively involved in the daily teaching

of technology, work collectively in attempting to strengthen the teaching of the mini-PAT effectively. Working together as a team offers various options that can assist in the implementation of the strategy to teach the mini-PAT. This also relates to the theoretical framework of this study, which promotes working together and sharing knowledge.

3.2.4.4 Participatory action research as emancipatory

PAR intends to assist people in finding and freeing themselves from the chains of unfair, irrational, sterile, unsatisfying social structures that hinder them from developing and determining themselves (Kemmis & McTaggart, 2007:282). In PAR, people's practices are shaped and controlled by broader social structures. The emancipatory viewpoint of PAR presents the chance to create more unbiased educational policies, which allows for educational reform from the bottom up (Miller & Maguire, 2008:85). PAR gives a voice to the voiceless, thus making the voice of the voiceless be heard (Nkoane, 2010:317), particularly to set equal power relations, liberty and hope among the researcher and the co-researchers (Lind, 2007:372; Netshandama & Mahlomaholo, 2010:79). Watters and Comeau (2010a:8) concur with Nkoane (2010:317) that PAR can assist people in obtaining support from others confronted by similar problems and challenges. The challenges raised by individuals, combined with the supportive network of a research team, increase the chances of one's voice being heard.

Through PAR, teachers are persuaded to work with learners and their colleagues in all spheres of life, which may contribute positively to the community. Reason (2004:16) asserts that since PAR is a liberating process, it is important that it liberates and recovers voices that have been downgraded to the margins, even in research. The focus of the emancipatory aspect of PAR is to acknowledge the cognitive, psychological, political, moral and social reality of all who participate in the research, including the researcher. The aim of focusing on the understanding of the group is to prompt orderly transformation to uplift human lives (Elizondo et al., 2013:425). Influenced by the emancipatory nature of PAR, our objective as a team was to establish a blueprint that technology teachers would use for the effective execution of the mini-PAT. This would respond to the problems teachers face in

terms of facilitating the mini-PAT. Thus, the team checked ways that could be used to decipher this challenge.

3.2.4.5 The critical nature of PAR

Crane and O'Regan (2010:16) state that the critical nature of PAR is supported by the principles of relationship, incorporation and fairness. The critical nature of PAR involves critical replications and standards, admiring the nature of one's own agency, interest and acknowledging the broader structured factors that protect the vulnerable and undermine the well-being of particular individuals and groups. Dube (2016:112) explains that the critical aspect of PAR affords co-researchers an opportunity to speak up, especially those in marginalised groups. During group deliberations, the team leader would pose questions to break the ice and make every team member feel at ease. According to Kemmis and McTaggart (2007:283), the objective of PAR is to assist people with recuperating and liberating themselves from the impediments embedded in the social media through which they interact.

3.2.4.6 PAR is reflective

PAR aims to help people to investigate reality to change it (Fals-Borda, 1979). It is a planned process by which people intend to change their practices through a coiled cycle of critical and self-critical action and reflection (Kemmis & McTaggart, 2007:282). PAR is not theorising in its approach; rather, it is a hand-on process of transforming how people communicate with one another in a shared social world. It is relevant to this study as the study uses constructionism as a theoretical framing. Constructionism encourages learning by doing, sharing with others and working collaboratively, as the reflexive nature of PAR demonstrates.

The next section discusses the formats of PAR.

3.3 FORMATS OF PARTICIPATORY ACTION RESEARCH

3.3.1 Giving a voice to others

One may encounter personal and societal benefits by engaging in PAR. Through involvement in the research process, one's confidence, knowledge of research processes and critical thinking skills may increase. Five themes were identified by Chapman and Dold (2009:10) in analysing the responses concerning the benefits and stumbling blocks of PAR. The first theme is giving a voice or making the voice of the voiceless be heard (Nkoane, 2010:317). PAR is necessary for people to acquire assistance from others confronted by the same challenges. The questions raised by individuals, together with the supportive network of a research team, increase the probability of one's voice being heard (Watters & Comeau, 2010a:8). This becomes evident in instances where people are confronted by challenges. If one person endeavours to rectify the issue alone, his or her attempts may prove to be in vain. However, if one becomes involved in a PAR project or work as a collective with people facing similar challenges, this gives one a louder collective voice (Duguay, as cited in Watters, Comeau & Restall, 2010:8). In terms of executing the mini-PAT, it is difficult for one person to master this task alone. However, a collective can share ideas, allowing every member an opportunity to suggest solutions, ultimately bringing forth a solution to the issue at hand.

3.3.2 Learning from one another

Being involved in PAR provides an opportunity to learn from one another, especially from people with similar issues to those one is facing. One principle of PAR is the equal power distribution within a team, which facilitates an environment that encourages the development of the team, peer support and friendship through truthful and respectful relations (Garcia-Iriarte, Kramer & Hammel, 2009:12). According to Kemmis and McTaggart (2007:271-329), PAR unlocks a communicative space among the co-researchers.

Networking has always been a positive strategy used by teachers to assist one another in terms of subject content. Networking with other co-researchers is a skill

acquired and filtered through involvement with PAR (Watters & Comeau, 2014:9). During the PAR process, research colleagues communicate with one another. Communicating with people allows for the building of one's professionalism and confidence at being able to interact as experts in the research process. Networking affords an opportunity to learn more about the issue being investigated (Morris, 2002:102). Through interaction with others, one forms part of organisations that have a similar point of view, and through them, one can get one's point across (Duguay, as cited in Watters et al., 2010:8). The primary aim of networking is persuading and creating awareness around the issues under study so that opportunities to advocate one's beliefs may crop up.

3.3.3 Empowerment

The third theme that defines PAR is empowerment. PAR, by definition, is said to be an emancipating process, which makes it possible for co-researchers to obtain an increased sense of control and address issues of significance. The process is intrinsically empowering, given that each member is openly engaged in a process that has an impact on the quality of other peoples' lives through social change (Lucock, Barber, Jones & Lovell, 2007:795-805). Involvement in a project can promote a sense of empowerment. PAR involves all its participants in research that allows the team members to make positive changes and contributions, which could lead to feelings of empowerment. It gives all team members power and control over the research processes and findings (Garcia-Iriarte et al., 2009:15; Ochocka, Janzen & Nelson, 2002:382). The empowering nature of PAR affords team members the opportunity to share views and positions on certain issues. It also guarantees the team members' involvement in decision making. Being empowered boosts one's confidence, self-efficiency and self-worth (Morris, 2002:162). This may influence the quality of one's life, enabling one to be more involved to the PAR process (Morris, 2002:35). In this study, the nature of empowerment of PAR plays a pivotal role in the lives of technology teachers because it would resuscitate their confidence so that they would perform to the best of their ability.

3.3.4 Social change

Bringing about social change was the ultimate goal of conducting PAR. Change in society would bring about change in the lives of all members of the community. The critical objective of PAR is utilising the findings of the project to decide on the manner in which improvements can be affected within society. Social change can be frightening to deal with; however, the magnitude of involvement to encourage transformation is broad and varied (Nelson et al., 1998:902). Social change can occur to raise awareness in the community or to create or improve resources, policy and programme development (Flicker et al., 2008:287). The outcome of the research study can be used to persuade all relevant stakeholders to advocate for policy implementation, for instance to familiarise technology teachers with technical subjects at an early stage in the case of technology, where policies are promoting learning by doing and the execution of the mini-PAT.

The success of PAR depends on the involvement, collaborative participation and action, and originality of the co-researchers. It is a dynamic involvement among all concerned, aimed at improving lives (Macaraan, 2013:5). The process of PAR is potentially empowering, liberating and raising consciousness for individuals, seeing that it provides a critical understanding of and reflection on social issues (Greenwood, Whyte & Harkavy, 1993:1778; Kemmis, 2008:121; McTaggart, 1997:36).

3.4 STAGES IN PARTICIPATORY ACTION RESEARCH

When PAR is used as a research methodology in a study, the research team should bear in mind the stages thereof. The stages followed when conducting research using the PAR approach are as follows:

Stage 1: Choosing an issue – What is the goal?

The first stage of the PAR process is identifying the issue of concern, which is done by a group or individuals. It is imperative that the issue of concern is chosen by individuals who are working or living with the issue (Watters & Comeau, 2010b:12).

During this stage, a research question has to be formulated and vividly articulated, as it will guide the research process and eventually assist in generating knowledge and resulting in the implementation stage. Having participants who are experienced in the field of the subject and research question ensures that the relevance and reflection of a specific community are paramount.

Stage 2: Choosing the co-researchers

After the problem has been identified, the research team has to be selected. The formulation of the team is based on people who are knowledgeable and possess the skills required to solve the issue at hand. Morris (2002:120) asserts that the research team should be selected or recruited from people who are experienced and facing similar circumstances. In this study, the co-researchers are teachers who teach technology and subject advisors of technology. In this stage, the roles of the co-researchers are also identified. The researcher's role is that of developing data systems, sharing capabilities in research methods and managing data generation and analysis (Johnson & Restal, 2010:32).

Stage 3: Finding funding for the research project

Conducting research is costly. During research, stipends should be provided to co-researchers, and the research may involve some administrative costs, such as costs of printing and distribution (Johnson & Restal, 2010:32). The funding proposal should be drawn up by all of the team members and be submitted to an organisation that funds research projects.

Stage 4: Deciding on the methodology

This step refers to how the team will generate data. There are numerous ways of collecting data. In this study, the data would be collected through working collaboratively and as equal partners with the co-researchers in responding to the research question.

Stage 5: Analysis and interpretation of data

After selecting the method for data generation and interpretation, the data require finalisation. Both the researcher and the co-researchers are responsible for selecting an appropriate method to analyse and interpret the collected data (Keilhofner, 2006:65).

Stage 6: Presentation of results

After the analysis and interpretation of findings have been completed, the presentation of results should be decided upon. There are different ways of summarising and presenting the findings of the research. This can be done by compiling a report that can be distributed to other target groups.

Stage 7: Taking action

This stage responds to the action that would be taken by the research team after obtaining the results of the study. Taking action refers to making conclusions about the study and utilising these to take steps towards changing the present status quo.

Stage 8: Evaluation

This is the final stage of PAR. During this stage, the project is evaluated. The team reflects on the whole process of the project from its initial stages. Evaluation is a process, rather than a stage. For example, the team may reflect on whether all the objectives have been achieved (Watters & Comeau, 2010b:16).

The eight stages of PAR lead to the next section, which is about the steps in PAR.

3.5 STEPS IN PARTICIPATORY ACTION RESEARCH

The process of PAR is mostly illustrated in terms of a mechanical sequence of steps (Kemmis & McTaggart, 2006:339). It involves spiral or self-reflective cycles, as reflected in Figure 3.1 below. The spiral is a non-linear pattern that includes

planning, acting, observing and reflecting on the changes in social situations (Voccarino, 2007:5). In reality, the process is likely to be more fluid, open and responsive. The steps overlap, and the process is cyclical, which makes it impossible to know the end from the start as each revolution is partly determined by the previous one (Qhosola, 2016:109). The time required for each stage cannot be anticipated (Bostock & Freeman, 2003:465).

The criteria of success is not based on whether the co-researchers have stuck to the steps but rather on whether they have had a strong and authentic sense of development and evolution in their practices. The steps are best undertaken as a collective by both the researcher and the co-researchers.

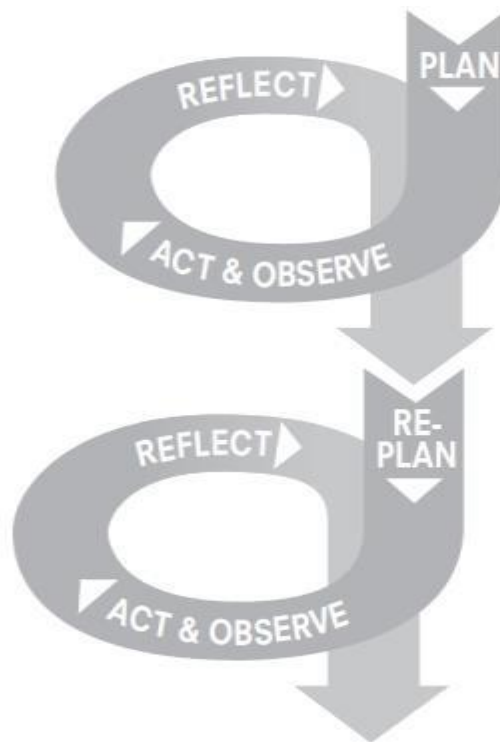


Figure 3.1: Self-reflective cycles(Kemmis & McTaggart, 2006:339)

3.5.1 Initial planning stage

The initial step of PAR includes a community assessment as the basis of action and finding a community partner. The initial planning stage of PAR involves developing a relationship between the researcher and the co-researchers. Working well with

people one does not know, requires one to win their trust and respect. It is imperative for the researcher to alert the co-researchers about his or her intentions, which involve bringing about transformation in their lives. McDonalds (2012:45) and Moles Jr and Fege (2011:21) attest to the above assertion by stating that PAR focuses on relationships between the co-researchers and the researcher. They further elaborate that fine relationships are grounded on the principles of hope and respect.

Kemmis and McTaggart (2007:276-277) confirm that PAR is a social process of learning together, realised by people who work collaboratively in altering the practices through which they interact in the shared social world in which we live with the repercussions of one another's actions. This explanation assisted extensively to clarify to the co-researchers the rationale of the study, because they were able to realise that the aim of the study is not to enrich the researcher but to empower all technology teachers in terms of the execution of the mini-PAT in their classrooms. The co-researchers were pleased about the research study. They even stated that they were hoping that all their challenges would be dealt with and that they would go back to their classroom better equipped in terms of the technological process and the content that is covered during the execution of the mini-PAT. I explained to the co-researchers that the duties or responsibilities would be shared among all. I also clarified that I was not the main person or leader who would make all the rules, but rather that all the members would be at liberty to contribute to the discussions.

During the planning stage, the co-researchers and I agreed on topics that were to be dealt with first, and which ones were to be looked at gradually to have a lucid way forward (cf. Qhosola, 2016:101). The co-researchers agreed that the five objectives of the study should be unpacked, starting from the challenges which would lead to the possible solutions. PAR connects well with the theoretical framing of this study (constructionism), which was also viewed as a social process that encourages hands-on learning, the sharing of knowledge and working collaboratively.

3.5.2 Implementation stage participatory action research

During this stage, the team interacted and deliberated on the objectives, suggesting possible resolutions to the effective teaching of the mini-PAT. The team worked collaboratively, ensuring that power issues were dealt with accordingly. The members were assured that no one was above the others – all team members were equal. The members were allowed to contribute to the deliberations, and each point or suggestion was viewed as important.

3.5.4 Reflection stage of participatory action research

The reflection stage is the critical element within PAR. It gives the researcher a chance to plan changes that could be made, to implement these changes and then reflect again (Voccarino, 2007:3). PAR suggests that action and reflection should go together. Action is described by McDonald (2010:37) as an ongoing process of reflection and action. Jasper (2003:1) describes reflection as involving taking our experiences as a springboard for learning by thinking about these in a purposeful way. By using the reflective process, we can come to understand them differently and take action as a result. When action and reflection take place simultaneously, they become creative and equally enhance each other.

3.6 EPISTEMOLOGY OF PARTICIPATORY ACTION RESEARCH

Epistemology is concerned with the acquisition of knowledge and the correlation between the researcher and the researched. Knowledge can be defined as a particular construction of a phenomenon given the “stamp of truth in our society” (Burr, 2003:68). Epistemology is instrumental in the relationship between the researcher and the co-researchers, whether or not the co-researchers are seen as dynamic contributors to the study or subjects to be studied. Epistemology also influences the manner in which the quality of methods is demonstrated and the actions undertaken to ensure data production and analysis are rigorous. Lastly, it influences the manner in which the researcher communicates with the co-researchers (Carter & Little, 2007:102).

The epistemological perspective of PAR can be characterised as critical subjectivity (Heron & Reason, 1997:278; Reason, 1994:325). PAR emphasises mutual interaction between researchers and co-researchers in creating knowledge, taking cognisance of the importance of the co-researchers' values, beliefs and interactions. In PAR, the reality can be constructed through shared experiences, deliberations, feedback and exchanges among people (Heron & Reason, 1997:280; Park, 1993:10). PAR shares the assumption that generating knowledge is not neutral and value-free but political and value-based (Brydon-Miller, 1997:89; Small & Uttal, 2005:67). As a result, PAR researchers critically examine power structures in the process of knowledge production (Fals-Borda, 2001:27-37; Ozanne & Saatcioglu, 2008:423-439).

Epistemologically, PAR is emphasised and treated as the primary methodological blueprint (Boog, 2003:430; Park, 1993:10; Reason 2006:198). Dialogue is used in PAR to analyse social problems critically from their lived experiences to raise critical awareness (Park, 1993:11). PAR also emphasises collaborative partnership between researchers and co-researchers in the design and implementation of research (Ozanne & Saatcioglu, 2008:423-439; Reason, 1994:326). In this study, experiential knowledge is valued as being fundamental to all knowledge. The process of developing a strategy to strengthen the teaching of the mini-PAT embraces PAR, since knowledge production is cyclical rather than linear, starting from the initial stage of planning to the reflection stages and back again in a cyclical manner. This relates to the process followed when executing the mini-PAT as the learners engage in a non-linear process of investigation and design, which is similar to the planning stage of PAR, then move on to making, which relates to the action stage of PAR, and lastly, communication and evaluation, which can be reflection in PAR. As mentioned above, the mini-PAT stages are non-linear, and one can pass a step and return to it later.

Khan and Chovanec (2010:34) also stress that PAR embraces the notion that knowledge claims promote human interaction and are socially constructed, embedded within the system of values and understood through the mental process. The epistemological stance of PAR relates to the theoretical framework of this study

as well. Constructionism encourages the sharing of knowledge and working collaboratively. Sharing and working collaboratively promote PAR as well.

3.7 ONTOLOGY OF PARTICIPATORY ACTION RESEARCH

The term “ontology” refers to the nature of social reality, the kinds of things that exist, the conditions of their existence and the relationships among these things (Blaikie, 2007:103). Ontologically, PAR assumes the interactions between subjective and objective realities (Baum, MacDougall & Smith, 2006:855).

The ontological perspective of PAR resembles that of constructionists in the sense that participatory action researchers trust that numerous realities exist in peoples’ minds, which recognise that subjectivity cannot be separated from objectivity (Reason, 1997:274; Reza, 2012:27). This perspective suggests that subjectivity and objectivity are in constant interaction, not apart from each other (Freire, 1970:50). The PAR philosophy encapsulates the concept that people have a right to shape their development, and it recognises the need for local people to form part of the process of meaningfully analysing their own situation, over which they share power and control in order to lead to sustainable development (McDonald, 2012:36). PAR perceives all human beings as dynamic agents capable of reflexivity and self-change.

PAR was chosen as a method of collecting data in this study for the reason that it disapproves supremacy, seclusion and the restriction of knowledge. In this study, the co-researchers were seen as human beings, not as subjects who did not have feelings or ideas or could be manipulated in a controlled environment. The co-researchers’ ideas and voices were acknowledged, and they were at liberty to utter their contributions and ideas to the discussions without being discriminated against or looked down upon (McGregor, 2010:423). PAR and constructionism are related to this study as they both seek to develop strategies that shed light on the components of people’s social reality, regarding what exists. They both emphasise working collaboratively as equals and the sharing of knowledge.

3.8 THE ROLE OF THE RESEARCHER

The role of the researcher in PAR is that of a facilitator who works collaboratively to involve the stakeholders in every aspect of the research process (McTaggart, 1991:289). Apart from being a facilitator, the researcher's role in PAR is also that of being a consultant partner with the co-researchers with the purpose of bringing about social change. Developing trusting relationships with key stakeholders is a key aspect of the research process, requiring negotiation and reciprocity. The relationship between the researcher and the other participants should be one of co-research, thereby allowing the co-researchers' input not only into the results but also into the definition of the problem or issue to be researched. Therefore, the researcher has to ensure that the co-researchers are afforded an equal opportunity to ventilate their views and the strategies they think might be effective to solve the problem at hand. This is confirmed by Dube (2016:121), who states the role of the researcher as that of an equal part of a group that is studying and improving practice. The researcher is also expected to be the team leader of the research project. The leader of a research project is responsible for identifying the relevant team members, as well as seeking permission to conduct research from the relevant authorities (in this case, the DoE).

Other responsibilities of the researcher include securing venues for meetings, preparing resources required for workshops and meetings, and keeping records of the meetings. Qhosola (2016:109) clarifies the role of the researcher as being the convener of the research, the facilitator, the initiator of the research and the conductor of the research with the research team. Watters et al. (2010:20) explain that the role of the researcher is to supervise research activities, assume responsibility for the project budget, allocate money to cover project expenses according to the project budget, provide input on the methods and tools to be used for data generation and analysis and to facilitate decision making.

3.9 ETHICAL CONSIDERATIONS

Ethical considerations are concerned with a genuine approach of executing the research study in dealing with the co-researchers, affecting the method of how the

data are collected, recorded, interpreted and used to circumvent harm to the co-researchers (Leowenson et al., 2014:74). Ethical considerations are a critical part of the research project as they are the norms or standards for conduct that distinguish between right and wrong (Dick, McKee & Porter, 2013:65). When conducting PAR, researchers need to take into cognisance a number of ethical principles, as outlined by Winter (as cited in McDonald, 2012:45). The first principle pertains to the researcher ensuring that all relevant stakeholders have been consulted and the principles guiding the work have been accepted before the commencement of the research.

In this study, permission to conduct the research was sought from the KwaZulu-Natal DoE, which was granted. Ethical clearance was also granted by the Ethical Committee of the University of the Free State. The co-researchers were identified and informed timeously about the research project. The essentials of the research were explained to the co-researchers, including the procedures that would be followed as well as how they would benefit from the study. The co-researchers were made aware that their participation was voluntary. They were not coerced to participate, hence they were at liberty to withdraw their participation, should they desire to do so. Consent forms were made available to the co-researchers – the teachers and the subject advisers.

DESA (2011:7) stipulates that researchers must recognise the participants' entitlement to privacy and accord them their rights to confidentiality and anonymity, unless they specifically and willingly relinquish this right. Therefore, pseudonyms were used in this study to ensure that the co-researchers remained anonymous (Babbie & Mouton, 2001:521; Basit, 2010:60; Shallwami & Mohamed, 2007:13), thereby ensuring confidentiality, which is a crucial element in ethical considerations. The co-researchers were assured that harmful effects of the research would be avoided as Mertens (2005:33) explains that the research "aims at maximising good outcomes, circumventing unnecessary risk, harm or wrong". In response to this, I highlighted that this research seeks not to harm anyone but to assist all in terms of the solution to the problem at hand. It was also clarified that the research findings and results would be open and available to all.

3.10 DESCRIPTION OF THE RESEARCH SITE

In this section, I delineate the research site. The description of the research site is imperative to researchers in CDA to highlight the “community’s historical and current context, culture and relationships” (Henning, Van Rensburg & Smit, 2004:3), which may configure the community’s way of thinking and ultimately affect their way of life. Amajuba is a semi-urban district situated in the northern part of KwaZulu-Natal. It consists of two circuit managements (CMs), namely the Dannhauser CM and the Newcastle CM. Each CM has four circuits, consisting of approximately 30 to 35 schools each. In total, the Amajuba District has 269 schools.

Out of the 269 schools, 200 are offering technology at the GET phase. These 200 schools include both primary schools with Grades R to 7 and high schools with Grades 8 to 12, as well as combined schools with either Grades R to 9 or Grades R to 12. Technology is offered in the senior phase (Grades 7-9). This implies that there are approximately 500 teachers who teach technology at these schools. The greater part of the Amajuba district is rural, and the communities are impoverished, resulting in most of the schools falling under quintile 1 – meaning they are no-fee schools.

3.11 SELECTION OF CO-RESEARCHERS

I selected a team of teachers from all the circuits in the Amajuba District to serve as co-researchers in this study. The Amajuba District has eight circuits; hence eight teachers were selected. Among the selected teachers there was one HoD, one deputy principal and six post level one teachers. Technology subject advisors were also included in the team of co-researchers. One of the selected subject advisors was a senior education specialist and the other one a deputy chief education specialist. All the co-researchers were selected because they displayed passion for and an interest in teaching technology, and raised concerns about certain issues regarding the subject. This was observed during on-site visits and technology workshops.

I am conscious of the fact that people who are concerned about what they do, are always keen to improve on what they have. Hlalele (2013:565) confirms that

solicitous people converge to construct their vision on how they want to learn in order to improve in future. The selected teachers and subject advisors are considered important as they are the people who are exposed to the daily teaching of the mini-PAT. They know exactly the challenges they encounter during their daily teaching of subject.

3.11.1 Credentials of the team

The co-researchers were selected purposefully based on their passion for the subject. During technology workshops and onsite visits they continuously demonstrated interest in technology, although some of them had no background in technology. Some of them specialised in commercial subjects, and others specialised in social sciences. A few have a physical sciences background and they teach subjects such as civil technology.

Pseudonyms are used to identify the co-researchers. The researcher used familiar surnames and the gender is also specified so as to demonstrate that both male and female teachers had been selected. The biographical information of the co-researchers is revealed in this study to demonstrate that some of the co-researchers had not specialised in technology.

3.11.1.1 The researcher

I, the researcher, started teaching in the year 2000. I taught mathematics in the GET phase. In 2001, I started teaching technology when it was first introduced in Grade 8 as part of Curriculum 2005. I also taught woodworking and civil technology in the FET phase (Grades 10-12). I was then appointed as a technology senior education specialist (subject advisor) in August 2008. As such, my duties included supporting teachers in teaching technology, as well the implementation of policies. I am currently engaged in a study towards a master's degree.

3.11.1.2 Teachers as co-researchers

Mr Dlamini is a HoD for sciences, who teaches technology to Grades 7 to 9 at a rural school. Some of the classes he teaches are multi-graded. He holds a Diploma in

Marketing and a Postgraduate Certificate in Education. He has six years' experience in teaching technology.

Mrs Nukeri is a post level one teacher. She has a BEd degree and an ACE, specialising in business studies. She teaches at a remote rural school, located about 150 km away from the Amajuba District Office. She teaches business studies in the FET phase (Grades 10-12), natural sciences in the GET phase, natural sciences and technology in the intermediate phase (Grades 4-6) and technology to Grades 7 to 9. The school is multigraded in the GET phase.

Miss Ndlela holds a BCom degree, specialising in accounting. She is a post level one teacher who teaches technology to Grades 8 and 9, as well as business studies and accounting in the FET phase.

Mrs Zulu is the deputy principal of a township school. She holds a Senior Teachers' Diploma and specialised in life sciences and Afrikaans. She also has an Advanced Certificate in Education and a BEd Honours degree in Education Management Law and Policies.

Mr Ramrij has been teaching technology since 2002. He holds a BSc degree, specialising in mathematics and physical sciences, as well as a Postgraduate Certificate in Education.

Mrs Nagel is a post level one teacher. She has a Primary Teachers' Diploma and a Higher Diploma in Education. She teaches at an ex-Model C school. She teaches natural sciences technology in the intermediate phase.

Mr Mkhize teaches at a combined school, which has Grade R to Grade 12. He holds a BSc degree in agriculture. He started teaching technology in 2015 and also teaches mathematical literacy in the FET phase.

Miss Msimango holds a BEd degree, specialising in civil technology and engineering graphics and design. She teaches at a high school situated in one of the two townships in the Amajuba District. This is the only high school in the section where it

is located; hence there is a huge enrolment in the school, resulting in large classes of approximately 80 learners per class. The Grade 8 and 9 classes have five sections (8A-8E and 9A-E). Miss Msimango teaches Grade 9 and is responsible for civil technology in Grades 10 to 12.

3.11.1.3 Subject advisors

Mr Sangweni is a deputy chief education specialist (technology and natural sciences), who holds a Senior Teachers' Diploma, a Higher Diploma in Education, a BTech degree and a master's degree in curriculum studies. As a manager, he is responsible for supervising his component and supporting technology teachers with regard to curriculum implementation and all other aspects required for effective teaching and assessment in technology.

Mr Khanyile is a senior education specialist in technology. Mr Khanyile holds a Senior Teachers' Diploma in Information Technology, an Advanced Certificate in Education and a BEd Honours degree in curriculum studies. He was appointed as a senior education specialist in 2008. He started teaching in 1989 and taught the following subjects as a post level one teacher: biology (life sciences), mathematics and mathematical literacy, and technology from 2001.

3.12 SPIRAL OF PARTICIPATORY ACTION RESEARCH

I communicated telephonically with the co-researchers after sending them letters in which they were requested to be co-researchers in the study. I set a date for the first meeting. Fortunately, all the co-researchers agreed to meet, and the starting time seemed to be convenient for all of them. During the initial gathering, I shared information about the intended research. I explained to the co-researchers that they were going to work collaboratively as equals during the generation of the data. I elucidated that PAR would be employed as the data generation method and clarified the details of how PAR operates. The consent forms were given to the co-researchers, and we discussed matters of ethics. It was spelt out that their identities would be protected. The goals were set and the research question formulated. We planned further meetings at which the objectives of the study would be discussed.

The co-researchers suggested that we created a Whats-App group and conducted some of our meetings on that platform. The suggestion was supported by the fact that they lived far apart from one another since they were from all eight circuits in the Amajuba District, consequently making it difficult to meet at one venue, namely the education centre. Pain, Whitman and Milledge (2011:5) declare that some plans might change from the way they had been planned, which supports the change of the way we intended to meet. I was tasked with creating the group, which was carried out with ease. At this meeting, a plan of action was collaboratively developed by the team to plan for the activities that were to take place to move forward. This plan responded to the objectives of the study to strengthen the teaching of the mini-PAT. The activities of the research would occur along the cyclical stages of PAR. The activities that were carried out during the first meeting were also included in the plan of action.

3.12.1 The plan of action

According to Molo (2014:123), an action plan should illustrate the activities that would be conducted by the team, the person responsible for leading the discussions, the timeframes and the monitoring strategies. The stage in terms of the PAR cycle is also included.

Table 3.1: Plan of action

NO.	ACTIVITIES	DISCUSSION LEADER/ PERSON RESPONSIBLE	TIMEFRAME	MONITORING	PAR STAGE
1	Information-sharing session, discussing ethics and securing consent	Principal researcher	60 minutes	Participation in discussions	Planning stage of the PAR cyclical process
1	Setting goals for the study	Mr Sangweni	30 minutes	Participation in discussions	

NO.	ACTIVITIES	DISCUSSION LEADER/ PERSON RESPONSIBLE	TIMEFRAME	MONITORING	PAR STAGE
1	Formulating research question	Miss Msimango	30 minutes	Participation in discussions	
2	Identifying challenges that hinder the successful execution of the mini-PAT	Mr Khanyile	60 minutes	Brainstorming as a group and feedback or conclusions on the findings during the discussions	Action
2	Discussing components of the solutions	Mr Mkhize	60 minutes	Brainstorming as a group and feedback or conclusions on the findings during the discussions	Action
3	Discussing conditions conducive to the successful implementation of the plan to strengthen the teaching of the mini-PAT	Mrs Zulu	60 minutes	Discussions and feedback sessions	Action
4	Discussing factors that might threaten the successful implementation of the strategy	Principal researcher	120 minutes (two meetings)	Discussions and feedback session	
5	Discussion on success indicators	Mr Khanyile	120 minutes (two	Feedback session	

NO.	ACTIVITIES	DISCUSSION LEADER/ PERSON RESPONSIBLE	TIMEFRAME	MONITORING	PAR STAGE
			meetings)		

The first meeting with the co-researcher was conducted in the form of a introduction to the research. This was an information-sharing meeting. The problem was identified. Consent issues were addressed where it was explained to the co-researchers that they were at liberty to withdraw their participation should they wish to do so. The roles of all involved were clarified and ethical matters were discussed. The research methodology was laid out for the co-researchers and they were further made aware that we are all equal in the research. The principles of PAR were to be observed at all times. The goals for the study were set and the research question was formulated.

During the second meeting, the challenges confronted by technology teachers were collaboratively unpacked. They were captured and they were then beamed in order to brainstorm them. The co-researchers and the researcher stuck to the principles of PAR throughout the session. Feedback was then given to the whole group, which led to concluding the findings.

During the third meeting, the discussions leader started by giving the brief, which was to look at the findings on the challenges and come up with possible solutions to the tabled challenges.

The following meeting dealt with the conditions conducive to the successful implementation of strengthening the execution of the mini-PAT. The conditions were brainstormed, discussed and the group agreed on them.

Factors that could threaten the implementation of the plan to strengthen the execution of the mini-PAT were also dealt with, following the same procedure as

when the challenges, solutions and conditions had been discussed. PAR principles were followed throughout all of the meetings.

The indicators of success were looked into at the last meeting convened.

3.13.1 Critical discourse analysis

After the generation of the data with the co-researchers, data analysis had to be conducted. In this study, CDA was adopted for data analysis. CDA is an acronym for critical discourse analysis. CDA, according to Van Dijk (1993:252), does not aim to contribute to a specific discipline, paradigm and school or discourse theory but is concerned about and influenced by presenting social issues, which it aspires to understand better through analysis. CDA concedes the need to examine in practical terms and how one goes about performing a critical analysis of text and talk (Van Dijk, 2011:89). Furthermore, CDA can be used as a means for the explanation, elucidation and interpretation of generated data (Van Dijk, 2003:352). Govender and Muthukrishna (2012:93) assert that CDA desires to know how structures, strategies and other properties of text, talk, verbal interaction or communicative events play a role in the modes of the reproduction of power relations, enactment, representation, legitimisation of denial, mitigation or the concealment of dominance, among others.

On the other hand, Rogers (2011:1) contends that CDA addresses disparities in educational sites, practices and systems, with appreciation for the fact that the world is characterised by inequality. Tenorio (2011:183) notes that “from inception, CDA was a discipline designed to question the status quo, by detecting, analysing, and also resisting and counteracting enactment of power abuse as transmitted in private and public discourses”.

3.13.2 Definition of critical discourse analysis

Van Dijk (2012:23) defines CDA as a discourse analytical research that primarily studies the way social power abuse and inequity are enacted, reproduced, legitimated and resisted by text and talk in the social and political process. It is founded on the insight that text and talk play a key role in maintaining and

legitimising inequality, injustice and oppression in society. CDA employs discourse analysis to show how this is done and seeks to spread awareness of this aspect of language use in society. It argues explicitly for change on the basis of its findings. CDA is meant to provide a higher awareness of the hidden motivations in others and ourselves, and therefore, enables us to solve concrete problems – not by providing unequivocal answers but by making us ask ontological and epistemological questions (Van Dijk, 2012:20).

From a different point of view, Locke (2004:2) views CDA as associations “between discursive practices, events and text and wider social and cultural structures”. Jorgensen and Phillips (2002:88) refer to CDA as a movement that endeavours to ensure equal representation of issues, making democracy possible through the analysis of issues, feelings and perceptions hidden in text and talk. The importance of CDA is that it “strives to explore how these non-transparent connections are a factor in fortifying power and hegemony, and it draws attention to power imbalances, social inequities, nondemocratic practices, and other injustices in hopes of spurring people to corrective actions” (Fairclough, 1992:32). Van Dijk (2008:89) explains that CDA is used to understand, explore and ultimately resist social injustice. This demonstrates that CDA is a theory that seeks social change where the interests of the poor or disadvantaged are taken into consideration in teaching.

CDA reproves inequality of any form that is revealed either in language, text, discursive or social practice (Dube, 2016:131). CDA confirms my selecting constructionism as the theoretical framing underpinning this study in the sense that CDA encourages people to solve social problems together to improve human conditions that people in society confront (in this case, teachers teaching technology). CDA also justifies the use of PAR as an approach for data generation since they both seek to fight for the disadvantaged members of society. In CDA, the generated data are analysed at three levels, namely the textual, discursive and social practice levels. The CDA levels of analysis are discussed in detail below.

3.13.3 Levels of analysis

3.13.3.1 Analysis at textual level

Analysis at text level is regarded as the first level of data analysis in CDA. This level focuses on how text is used and what relationships exist between text, interactions and social practices (Fairclough, 1992:97). Fairclough further elucidates that text may be spoken or written in the form of transcribed text. Huckin (2002:9) attests to the above statement by saying that text level analysis includes “genre, heteroglossia, framing, extended metaphor, foregrounding, omission and auxiliary embellishments”. Text and talk signal their contextual relevance in numerous ways; therefore, context structures need to be observed and analysed in detail (Van Dijk, 1997:29).

According to Nasir and Xiaoyong (2013:9), CDA in relation to text-level analysis is the “space which allows for analysis of written and spoken text to explore the discursive sources of power, dominance, inequality and bias”. Govender and Muthukrishna (2012:29) aver that success in the utilisation of text for analysing data “requires that structures, strategies or other properties of text, talk, verbal interaction or communicative events play a role in the modes of reproduction of power relations, enactment, representation, legitimating denial, mitigation or concealment of dominance among others”. In this study, textual analysis (spoken words and written formats) was conducted by the co-researchers and me as equal partners in this research. Issues of inequality, dominance by one party during deliberations and social justice were taken into cognisance. During discussions, spoken text was audio-recorded. The audio recordings were voice notes in the case of meetings held on the WhatsApp group. The audio-recorded text was analysed at textual level.

The second level of analysis was the discursive level. It is discussed below.

3.13.3.2 Discursive level of analysis

The second level of analysis focuses on language as a discursive practice. The discursive level of data analysis is concerned with how text is produced and interpreted by the participants to interpret the configuration of discourse practice

(Fairclough, 1992:97). Fairclough and Wodak (1997:258) elucidate that the discursive level of analysis pays attention to issues that sustain and reproduce the social status quo and how these issues can be transformed. Jansen (2009:109) states that the discursive level of data analysis examines issues that “construct and maintain unequal power relations”. Discursive practices may have “major ideological effects – that is, they can assist produce and reproduce unequal power relations between social classes, women and men, and ethnic or cultural majorities and minorities through the ways in which they represent things and position people” (Fairclough & Wodak, 1997:258).

At the discursive level of analysis, the responses of the co-researchers with regard to issues raised during the discussions were examined. The responses given, portrayed the underlying assumptions about others; hence the analysis at this level sought to unearth the often-tacit conceptions of people as emanated in the discussions, especially when they sought to reproduce social inequality (cf. Dube, 2016:134).

3.13.3.3 Discourse as a social practice

The third level considers discourse as a social practice. The primary focus at this level is to describe and explain how social issues (gender, power, culture, religion, policies and contextual issues) may have influenced what people perceive to be knowledge and what impact the mentioned social issues have on the construction of that knowledge (Fairclough, 1997:97). This level is concerned with an explanation of how and why social practices are constituted, changed and transformed in the ways they are. The analysis at all three levels mentioned in this study is interpretive, descriptive and explanatory (Rogers, Malancharuvil-Berkes, Mosley, Hu & Joseph, 2005:371).

Analysis at the social practice level of CDA implies a “dialectical relationship between a particular discursive event and the situation(s), institution(s) and social structure(s) which frame it” (Fairclough & Wodak, 1997:258). During this level, I (the researcher) examined the co-researchers’ inputs or suggestions during the research process. I then examined the co-researchers’ words to establish whether there were

any signs of technologies of inclusion and exclusion. The spoken and written discourse are forms of social practice in the sociocultural context and the language. Language users may enact, confirm or challenge more comprehensive social and political structures and institutions (Van Dijk, 1997:30).

3.13.4 Origin of critical discourse analysis

The roots of CDA lie in rhetoric, text, linguistics, anthropology, philosophy, socio-psychology, cognitive science, literacy studies and social linguistics. Three schools of thought are linked to CDA. Firstly, it links to Amsterdam. CDA emerged in the 1970s. It was a form of discourse and text analysis that recognised the role of language in structuring power relations in society (Wodak, 2001:13). Wodak (2001:4) further elucidates that CDA rose through a small symposium in University of Amsterdam in January 1991, where scholars such as Teun, Van Dijk, Norman, Fairclough, Kress, Theo and Van Leeuwen discussed CDA theory and its approach. In contrast, scholars such as Huckins, Andrus and Lemon (2012:108) state that CDA rose in connection with critical linguistics, with scholars such as Gunther Kress, Roger Fowler, Bob Hodge and other students of Halliday in the 1970s.

CDA is characterised by numerous principles; for example, all approaches are problem-oriented and thus necessarily interdisciplinary and eclectic in nature. Moreover, CDA is characterised by common interest in demystifying ideologies of power through systematic and reproducible investigation of semiotic data (written, spoken or visual) (Wodak, 2008:3). CDA researchers also attempt to make their own position and interest explicit while retaining their respective scientific methodologies and remaining self-reflective of their own research process (Van Dijk, 2012:21). Hart (2007:106) notes that CDA is a “multidisciplinary theory of analysis consisting of a number of different theoretical approaches to micro level analysis of text and talk that has to do with the social and or political”.

3.14 SUMMARY OF THE CHAPTER

The focal point of this chapter was PAR, which was used as an approach for data generation. PAR was used, seeing that it is a method of data generation that seeks

to bring about transformation, actively involving all people within a community to work towards this change. PAR was further discussed, referring to its origin, formats, objectives, stages and steps, which distinguish PAR from other data generation approaches. The epistemology and ontology of PAR were touched on, as well as ethical considerations, which are critical in any research project. CDA was then discussed as it was utilised in this study for data analysis. The study also demonstrated how CDA was used to analyse data at textual, discursive and social practice levels. The next chapter explores an analysis of the data that were generated.

CHAPTER 4

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

4.1 INTRODUCTION

The study aimed to find ways that could be employed by technology teachers in the Amajuba District to strengthen the teaching of the mini-PAT in a senior phase technology class. This chapter focuses on the analysis, interpretation and presentation of the data generated during PAR meetings with the co-researchers. Van Dijk's CDA is utilised for data analysis. The generated data are analysed at three levels, namely textual, discursive and social practice. At the textual level of data analysis, the language (or words) used to communicate certain meanings is (are) scrutinised. The discursive level deals with inappropriate practices displayed in the language. At the social structural level, power relations are checked. The empirical data generated through PAR respond to the five objectives of this study, as stated in the first chapter.

4.2 CHALLENGES TO THE TEACHING OF THE MINI-PAT IN A TECHNOLOGY CLASS

This section discusses the challenges encountered by teachers during the teaching of the mini-PAT in senior phase technology classes. The challenges identified by the co-researchers are as follows: inadequate PCK, the shortage of educational resources, the high learner-teacher ratio and inadequate professional development.

4.2.1 Pedagogical content knowledge

Pedagogical content knowledge (PCK) is a fundamental area of teacher development in advanced levels of teaching (Shulman, 1987:20). The ministry of education corroborates that while teachers in South African schools are experienced to teach a number of subjects, many teachers who are teaching technology are grappling with an inadequate knowledge base and inadequate pedagogical skills of technology (Mapotse, 2014:2; Omorogbe, 2013:181). Mastering content is the basis

for effective teaching. Spady (2008:9) states that in conventional educational practices across the world “content is king”, which means that the education system is arranged around the content the teacher wants the learners to remember and understand. Content knowledge and pedagogical knowledge are closely associated. Literature has denoted that teachers are confronted by a huge challenge in teaching technology skills and content (Makgato, 2013:3689).

One of the challenges towards the teaching of the mini-PAT, as articulated by co-researchers and supported by the reviewed literature, is inadequate PCK. Inadequate PCK is a contributing factor in the failure of executing the mini-PAT effectively. Technology teachers need to have sufficient content knowledge of the subject. This is not the case in the Amajuba District as the subject is a newcomer to the South African curriculum (see 2.9.2.1).

The group constituted of all co researchers.

During our group discussions with co-researchers, all of the co-researchers were in agreement regarding the state of content knowledge:

Mr Mkhize: *“We experience challenges in graphic communication and making models. Most of us did not specialise in technology; hence we struggle a lot with 2D, 3D drawings, perspective drawings, both single- and double-point and first-angle orthographic projections.”*

Miss Msimanga interrupted: *“The drawing part is important in design processes because learners are expected to design their models and all these drawing skills are required.”*

Mr Dlamini added: *“Now if drawing is a challenge to us as teachers, it is transferred to the learners and they also struggle to do the mini-PAT because they are not guided properly by us as teachers.”*

Mr Mkhize further pointed out: *“Teaching systems and control is a problem to me. If, for example, in my Grade 7 class, learners have to design and make a ‘jaws of life’, pneumatic and hydraulic systems are the mechanisms that have to be used there.”*

Mr Mkhize then posed a question, saying that if he as a teacher was battling with the content of how these mechanisms function, *“How will the learners know?”*

The team expressed their distress regarding the lack of PCK, concurring that it is a huge obstacle. During the empirical data generation, it was evident that most of the teachers had not specialised in technology. The team admitted that they faced this problem because they had not specialised in technology. They were worried about what would happen to the learners who depended on them when they were experiencing difficulties in teaching the mini-PAT.

Mr Mkhize's assertion was that *"most of us did not specialise in technology"*. It was evident that technology was not their area of specialisation; hence they were not well developed, which resulted in their lack of PCK. They questioned their ability to teach technology while they did not have sufficient content knowledge themselves. This was after Mr Mkhize posed the question: *"How will the learners know?"* The co-researchers strongly felt that what they were doing was social injustice.

It is noticeable that the co-researchers kept on saying *"I"*, which reflects that they worked in silos. Nothing seemed to demonstrate their working together to share knowledge and assist one another in the areas of knowledge where they encountered challenges. The analysis indicates that teachers are confronted by the huge challenge of not understanding some parts of the content in technology, which has a negative impact on their teaching. The co-researchers mentioned graphic communication, which is essential in the *"design"* part of the mini-PAT, as well as mechanical systems and control, and electrical systems.

Constructionism believes in the sharing of knowledge and the team raised the impossibility of sharing what one does not understand (Bers et al., 2002:132). It is evident from this study that teachers' enhancement of their PCK in technology is of vital importance for them to be able to cascade knowledge and skills to the learners. Content knowledge entails knowledge representation of the subject matter, and pedagogical knowledge speaks to teaching strategies (Shulman, 1986:9). Literature attests that inadequate content knowledge of technology teachers is contributory to the injustice done in teaching the mini-PAT. I specifically noted in this study that the teachers were struggling with content knowledge. This calls for intervention so that justice could be done in the execution of the mini-PAT.

4.2.2 Educational resources

The second challenge raised during the empirical data generation was the unavailability of required resources. The literature affirms this by stating that a lack of ideal teaching resources poses to be a challenge in the teaching the mini-PAT (see 2.9.2.2). CAPS (DBE, 2011a:13) stipulates the requirements for technology, under which it is mentioned that it is the school's responsibility to ensure that every learner is provided with the minimum tools and material to meet the requirements of the subject. Furthermore, it mentions that each learner must have an approved textbook. The SMT, with the HoD in particular, has a responsibility to ensure that all the teachers under their supervision or in their departments are equipped with the essential tools of trade for the effective implementation of the curriculum (in this case, the execution of the mini-PAT). This is confirmed by the Personnel Administrative Measures document (1998:36) which stipulates that the HoDs are responsible for ensuring that all subjects and teachers under their supervision are furnished with the relevant resources. Providing the essential resources assists both the teachers and the learners to teach and learn effectively.

Literature reveals that teaching resources are not just the objects that are used during the teaching and learning process but anything used by teachers and learners to make teaching more real and practical (see 2.9.2.2). Bolick et al. (2003:23) elucidate that teaching resources are a fundamental element of a teaching and learning situation. Omorogbe (2013:186) confirms that the unavailability of ideal resources for teaching in Nigerian schools has been a main issue as teaching and learning resources assists in making teaching successful and effective.

A lack of teaching resources also prevails in schools in the Amajuba District, as indicated by the research team. The data generated during the group discussions or research meetings reflected the following comments from two co-researchers – Mrs Nukeri and Mrs Nagel. **Mrs Nukeri** highlighted that the unavailability of required material is problematic in their school:

I am teaching technology in Grade 7 and it is difficult to get these materials from learners. I ask them to bring material for a project and a few learners bring the material. If the school management team can help by providing the required material to use on a mini-PAT...

Mrs Nagel emphasised that she taught in a former Indian school and painted the following scenario:

Learners don't come with models or they come with bad models, while some come with good models because of resources and parent involvement.

The co-researchers' statements that "*it is difficult to get these materials from these learners*" and "*[L]earners don't come with models*" indicate that teaching becomes a challenge, especially demonstrating the practical elements. The above statements spell out that there is a challenge in terms of the availability of resources.

Mrs Nukeri described the difficulties of executing the mini-PAT exercises because of the lack of resources. Furthermore, she emphasised that her endeavours of getting learners to bring the material, proved to be unsuccessful. Mrs Nagel's condition is different from Mrs Nukeri's. She teaches in a former Indian school and struggles with getting this task done by all of the learners because of the lack of the required resources. Mrs Nagel's statement demonstrates that not all the learners provide resources for the "making" part of the mini-PAT. This demonstrates that the learners come from different backgrounds. Issues of socio-economic backgrounds transpire in her assertion. This might be as a result of negligence and disobedience on the part of the learners or alternatively, it could be as a result of a communication breakdown between the school and the parents. Mrs Nagel's statement might also suggest that the parents of the learners who do not provide consumable resources are not involved in their children's schoolwork. This is confirmed by Modisaotsile (2012:3), stating that poor support for learners at home has proven to be a challenge, and it is difficult to get some parents involved.

The statement made by Mrs Nukeri, "*if the school management team can help by providing the required material*", discloses a lack of consultation from the side of the SMT. The teacher's language affirms that there is a disjuncture between the interests of the teacher and the SMT, which denotes power and dominance from the SMT. A good leader invites input from all the people involved under his or her supervision, but if subordinates (supervisees) cannot reach out to the leader, it portrays superiority on the leader's side.

The HoD has to procure the LTSM as they attend SMT meetings where the activities of the school are planned. Their core duty is curriculum implementation and the monitoring thereof. Mrs Nukeri's statement above shows a lack of communication among the subject teacher and the SMT, which might be as a result of not holding departmental meetings where these issues are discussed or negligence on the part of both the subject teacher and the SMT.

The above instances are contrary to the principles of constructionism, which propagate the promotion of working collaboratively and the sharing of knowledge (Bers et al., 2002:132) (also see 2.4). If the school (i.e. teachers and the SMT), parents and learners can work collaboratively towards achieving a common goal of ensuring that the required educational resources are made available, the mini-PAT can be appropriately executed.

It is evident from this study that the lack of educational resources for use during the execution of the mini-PAT portrays that the teachers are excluded in the procurement of teaching resources. This reflects a lack of a collaborative culture and a lack of consultation between the SMT and the subject teachers. Both the teachers and the SMT seem to be lacking in ensuring that the required resources are made available for the effective implementation of the assessment requirements as per the prescripts of the CAPS curriculum. The CAPS document (DBE, 2011a:39) stipulates the formal assessment requirements for technology, which are the mini-PAT and pen and paper tests or examinations.

4.2.3 Learner-teacher ratio

The Education Labour Relations Council (Resolution 4 of 1995) provides a yardstick on the learner-teacher ratio for ordinary schools, which is 35:1 in secondary schools and 40:1 in primary schools. Teaching manageable classes breeds positive results in the sense that a teacher is able to take note of each learner in the classroom. This enhances learning and learner performance. Furthermore, manageable classes allow all the learners to participate fully, and teachers are able to provide immediate and individualised feedback (Sparks, 2010:16).

In the Amajuba District, the issue of learner-teacher ratio is a challenge, in particular to technology teachers as technology is a hands-on subject. This is especially evident in the township schools in the Amajuba District. Literature affirms that high learner-teacher ratios hamper the practical nature of technology as classes are congested (Mapotse & Gumbo, 2012:139). Unmanageable learner numbers in a technology class render the teaching of technology ineffective, while depriving the learners of active involvement and consequently restricting the development of the learners' cognitive skills. Classroom management also becomes impossible for teachers because of the large numbers of learners (Mapotse, 2012:29; 2014:0508).

During our discussions, the following comments were made by Mr Ramrij, Miss Ndlela and Mrs Zulu:

Mrs Zulu indicated: *“Most of us are teaching approximately 65 learners per class, which makes it difficult for us to do justice in teaching the mini-PAT.”*

Ms Ndlela agreed: *“Yes, the floor space is a problem because learners are squashed in classrooms where they are seated three per desk. As a teacher, you can't even move in between the desks. You can't even control the learners because of the numbers.”*

Mrs Zulu added: *“What makes matters worse is that one is always berated and told that your classroom is making a lot of noise because it is not easy to control the learners. When you try to raise this issue of large numbers in the staff meetings, you are told that other subject teachers are not complaining because even the SMTs do not understand the nature of the subject.”*

Mrs Nagel indicated: *“I really don't have a problem with overcrowding because in my school we have an average of 33 learners per class.”*

Mr Mkhize indicated: *“It becomes difficult for me as a teacher to teach, assess and give immediate feedback due to the number of learners per class... it is difficult to give individual assistance and attention to learners. Moreover the large numbers prohibits the differentiation process in class.”*

Mrs Zulu's concern that *“it is not easy to control the learners”* indicates that classes are unmanageable, which makes it difficult to assess and give immediate feedback and pay individualised attention to the learners. The above statement *“one is always berated and told that your classroom is making a lot of noise”*, made by Mrs Zulu

indicates that the SMT does not support the teachers and does not understand the nature of technology as a subject. The SMT does not even understand that large numbers in technology classes hinder full participation of the learners because of the learner-teacher ratio, which in turn, affects positive results in terms of learner performance as well as teacher performance. This works against the principle of social justice in that the concern of the teacher would not be considered as it was highlighted that other teachers do not have a problem with the number of learners per class. Mrs Nagel indicated, "*I do not have a problem with overcrowded classes.*" This aspect creates inequitable working conditions among teachers as some schools have manageable numbers of learners per class, while some have too many learners. In this instance, unequal social parameters among teachers are evident in the study.

Mrs Ndlela's assertion demonstrates that classes are overcrowded in such a way that even the furniture in the classrooms is not enough, resulting in learners being "*squashed*" or squeezed together in classrooms. The team highlighted two reasons for or causes of overcrowding. The first reason was not having enough teachers per school, which makes it difficult for the school to have manageable numbers in classrooms. Some learners are left unattended and the floor space is inadequate, meaning that there is a shortage of classrooms, which causes overcrowding. This implies that the causes of overcrowding differ from one situation to another, which proves that schools operate autonomously, depending on the geographic location. Moreover, the team raised the critical issue of not being able to control the learners due to large learner numbers, leading to chaos and undesirable incidents in their classrooms.

Mrs Zulu's statement about the SMT, about teachers of other subjects not complaining about the number of learners per class works against the principle of social justice in that teachers are hindered from performing their duties to their optimum ability because of a large number of learners in a class. This shows that there is inequity and some things are perceived as normal if they happen in certain schools. The fact that teachers are reprimanded by the SMT for the high levels of noise in their classrooms demonstrates that the SMT does not take it upon itself to comprehend what each subject entails. Issues of power abuse are also evident. The

fact that the SMT disregards the complaint made by teachers demonstrates that the SMT exercises its power while violating the rights of teachers. This is contrary to the principle of CDA of advocating social justice. The actions of the SMT appear to impose its dominance on the matter of teachers as they are overruled on the issue of learner numbers.

Constructionism seeks to promote learning by doing. It argues that learners are most likely to become intellectually engaged when they are working on meaningful activities and projects (Bers et al., 2002:132). It also encourages the fact that the learning environment is marked by a deep involvement of all participants (see 2.4.2). Constructionism further stands for working collaboratively. This circumstance of teachers having to teach more than 65 learners per class works against the principles of constructionism. Similarly, the behaviour of the SMT is contrary to working collaboratively.

4.2.4 Professional development

Ongoing teacher development is essential as it is an integral part of teacher education in the sense that only continued learning and training guarantee an optimum level of expertise and enable teachers to keep their professional skills and knowledge up to date (Avalos, 2010:12). The Personnel Administrative Measures document (EEA 76, 1998:c-63) stipulates that the employer can subject teachers to attend 80 hours of professional development. The condition is that teachers must be notified three months in advance if such training will take place. Teacher development is central to the success of curriculum transformation (Brown et al., 2000:32). Capacitating teachers is explained as “the professional growth which a teacher achieves as a result of gaining increased experience and examining teaching systematically” (Reimers, 2003:1).

Teacher development keeps teachers up to date in terms of curriculum changes. The co-researchers indicated that they have faced a challenge in terms of inadequate professional development. This is confirmed by literature denoting that teachers confronted the challenge of not being developed in terms of technology as a subject. This is confirmed by Ampofu (2009:15), who states that although teachers

in South African schools are competent to teach a number of subjects, they are not qualified to teach technology (also see 2.9.2.4). Moreover, it is highlighted that although teachers have been trained during the implementation of outcomes-based education, the training was insufficient for them to be able to implement technology, especially the practical part of it, which is the mini-PAT (Pithouse in Mapotse, 2012:39) (also see 2.9.2.4).

During the group discussions, the following points were raised:

Mr Dlamini: *“I studied marketing at tertiary and I also did PGCE; therefore I need support in technology content and how to teach technology effectively”.*

Miss Msimango pointed out: *“Tech is a new subject in our curriculum.”* She explained further: *“I have been teaching for 20 years, but I must confess that I am still struggling with teaching tech, especially the practical part which carries a lot of weight in the learners’ term mark.”*

Mrs Nukeri: *“I end up teaching some topics and leaving other topics because I am not well developed in tech.”*

Mrs Mkhize pointed out: *“Most of us were not exposed to skills that tech subjects develop because they were seen to be male subjects.”*

The comments above by the co-researchers authenticate that technology teachers have not specialised in technology. Teacher development is most essential to technology teachers because they have not been exposed to these subjects in the previous curriculum and they have not studied technology at tertiary level. The co-researchers deduced the need for intense training, particularly in technology content and pedagogy. Training programmes focus more on unpacking the policy. It appears that although most of the co-researchers are qualified to teach other subjects, they are still grappling with the technology content, particularly the mini-PAT.

The above statements *“I was doing marketing in tertiary and I also did PGCE”*, *“tech subjects... were seen to be male subjects”* and *“I end up teaching some topics and leaving other topics because I am not well developed in tech”* reveal that technology teachers are teaching technology without any training at tertiary level. This also indicates their inadequate level of expertise and that they are not well enlightened on knowledge and skills of the subject. Mrs Mkhize’s assertion above also depicts that

technology is regarded as a male subject and that female learners do not do well in this subject. In this instance, the dichotomy between male and female learners displays the stereotype that certain things cannot be done by female learners, and male learners do better than female learners in practical work.

This works against the principle of social equity. Mrs Nukeri's assertion, "*I end up teaching some topics and leaving other topics*", shows that justice is not done in the teaching of technology. Spot teaching reveals that learners are deprived of their right to be taught all that is to be learned in a particular grade. This unacceptable practice causes learners to move to the next grade with content deficits.

Constructionism advocates that knowledge is co-constructed. If teachers are not well equipped in terms of technology content, it means they cannot construct anything (see 2.2.2). It is evident in this study that "content is king", that is, no effective teaching can occur when there is a lack of content knowledge. If teachers' content knowledge can be enhanced, the mini-PAT can be effectively executed.

4.3 SOLUTIONS FOR SUCCESSFUL TEACHING OF THE MINI-PAT IN A TECHNOLOGY CLASS

This section discusses the possible solutions that will work towards addressing the challenges delineated in 4.2 above.

4.3.1 Pedagogical content knowledge

In resolving the concern of inadequate PCK, team teaching was recommended by the co-researchers. Related literature corroborates with co-researchers and has proven that team teaching boosts many pedagogical and intellectual advantages (Fall, 2006:1). It assists in the creation of a dynamic and interactive learning environment. During team discussions, high levels of intellectual debate among colleagues are displayed. During meetings, teachers are indirectly coerced to take part in a group discussion, which forces them to engage and share their views regarding the content that is put on the table (see 2.9.2.1).

Furthermore, team teaching assists teachers in enhancing their PCK as during deliberations the members are favoured with an opportunity to ask questions about the topic under discussion. Teams are formed by people with different strengths and weaknesses, who consequently complement one another. Transforming from the traditional method of teaching to learner-centred methods can also be beneficial as some learners are more capable than other learners. They can work together and support one another. This is what technology promotes, namely collaborative learning and teamwork. In a research conducted by Jones and Moreland (2004:4), they discovered that negotiated intervention planning and appropriate resources to be used by teachers during teaching are other important aspects that assist in enhancing PCK. This is easily done if teachers work together.

The co-researchers referred as follows to PCK during the discussions:

Mrs Nukeri highlighted: *“Content workshops can be of great assistance in this aspect as well.”*

Mr Rambrij added: *“We use clusters for planning of lessons and formal task development... during cluster meetings, teachers’ work collaboratively in planning lessons and if one is encountering a challenge in a particular aspect those challenges are addressed on the spot.”*

Miss Msimango agreed: *“Sometimes we are unable to attend the cluster meetings because the SMT does not allow us to leave the school earlier and others are also teaching other grades.”*

Mrs Mkhize pointed out: *“In my school, more than one teacher teaches technology. We usually work together by specialising in the one aspect that one teacher is excellent in teaching.”*

Mrs Nagel agreed: *“Ohhh, that results in adequate coverage of all the technology content and learners benefit in all the aspects that are to be covered.”*

The above text, “[w]e usually work together by specialising”, indicates the attitude of teachers towards working together to improve their PCK. This comment displays a positive attitude which can contribute towards enhancing their PCK. With this stance, the positive attitude of teachers brings hope to technology teachers. To the contrary, the attitude of the SMT demonstrates the abuse of power in the sense that if one is a leader of an institution, one should always ensure that everything that happens is in the best interest of one’s subordinates or clients (in this case, the learners).

The analysis of the responses above also reveals that working collaboratively as a team breeds success in any team. Furthermore, it shows that content coverage and the grasping of problematic concepts can be alleviated through team teaching. Moreover, the attitude of the SMT demonstrates that there are challenges in the face of any endeavour to bring about positive change in terms of the execution of the mini-PAT in schools. The co-researchers demonstrated that they were eager to improve themselves on PCK to yield good results in technology.

The responses further reveals that the language of the co-researchers affirms that they are determined to turn around the status quo of technology in their schools. The language of the co-researchers not only reflects courage but also embraces an attitude of making it happen. The same cannot be said about the SMT – its members conveys dictatorship and a “what I say goes” attitude, which brings disunity to the school and resistance on the part of teachers.

Miss Msimango’s assertion, “*the SMT does not allow us to leave the school earlier*” also displays a lack of consultation between the teachers and the SMT in the sense that permission cannot be withheld if permission for early departure has been requested timeously. Moreover, the cluster meetings occur once or twice per term and the commencement time is usually 13:30 or 14:00. Nonetheless, the action of the SMT appears to show their dominance on matters pertaining to the management of school activities. This indicates that there is a lack of collaboration between the teachers and the SMT, which is in disagreement with the principle of social justice. However, the team teaching that is practised by the teachers is in favour of constructionism, which nurtures working collaboratively, the sharing of knowledge and hands-on learning.

4.3.2 Educational resources in the teaching of the mini-PAT

For the mini-PAT to be taught successfully in schools in the Amajuba District, it is imperative that schools ensure that the essential resources for teaching the mini-PAT are available. Technology is a practical subject that requires resources for it to be effectively taught. The required resources include both consumable and non-consumable resources. Teaching resources are essential for the realisation of the purpose of introducing technology in the South African curriculum, which is to groom

technologically literate people for the present world (DBE, 2011a:13). The CAPS document (DBE, 2011a:13) further stipulates that it is the responsibility of the school to ensure that learners are furnished with the minimum tools and material to meet the requirements of the subject. (A list of relevant material is included as Annexure A in the CAPS document.)

One of the solutions to alleviate the lack of resources in schools as discussed by the co-researchers and confirmed by literature could be to ensure that the essential resources are requested timeously and the request is put forward to the SMT. Downloading from different sites on the internet has been found to be another possible solution in dealing with the shortage of textbooks, which is perceived as the primary resource required for the effective teaching of any subject (DBE, 2011a:13). This then requires that the school prepares for the duplication of such resources. Purchasing toolkits using the LTSM allocation is another option. A third solution is ensuring that learners are timeously issued a list of the consumable materials that would be required for a specific term so that they can start collecting these materials as early as possible (see 2.9.3.1).

During our group discussion sessions with the co-researchers, the following comments were made:

Mr Khanyile: *“If all schools can be in possession of data projectors, integrating ICT where you use your phone on a data projector to beam the content from the internet can be done.”*

Mrs Nagel: *“The money used for purchasing textbooks can be redirected and used for buying tools.”*

Mr Sangweni added: *“Even the workbooks can be downloaded and used during teaching.”*

Textbooks are the primary teaching resource used by teachers. The provision of resources is mandatory and the school has to make sure that they perform their duty, which is to provide tools for teachers to use during teaching. The assertion made by the subject advisor, Mr Khanyile, as captured in the above excerpt, indicates that there are different means of getting information other than from printed textbooks. We need to move forward from the era where only textbooks were utilised as the primary source of information to a new era of ICT. Instead of utilising

textbooks, schools can provide data projectors and install Wi-Fi so that teachers can use their mobile devices to beam the content from the internet. This solves the shortage of textbooks as a primary resource. Improvising consumable resources by learners is also mentioned. Mr Khanyile indicated that integrating ICT could be of great assistance in terms of addressing the issue of a shortage of resources, particularly textbooks.

Constructionism stands for the sharing of knowledge. The co-researchers demonstrated in the discussions that they were sharing what could be done to alleviate the issue of resources. They also agreed that community involvement crops up in the sense that learners can improvise, especially with regard to consumable resources. This automatically involves parents in the sense that if children need anything, they would ask their parents to assist (Regner et al., 2009:264).

It is evident from this study that the means to get resources are in the pipeline and teachers have good strategies that they will use to ensure that they get these resources.

4.3.3 Learner-teacher ratio

In an endeavour to address the issue of overcrowded classrooms, working in small groups has been found to be functional. This is affirmed by Mulryane-Kyne (2010:23), who articulates that using small groups has been found to be one of the solutions to deal with large numbers in classrooms (see 2.11.3.3). Mulryane-Kyne further highlights that changing desk arrangements or seating plans to accommodate small groups, establishing simple rules and allocating duties to each member of the group are of vital importance to be able to manage large numbers of learners in classrooms. This is confirmed by the explanation by Barkley, Cross and Major (2005:15) that learner teams function most effectively when members have designated roles.

The team discussed possible solutions which we thought could militate against the challenge of large learner numbers in teaching the mini-PAT in technology. The team remarked as follows:

Mr Dlamini: *“What I usually do, is to take the independent learners to the classroom that is not occupied and they continue with their work. This allows me to move around freely and focus on the struggling learners.”*

Mr Ramrij: *“Giving learners clear instructions, preferably in writing, so as to make sure that all the members of the group have a clear understanding of what has to be done also make group work effective for me.”*

The discussions continued and the following comments were put forward:

Miss Msimango: *“What I do, is to group learners equally. I make sure that each group has both male and female learners with different abilities.”*

Mr Dlamini: *“I use a raffle for learners to select their responsibilities so that they are all involved.”*

The co-researchers in the above citations reflected that group work seemed to be an effective strategy to outwit the issue of large classes. It also highlights that learners are randomly grouped to increase diversity. The issue of social justice is considered in this assertion in the sense that the co-researchers made provision for diversity, where female learners are also considered to lead teams. Group work promotes togetherness and the sharing of knowledge; it encourages active learning and develops key critical thinking skills. The preceding statement reveals strategies that can be employed to deal with large numbers in classrooms. The statement, *“I make sure that each group has both male and female learners”*, demonstrates the manner in which this grouping of learners is conducted. Issues of diversity and mental capacity are taken into cognisance as the groups are formed.

Furthermore, group work develops good communication skills, which are allied with constructionism as the theoretical framework used in this study. Technology stimulates learners to be innovative and develop their creative and critical thinking skills. Moreover, it provides opportunities for collaborative learning and nurtures teamwork (DBE, 2011a:8). The principles of social justice and equity are considered as positions in the groups are not imposed on the learners, but they select duties in a raffle box. They are even given the opportunity to swap duties if they wish to do so or if they are uncomfortable with the duties they have picked.

The manner in which the co-researchers were pronouncing the issue of learner numbers per class served as evidence in this study that they have accepted the situation. This is contrary to the principle of social justice as the rights of the teachers are violated here. Moreover, this is contrary to policy as the Education Labour Relations Council (Resolution 4 of 1995) states clearly the number of teachers against that of learners. This also displays power and dominance on the side of the SMT in the sense that it seems as if the SMT does not consider assisting teachers by reducing the number of learners per class.

4.3.4 Solution to professional development.

Professional development is defined as “the process of improving skills and competencies needed to produce outstanding educational results for students” (Hassel, 1999:18). Guskey (2000:4) states that “one of the constant findings in research literature is that notable improvements in education almost never take place in the absence of professional development”. He further elucidates that professional development is key to achieving the current educational demands. For the successful implementation of the strategy, teachers need to be well capacitated in terms of content knowledge and methodology. Literature concurs that the training of teachers should be done holistically.

Teachers should be apprised in terms of the practical skills required in technology, as well as its content. This would assist teachers in responding to enabling tasks, and they would be geared for practical work (De Jager, 2011:145). Intensifying teacher education and training at tertiary level can contribute towards producing teachers with proper pedagogy in teaching and learning technology (Makgato, 2013:1). Mapotse (2014:8) suggests that more contact workshops or sessions should be held on a regular basis – at least once a month. In attempting to resolve teacher development, certain strategies have been put in place. Rollnick (2009:26-27) outlines that universities have introduced the ACE programme to improve teacher’s content knowledge and pedagogy. Rollnick also suggests that during teacher training, the activities should be “hands-on” and take on the form of design-based activities.

The following comments were made during our group discussions:

Mrs Nukeri indicated: *“We need to have workshops which will be hands-on every term where it will deal diligently with the content and mini-PAT of the following term.”*

Mr Mkhize said: *“If the department can provide bursaries for technology teachers so that they can upgrade themselves in technology content and methodology...”*

The comment made by Mr Nukeri, *“We need to have workshops which will be hands-on”*, supports the related literature review. It portrays that workshops and the upgrading of teacher qualifications, specifically in technology, would aid in resolving the issue of enhancing teacher development. Content workshops, which are to be conducted during school holidays, covering the content of the following term as per the suggestion made by one of the team members, would bring hope to technology teachers as their confidence would be resuscitated. This is indicated by the response as this suggestion was put forward.

In the abovementioned citations, the co-researchers raised the issue of content workshops, which should take place regularly. They went further to explain that the workshops should deal diligently with the subject content, meaning all the expected activities of the mini-PAT should be done practically by the teachers before they go back to their respective schools and implement the process.

The workshops should be planned and conducted before the commencement of each term for all senior phase grades. In the statement, *“If the department can provide bursaries for technology teachers so that they can upgrade themselves in technology content and methodology”*, the issue of upgrading qualifications and the provision of bursaries were raised. This implies two things: firstly, it might be that the teachers want to improve themselves in technology, but encounter a challenge in the form of financial support; secondly, they are aware of the fact that they need support because at times, people deny being in need of support.

Constructionism demands that everything be understood by being constructed (see 2.2.1). It is evident from this study that teachers need capacity building in

technology. This can assist tremendously in the execution of the mini-PAT and the teaching of technology.

4.4 CONDITIONS CONDUCIVE TO SUCCESSFUL IMPLEMENTATION OF THE STRATEGY TO STRENGTHEN THE TEACHING OF THE MINI-PAT

This section discusses the conditions that are conducive to the successful implementation of the strategy to strengthen the teaching of the mini-PAT. These conditions could not be overlooked as they could have a negative impact on the successful implementation of the strategy.

4.4.1 Enhancing teamwork

Being committed to something is pivotal to its success. Related literature agrees with this sentiment in that commitment in a team is critical as it begins with commitment to one another, commitment to the team and its success, and finally, commitment to the ultimate goal of teaching, which is to groom critical thinkers (Bishop et al., 2000:1114). Evidence of the lack of commitment from team members displays that the team might be dysfunctional. A functional team manifests the urge to share knowledge and experiences. Diversity is another factor that should be closely monitored. Allowing diversity and comprehending that people are dissimilar draw them together, consequently allowing the sharing of knowledge, which eventually creates an empowering atmosphere.

During the situational data collection, the co-researchers concurred with the issue of enhancing teamwork as a mechanism of creating a space conducive to the successful implementation of the strategy.

In the group discussions with the co-researchers, they indicated as follows:

Miss Ndlela indicated: *“Working together in harmony as a team during the implementation of the strategy is important.”*

Mrs Nukeri added to what Miss Ndlela mentioned and said: *“Dedication and thoughtfulness should be demonstrated by all.”*

Mr Dlamini commented: *“Working in teams can benefit all of us because we will plan together, and help each other with problematic aspects and everyone will be confident.”*

The statements above reveal that the co-researchers agree with the assertion that working together breeds success. This suggests that teamwork should be enhanced for the successful implementation of the strategy to strengthen the teaching of the mini-PAT. This means that if working as a team is not enhanced, the implementation of the strategy would be compromised. Working together as a team implies having a positive attitude towards others, honouring time during meetings, being respectful to one another and being committed. This assists in achieving the ultimate goal of the team, which in this case is the successful development and implementation of the strategy to strengthen the teaching of the mini-PAT.

The statement, *“Working together in harmony as a team during the implementation of the strategy is important”*, suggests that working collaboratively in harmony, respecting one another and being committed to the team will enhance teamwork. Being thoughtful means respecting one another, and working in harmony means working together without conflict. The mention of being confident, as raised by Mr Dlamini, demonstrates that if one is unsure of what has to be done, one becomes sceptical of one’s ability.

Enhancing teamwork is congruent with the principles of constructionism, which are working collaboratively and the sharing of knowledge (Bers et al., 2002:132). This will bring hope to teachers who have been struggling in terms of executing the mini-PAT in the sense that information sharing will take place without discriminating and looking down upon those who are still grappling with the content and pedagogy of teaching the mini-PAT. Being dedicated is another factor that plays an important part in teamwork. Dedication means commitment to what one is doing. It means honouring appointments, being on time, coming to the meetings prepared, contributing positively to discussions and accepting other peoples’ views and working together on them.

4.4.2 Good communication skills

Communication is paramount for a team to be functional (see 2.9.4.2). Literature concedes that open-line communication is required in teams to function properly; it raises the opportunity to share good ideas and best practices openly (Bhohkour, 2006:350). The attitude of an individual contributes immensely towards achieving set goals. A positive attitude assists in meeting goals and in the success of the planned projects (Boyer, 2014:1). A positive attitude further assists in accomplishing the set goals and completing tasks faster.

The following comments were made by the co-researchers:

Mr Sangweni indicated: *“Good communication skills are central to any successful project.”*

Mr Mkhize added: *“If there is communication breakdown in anything that has to be done by a group of people there is a high possibility that it will not succeed.”*

In the above statement, Mr Sangweni indicates that through good communication skills among teachers, every endeavour of rectifying issues and challenges they encounter will come to pass. This suggests that if there is a communication breakdown, the success of the strategy would be compromised.

The view of the subject advisor indicates that they understand the worth of good communication skills in the implementation of the strategy. Regarding something as “central” demonstrates that nothing can possibly occur without acquiring these skills. Good communication skills are critical in ensuring that the team succeeds. This implies that for a team to achieve the intended outcome, the members of the team should be able to communicate effectively. During planning and deliberations, it is essential that the co-researchers afford one another an opportunity to give input and whenever one is on the floor, the others should listen.

This assertion agrees with constructionism in this study, which advocates working collaboratively (Bers et al., 2002:132). Communication skills assist in building relationships, ensuring that new ideas and best practices are shared (Bhohkour, 2006:350). This study proves that if there is a lack of communication in a team, the

team becomes dysfunctional, leading to failure to achieve the ultimate goal, which in this study, is strengthening the teaching of the mini-PAT.

4.4.3 Availability of educational resources

Resources are an integral feature of any teaching and learning situation. These resources (consumable and non-consumable) play a vital role in making knowledge accessible to learners, and the availability of material encourages learners to engage with knowledge in different ways. The availability of resources is another important condition that can lead to the success of the strategy. The literature attests to this in stating that textbooks that are congruent with the ATP have been developed and made available to all schools to purchase (Mapotse, 2012:9). Furthermore, a catalogue that includes all CAPS-compliant textbooks is made available to all schools. Technology workbooks have also been developed and are available on the internet. The workbooks include both learners' books and teachers' guides. They are not secured (copyright), which means that teachers can download them and they are printable.

The MST sub-directorate supplied all districts in KwaZulu-Natal with toolkits to use during workshops. The Amajuba Education Centre, in collaboration with the Teaching and Learning Services – GET, technology and natural sciences subject advisors, formed a partnership where the Education Centre supervises the lending of tools to schools. The lending services from the Amajuba Education centre have been made known to teachers for them to borrow tools, should the need arise. This is a temporary arrangement for the benefit of schools that have no tools. However, principals are encouraged to buy the tools as per the CAPS requirement (DBE, 2011a:8).

In affirming the conditions that are conducive to resources in the implementation of the strategy, **Mrs Zulu** pointed out:

The availability of the resources will make it easy for us to understand exactly what needs to be done by learners during the execution of the mini-PAT. It will help in ensuring that the hands-on nature of the subject is adhered to.

The co-researchers indicated that if resources were made available to them during their training, it would be much easier for them to go back to their schools and request the SMT to purchase the material. They would have more expertise on what is expected from learners. Furthermore, they would know which tools are required for which mini-PAT. Being hands-on is in support of the principle of constructionism, which advocates learning by doing (Bers et al., 2002:132). Having a clear picture of what is required would bring hope to teachers in the sense that their confidence would be boosted and they would have a clear picture of what exactly has to be done during the execution of the mini-PAT.

4.5 THREATS THAT COULD HINDER THE SUCCESS OF THE STRATEGY TO STRENGTHEN THE TEACHING OF THE MINI-PAT

In 4.4 above, the conditions favourable for the successful implementation of the strategy to teach the mini-PAT were discussed. In this section, the threats to the successful implementation of the strategy to strengthen the teaching of the mini-PAT are explored. The threats that can threaten the successful implementation of the strategy are, firstly, nominal collaboration, in the sense that for a team to be effective, the team members should be free to vent their views, and they should not be threatened by the presence of other people during their teaching. This is as a result of people used to working in solitude. The second threat is the absence of educational resources. Unavailability of educational resources can threaten the successful implementation because if resources are not available, it becomes difficult to demonstrate the enabling tasks that have to be done by the learners. Subsequently, this leads to the failure of the strategy. The third threat is pedagogical approaches in the sense that some approaches make it difficult for learners and teachers to cover all the required skills as per the CAPS requirements.

4.5.1 Nominal collaboration

Team teaching can be a threat to some teachers in the sense that they might feel threatened by the presence of other people while they are teaching. This is confirmed by Dearman and Alber (2005:636), asserting that some teachers may feel intimidated by the presence of the team and may think that they are incompetent.

When they exchange classes, teachers may also feel undermined; owing to the fact that they may think their learners might lose confidence in them and want to be taught by the other teacher permanently. The availability of time for planning and sharing ideas among teachers poses to be another factor that might threaten the successful implementation of the model of team teaching and the strategy.

It has been articulated that respect is the key to success. In a team where respect for one another does not prevail, there is a high possibility of the team failing. Teachers who are of an inflexible personality type may be fixated to a single method of teaching, which would be detrimental to the success of the strategy and of team teaching as an endeavour to address the challenge of content knowledge.

Discussing the anticipated threats to the successful implementation of the strengthening of teaching the mini-PAT in a senior phase technology class, the following was said:

Mr Mkhize commented: *“I do not feel comfortable teaching while there is someone watching me.”*

Mr Khanyile pointed out: *“Colleagues, we need to be enlightened that team teaching is an instrument that can assist in alleviating the challenge of content knowledge because you will help each other. We also need to know that this works both ways, meaning that your colleague will teach your learners in your presence and you will also do the same.”*

The first comment above indicates the attitude of teachers towards working together as a team. Mr Mkhize indicated that he did not feel comfortable when there was someone in the classroom while he was teaching. Mr Khanyile’s assertion attempted to dismiss the mentality of being uncomfortable by explaining that team teaching occurs both ways and the rationale behind this is to assist one another towards addressing the challenges encountered by technology teachers during the execution of the mini-PAT.

The fact that the Mr Mkhize referred to himself, “I”, reveals that he prefers working in a silo and reveals the lack of collaboration between teachers. This works against the principle of constructionism, which encourages working collaboratively and the sharing of knowledge (Bers et al., 2002:132). This study has shown that working

individually puts the workload on one person, whereas working as a team distributes the load to all of the team members, which reduces the time taken to complete the task at hand. This is also evident from the discussions I engaged in with the co-researchers. Working as a team makes things easier and problems are solved collaboratively, taking strain away from the individual. Teamwork would definitely assist in strengthening the teaching of the mini-PAT.

4.5.2 Absence of educational resources

The unavailability of resources is a threat to the success of strengthening the teaching of the mini-PAT. As mentioned earlier, the mini-PAT is a practical task that requires that learners engage in practical activities. Without resources, this becomes impossible, as evidenced by Peacock (2009:250) and Chisholm (2005:94), who describe that the shortage of resources is the primary factor that makes curriculum reform have an unintended impact on teaching and learning. Inadequate resources do not only affect the teaching and learning process but demotivate the teachers. Such teachers perform substandard work because they feel they are not supported by ensuring that resources are provided.

The following comments were made by the co-researchers during the discussions:

Miss Ndlela indicated: *“Although the department has tried to supply the districts with resources, this doesn’t help us because they are used during teacher training. Schools still do not have resources to teach technology.”*

Miss Msimango pointed out: *“The lending of material from the centre does not cater for all schools.”*

The statement made by Miss Ndlela, *“Although the department has tried to supply the districts with resources this doesn’t help us”*, shows a negative attitude towards the endeavours of the department to provide tools and material, which is a threat to the implementation of the strategy. Although the material is available for lending, some teachers still hide under the shadow of the unavailability of material. It is evident in this study that the unavailability of material can threaten the success of the strategy because some teachers will continue doing an injustice to the execution of the mini-PAT.

4.5.3 Pedagogic approaches

Another factor that could threaten the attainment of the set goal is the transformation in teaching approaches. Ayodele (as cited in Omorogbe, 2013:184) identifies the use of inappropriate non-effective teaching methodologies as a major factor hindering the success of teaching technology effectively in class (see 2.9.5.3). Teachers' misconceptions about learner-centred instruction can also threaten the success of the strategy. Teachers are still wedded to the past teaching methods, where teaching was teacher-oriented. This is confirmed by Spreen and Valley (2010:42, 48) in stating that teachers are stuck in the teacher-centred approach. This particularly applies in the South African context, where the majority of teachers have received their education during the apartheid era where limited exposure was given to learner-centred instruction. Having articulated the above change has always been a problem to most people because it means that one has to move away from one's comfort zone.

In teaching subjects such as technology, different teaching approaches are essential. For instance, the problem-based learning teaching approach, the design or activity approach and the problem-solving approach have been recommended as approaches suitable for teaching technology, particularly the mini-PAT. This is substantiated by Nieuwoudt and Baxter (as cited in Ziyambi, 2009:27), who state that a technology class should not be typified by firm and prescriptive instructional members and "one-way traffic". Majumdar (2006:321) adds that learner-centred approaches improve interaction between learners and teachers as well as among learners.

The co-researchers raised their concerns regarding different teaching approaches during our discussions:

Miss Ndlela commented: *"It is difficult to control these learners when learner centred approach is used."*

Mr Dlamini agreed with Miss Ndlela: *"The learners take too much time to complete tasks."*

Miss Ndlela's assertion, "*It is difficult to control these learners*", displays that she has tried to use the learner-centred approach but has encountered challenges. This might be as a result of being negative in terms of using the learner-centred approach, or it might be because she lacks the expertise of how to deal with such classes. This works against the statement by Vakalisa and Gawe (2011:2) that a teacher needs to strive for active participation of the learner in reflective and critical thinking exercises about content. Mr Dlamini's statement "*The learners take too much time to complete the tasks*" reflects that he has also encountered problems in terms of completion of tasks. This might be as a result of not giving clear instructions to the learners.

The phrase "*difficult to control*" demonstrates that Miss Ndlela wants to take charge in the classroom without being interrupted by the learners engaging in their work. Issues of power and dominance are at play here. In this study, it was evident that Miss Ndlela's attitude is contrary to the principle of collaboration and teamwork, as advocated by social justice. This is contrary to the principle of constructionism, which advocates for the sharing of knowledge and for working collaboratively (see 2.4). Constructionism focuses on how learners engage in a conversation, boosting self-directed learning and ultimately facilitating the construction of new knowledge (Crotty, 2003:42). Constructionism promotes learner-centred approaches and encourages the use of problem-based learning, which is regarded as a constructionist method as it permits learners to learn about a subject by exposing them to various problems and asking them to construct their understanding of the subject through these problems (Alesandrini & Larson, 2002:119-121). This is what teaching the mini-PAT requires. The resistance to shift from the teacher-centred approach to the learner-centred approach threatens the effectiveness of the strategy as in technology, learners have to work independently on activities and eventually produce an artefact.

4.5.4 Time and financial constraints

Policy stipulates that teachers have 80 hours to attend professional development sessions per annum. This can happen during school vacations, which require the province to notify schools three months in advance (EEA, 1998:c-59).

In this section, I discuss time and financial constraints as hindrances to strengthening the teaching of the mini-PAT in a technology class. Time constraints are detrimental to the success of any project. The availability of time is another factor that I found to be a threat to attaining the objectives of this study. Workshops that are supposed to assist in enhancing content knowledge should commence at 13:00 due to the directive that was delineated by the DoE through HRM 4 of 2009 (see 2.9.5.4).

Insufficient time makes it impossible to be practical during training. As a result, the workshops end up taking a narrative form instead of practically engaging in the activities. Financial constraints additionally threaten the teaching of the mini-PAT in the sense that sufficient money makes it possible for any project to be successful. If resources cannot be provided, workshops cannot be held because there are many requirements involved in the organisation of workshops; these include, but are not limited to making copies, acquiring material to be used during workshops, such as flip charts, koki pens and so forth. Moreover, teachers frequently cannot enrol for an ACE or any other degree in technology due to financial constraints. The unavailability of time also has a negative impact on attendance of the planned professional development sessions; hence poor attendance is experienced during such workshops.

The co-researchers made the following comments during the discussions:

Miss Msimango commented: *“The problem that we have, is that our workshops start at 13:00-15:00. We don’t get enough time to be hands-on.”*

MsDlamini agreed: *“Yes, we are no longer allowed to interfere with contact time.”*

The above extract *“our workshops start at 13:00-15:00”* lays bare the fact that time is limited when it comes to workshops, which are the means of developing teachers in terms of teaching technology. It was evident, even in this study, that time is a threat in most projects. I observed during our meetings that co-researchers became agitated when a session was taking longer than the stipulated time. The issue of time hinders the hands-on nature of technology, especially the practical part, namely the mini-PAT.

4.6 INDICATORS OF SUCCESS IN STRENGTHENING THE TEACHING OF THE MINI-PAT

In this section, the indicators of success are discussed. One of the objectives of this study was to respond to the challenges discovered in connection with strengthening the teaching of the mini-PAT in technology. The favourable outcome of the study would be observable when the teachers who participated in the study displayed knowledge and skills that effectively facilitate the mini-PAT in their classrooms. Improved PCK, collaboration among teachers, teaching resources and improved learner performance indicate success in strengthening the teaching of the mini-PAT in a senior phase technology class.

4.6.1 Improved pedagogical content knowledge

In this study, PCK is referred to as “king”. While pedagogy is the instrument used to enforce learning content. technology teachers are now adhering to the ATP, as prescribed by the CAPS curriculum, because the content, including the design process skills, was unpacked through working collaboratively. The KwaZulu-Natal DoE has developed pacesetters that assist teachers with pacing themselves to ensure that all the prescribed topics are covered and that there is 100% curriculum coverage. The issue of spot teaching has dropped tremendously because each topic was diligently dealt with during workshops.

During the workshops, the teachers practically designed and made the mini-PATs, and they also practically completed the enabling tasks. This has enhanced the teachers’ content knowledge drastically, which is evidenced by the good mini-PATs that are produced by the learners in their schools. The learner performance in technology has also improved. Reviewed literature confirms that increased PCK has enhanced teacher knowledge and teachers are exploring different pedagogical approaches, which include project-based learning, the design approach and the activity-based approach (Jones & Moreland, 2004:4). Technology teachers meet regularly in clusters to plan together and support one another on problematic areas of knowledge in the subject.

4.6.2 Teacher collaboration

Team teaching was one of the strategies that could be implemented to address challenges experienced in the teaching of the mini-PAT. When teachers are working as teams, they are working collaboratively. This is another area where success is evident. Teachers are now actively involved in clusters where they plan together, assist one another where challenges are encountered and set good quality formal tasks as clusters. This includes discussing activities to be done in the mini-PATs for each term.

4.6.3 Educational resources

In KwaZulu-Natal, all 12 districts have been issued with toolkits for technology and science (consumable and non-consumable resources). These are not enough for all schools; hence they are kept at the Amajuba Education Centre for schools to borrow them. Some of the school have bought their own toolkits. The MST sub-directorate has furnished districts with workbooks for technology. The consignment received in the Amajuba District had teachers' guides only; however, the MST sub-directorate furnished all the MST subject advisors with a flash disk that has all the workbooks from Grades 4 to 9; the schools were then provided with disks containing all the workbooks. The teachers' guides were distributed during workshops. These are the means of addressing the issue of inadequate resources. The Amajuba Education Centre has given all the schools in the Amajuba District e-content as another resource. Some schools have installed Wi-Fi so that teachers have access to the internet. The developments mentioned above in terms of educational resources indicate success in terms of this issue.

4.6.4 Improved learner performance

Technology teachers have managed to afford learners the opportunity to develop critical thinking skills that enable them to produce good mini-PATs. This is achievable as a result of introducing the learner-centred approach where learners are involved hands-on during the execution of the enabling tasks. Enabling tasks are activities that are completed by learners in preparation for the mini-PAT. Learners do

practical activities that will be part of the mini-PAT, but they do them separately. The success of following the learner-centred approach is evidenced by the good prototypes that are made by learners, and it has contributed positively towards learner performance and the acquiring of different skills. This factor also indicates that teachers have truly improved in terms of their facilitation skills.

4.7 SUMMARY OF THE CHAPTER

This chapter dealt with the presentation, analysis and interpretation of the data for each of the five objectives of this study. The chapter analysed the challenges confronted by technology teachers in the teaching of the mini-PAT. The challenges that were highlighted by the team were inadequate PCK, the shortage of educational resources, the high learner-teacher ratio and inadequate professional or teacher development. These challenges were found to be hindering the execution of the mini-PAT. The analyses of the challenges channelled this study towards the possible solutions, which were accepted and improved to address the relevant challenges.

Timeously requesting resources by the teachers and HoDs was found to be one of the solutions which would alleviate the issue of the unavailability of educational resources. Team teaching was found to be one of the solutions that could improve teachers' PCK. In terms of learner-teacher ratio, dividing learners into small, manageable groups was recommended as a solution to address the problem of large numbers of learners in classrooms. Organising professional development workshops and the utilisation of clusters was recommended as possible solutions to teacher development. The conditions conducive to the successful implementation of the strategy were explored as well.

The next chapter presents the findings and recommendations of the study.

CHAPTER 5

SYNTHESIS OF FINDINGS, RECOMMENDATIONS, DISCUSSIONS AND THE CONCLUSION TOWARDS STRENGTHENING THE TEACHING OF THE MINI-PAT IN A SENIOR PHASE TECHNOLOGY CLASS

5.1 INTRODUCTION

This study aimed to develop a strategy to strengthen the teaching of the mini-PAT in a senior phase technology class. This chapter presents a synopsis of the findings of the study. The findings of this study are structured according to the objectives of the study, which were to identify and justify the need to develop the strategy, to identify the components of the strategy, to determine the conditions conducive to the strategy, to identify and circumvent the threats to the strategy and lastly, to find and test the strategy. The recommendations are also presented. The conclusion gives a brief reflection on the value of the study to strengthen the teaching of the mini-PAT.

5.2 BACKGROUND OF THE STUDY

The study aimed to design a blueprint to strengthen the teaching of the mini-PAT in a senior phase technology class. This was done by exploring the challenges teachers confront in their teaching of the mini-PAT. The solutions that assist teachers in ensuring that justice is done in terms of the execution of this task were discussed. During the meetings with the co-researchers, the conditions conducive to the success of the strategy were discussed. The threats that might threaten the successful implementation of the strategy are also explored.

5.2.1 Problem statement

The study and literature reveal that technology teachers are struggling with the teaching of the mini-PAT. Various reasons are stated, ranging from teachers not having specialised in technology at tertiary level, the lack of educational resources

and so forth. The study focuses on the factors that will assist in strengthening the teaching of the mini-PAT.

5.2.2 Research question

The main research question that was central to this study was: How can the teaching of the mini-PAT be strengthened in a senior phase technology class?

5.2.3 Research aim

The aim of the study was to strengthen the teaching of the mini-PAT in a senior phase technology class.

5.2.4 The objectives that informed the study

- To identify and justify the need to strengthen the teaching of the mini-PAT in a senior phase technology class.
- To identify the components for strengthening the teaching of the mini-PAT in a senior phase technology class.
- To determine the conditions conducive to strengthening the teaching of the mini-PAT in a senior phase technology class.
- To identify and circumvent the threats to strengthening the teaching of the mini-PAT in a senior phase technology class.
- To find and test best practices to strengthen the mini-PAT in a senior phase technology class.

5.3 FINDINGS AND RECOMMENDATIONS

This section presents the findings of this study as they emanated from the literature, during discussions with the co-researchers and during the data analyses.

5.3.1 Findings on educational resources

Educational resources are central to the effective execution of the mini-PAT. The CAPS document (DBE, 2011a:13) stipulates that it is the responsibility of the school to provide educational resources. I discovered that most of the teachers experience problems with acquiring the resources to use during the mini-PAT. This was prevalent during the deliberations with the co-researchers, and the literature attested to this challenge as well. The issue of inadequate educational resources is confirmed by Ampofu (2009:96) in his statement that the provision of learning material, including textbooks and practical material, has been found to be a challenge in teaching technology (see 2.9.2.2). This applies not only to South African schools but schools in other countries also confront the same predicament. Omorogbe (2013:186) qualifies this statement by articulating that educational resources have been a major challenge in Nigerian schools (see 2010.2.2). Educational resources include everything that can make the process of teaching and learning effective. Technology labs are also essential. During the deliberations with the co-researchers, we found that SMTs do not do their utmost best to make sure that the necessary resources are available to teachers to utilise during the practical part of the mini-PAT (see 4.2.1). The co-researchers raised the issue of learners not helping either in terms of trying to improvise or supply the resources – some try to bring them, while others do not even try.

5.3.1.1 Recommended components of lack of educational resources

HoDs should hold departmental meetings where these issues can be discussed. Teachers need to submit a list of required resources timeously so that the HoD would be able to discuss it with the SMT during SMT meetings. The resources, especially textbooks, should also be requested timeously, and schools should ensure that they put in place retrieval policies and implement what they have agreed on. This would assist in addressing the issue because learners and parents would know well in advance what measures would be taken if a learner does not return his or her textbook. Furthermore, schools have to continue topping up the textbooks so that eventually each learner would have a textbook to take home as per the recommendation stipulated in the first issue of the DBE *Curriculum News* (2010:8).

Printable workbooks can be downloaded from the internet free of charge. Tools can be borrowed from the education centre where they are kept in the Amajuba District, although this is temporary because the school has to return these. Schools can buy the toolkits since they are now included in the catalogue. On the toolkits provided by the DoE, the details on how to order the toolkits are pasted on the boxes, that is, the address and contact details of where the toolkits can be bought. Buying data projectors and installing Wi-Fi in schools are other solutions that have been raised by the co-researchers during our meetings that can assist the school in addressing the issue of resources, especially textbooks, as the teachers can beam the content onto a screen using their mobile devices (see 4.3.1).

5.3.1.2 Threats in educational resources

The team discovered that the unavailability of teaching resources can threaten the successful implementation of the strategy to teach the mini-PAT in the sense that learners cannot perform to their best ability if the essential resources are not available and only the learners with parents who have the necessary funds are able to complete good projects. This has been confirmed during the discussions with the co-researchers (see 4.2.1). Peacock (2009:250) and Chisholm (2005:94) also confirm what has been established during discussions with co-researchers. They express that the shortage of resources is the main factor that threaten curriculum reform, causing it to have an unintended impact on teaching and learning and ultimately hindering both learners and teachers to excel in their work. The co-researchers further voiced that even if the DoE provided the resources for teacher training, teachers would still struggle in their respective schools as the lending process that is controlled by the education centre caters only for a minimum number of schools (see 4.5.2).

5.3.1.3 Recommended conditions for educational resources

The team agreed that sharing knowledge and improvising resources among teachers could lead to the success of the strategy. The team decided that timeously requesting educational resources was another condition that would lead to the success of the strategy in the sense that all teachers would be in possession of vital

resources in good time so that they would not encounter challenges regarding resources in terms of executing the mini-PAT.

5.3.2 Findings on pedagogical content knowledge

During the discussions with the co-researchers, we discovered that inadequate PCK is a challenge for technology teachers. The literature also confirmed it (see 4.2.2). Makgato (2013:3689) reports that studies have shown that teachers experience a real problem with teaching the technology content knowledge and skills. This was confirmed by Mapotse (2014:2) and Omorogbe (2013:181). The reasons for this were presented, including that most teachers did not specialise in technology at tertiary level. This finding confirms what literature reports on the issue of training, that is, that teachers are not being trained sufficiently on the content and methodology of teaching technology (see 4.2.2). The study further found that although teachers attended workshops, the workshops did not assist in terms of content since the time was limited to five days (Khumalo, 2004:15). Even the facilitators of the technology workshops were not well conversant in technology content. Graphic communication, mechanical systems and control, and electrical systems and control were highlighted by the co-researchers as the most problematic content areas in technology (see 4.2.2).

5.3.2.1 Recommended components of pedagogical content knowledge

Team teaching was found to be the most effective solution that could assist in improving PCK. This was asserted by the literature and the co-researchers during our meetings, both stating that team teaching assists with the creation of a dynamic and interactive learning environment. Furthermore, it boosts pedagogical and intellectual advantages (Fall, 2006:1). High levels of intellectual debate among teachers are also displayed by team teaching. Team teaching enhances teacher content knowledge as it coerces teachers to engage in deliberations, which promote collaborative learning. The team also agreed that working as team assists to a considerable extent in teaching, especially when a group of teachers work together to plan their lessons, set common tasks and assist one another as needed.

5.3.2.2 Threats in pedagogical content knowledge

Using different teaching approaches in teaching technology, especially shifting from a teacher-centred approach to learner-centred approaches, threatens the teaching of the mini-PAT. This was indicated by the co-researchers and the literature attested to it. During the execution of the mini-PAT, the learners are expected to engage in discussions where they work collaboratively in investigating, designing the possible solutions to the scenario, making the prototype or the artefact, communicating and evaluating their ideas. If the teachers are still wedded to a teacher-centred approach where they take charge of everything in class, the learners will be hindered from performing at their optimum level. This was evident in the discussions among the co-researchers during the data generation (see 4.5.3).

Team teaching has also been found to be a threat to some teachers. Some teachers are intimidated by the presence of the team while they are teaching. They fear that the learners might lose confidence in them if they allow other colleagues to teach their learners. The unavailability of time for sharing sessions, where teachers plan together and assist one another in areas where they encounter challenges, poses a threat to team teaching.

5.3.2.3 Conditions conducive to teamwork

The team agreed that enhancing teamwork is one condition that is conducive in ensuring that content knowledge is shared among teachers. Being committed to the team is another important factor that enhances teamwork and leads to the success of the team. Catering to diversity was also mentioned, and the co-researchers agreed that it assists with teamwork because all of the team members will understand that people are dissimilar and they will accommodate one another. The co-researchers also agreed that working collaboratively as a team can benefit each member of the team, which would eventually assist in dealing with problematic aspects of the mini-PAT.

5.3.3 Findings on learner-teacher ratio

In discussions with the team and in the related literature, high learner-teacher ratios were found to be a huge challenge, especially when teaching practical subjects such as technology. It was discovered that in most township schools, the learner-teacher ratio ranges from 65:1 to 95:1. This is confirmed in the literature by Gumbo and Mapotse (2012:139) and Mapotse (2012:29) (see 2.9.2.3), as well as by the team (see 4.2.3). The co-researchers and the related literature revealed that large learner numbers impede the practical and hands-on nature of technology. They further indicated that unmanageable learner numbers render the teaching of technology ineffective, while depriving learners of active participation and subsequently limiting their development of critical thinking skills (see 4.2.3). The co-researchers further highlighted that learners take a long time to finish activities, which leads to incompleteness of the prescribed content as per the CAPS document (see 4.2.3).

5.3.3.1 Recommended components of learner-teacher ratio

Working in small groups, changing the desk arrangement, establishing simple class rules, allocating duties to all members of groups and giving clear instructions, preferably in writing, have been found to be approaches that could assist in solving the challenge of large learner numbers or overcrowding in classrooms (see 4.3.3). This was revealed by the co-researchers during our meetings, and they attested to the fact that these solutions assist in the sense that the teachers are able to give learners different roles to play in their groups, which ensures that all the members of a group contribute to the task at hand (see 4.3.3). Mulryane-Kyne (2010: 56) and Deslauriers et al. (2011:32) share the same sentiments; however, they add that using the abovementioned approaches assists in reducing anxiety and allow more learners to engage with one another (see 2.9.3.3). Cooper and Robinson (2001:1) add that working in small groups encourages learners to be critical thinkers.

Another component that has proven to be effective for teachers who experience the problem of too few teachers per school, as indicated by the co-researchers and confirmed by literature, is taking independent learners to another classroom and giving them work to do. This solution has proven to assist in dealing with large

classes in the sense that the teacher is left with a manageable number of learners in the classroom and is able to give them individual attention (see 4.3.3).

5.3.3.2 Threats in learner-teacher ratio

During our discussions with the co-researchers it was discovered that leaving learners on their own poses to be a threat in the teaching of the mini-PAT. The reason put forward was that learners tend to be mischievous when they are left unattended. Taking independent learners to another classroom can be threatened by learners being unruly when there are left without supervision. As a result, accidents can occur and the learners can harm one another because in technology, hand tools, such as glue guns, hammers, cutting knives and so forth, are used during the “making” part of the mini-PAT. This requires close supervision by the teacher. Furthermore, lazy or passive learners may hide behind the active learners, although in the end, they would all be allocated the same marks. The literature concurs with our findings in terms of the threats mentioned above. This is confirmed by Blodgett (2016:1), asserting that leaving learners unattended has led to health crises.

5.3.3.3 Conditions conducive to learner-teacher ratio

The co-researchers raised the following conditions to ensuring that teachers are coping with large numbers in classrooms. Thorough lesson preparation is one condition that is conducive to working with large numbers of learners. If the teacher is well prepared and knows exactly what should be done by the learners during contact time, the challenge of large numbers is alleviated to a certain extent. The team agreed that setting clear ground rules collaboratively (learner and teachers) and committing to them may lead to success in the implementation of the intended project. Ensuring that learners are allocated responsibilities assists to a considerable extent in ensuring that teaching and learning continues harmoniously.

5.3.4 Findings on teacher development

During our discussions with the co-researchers and during the literature review, I discovered that most technology teachers are qualified to teach other subjects, but

they are not qualified to teach technology (Ampofu, 2009:15). The co-researchers acknowledged that most of them did not major in technology at tertiary level. They even mentioned that most of them had been trained before the introduction of these new subjects in the South African curriculum. This is also affirmed by literature stating that technology is a newcomer to the South African curriculum (International Technology and Engineering Educators Association, 2011; Mawson, 2007:21). It was introduced after the first democratic election (see 2.9.2). We also discovered in the literature that short workshops were conducted for teachers, but these workshops did not address the challenges faced by teachers. The co-researchers attested to this. The literature also revealed that even the facilitators of these workshops were not well acquainted with technology; subsequently, they only focused on unpacking the policy, ignoring the content.

5.3.4.1 Recommended solution to teacher development

In this study, the co-researchers concurred in that continuous teacher development in the form of practical or hands-on workshops can aid with improving their skills. This is affirmed by the literature, which elucidates that continuous teacher development can assist with enhancing teachers' subject knowledge and keeping them up to date with new developments in the subject (Darling Hammond, 2006:80). This is also evident in the excerpts from the discussions with the co-researchers (see 4.2.4). The co-researchers raised the issue of bursaries. They spoke in one voice in suggesting that bursaries should be made available for them to enrol for qualifications in technology. This is also in agreement with literature stating that higher educational institutions introduced the ACE in technology for teachers to improve themselves and improve their content knowledge (Makgato, 2013:1; Rollnick, 2009:26-27)

5.3.4.2 Threats to teacher development

We discovered in this study that the unavailability of time during school hours to conduct teacher development sessions poses to be a threat to teacher development. Conducting workshops during school vacation seems to be a threatening factor to the success of the endeavour to train teachers to improve them in terms of

technology content and pedagogy. This is because teachers often do not attend these workshops; hence the attendance of workshops is extremely poor. Unavailability of training resources during workshops is another threatening issue. The issue of the unavailability of time was affirmed by the literature (HRM 9 of 2009) and the co-researchers during our discussions. HRM (9 of 2009) prohibits district officials from taking teachers out of the classroom during school hours. Subsequently, the workshops now commence at 13:00. Teachers are also struggling to gather funds to pay for their studies should they wish to enrol for a qualification in technology.

5.3.4.3 Conditions conducive to teacher development

For teacher development sessions to be effective, the literature and the team found that it is vital that the facilitators and teachers possess good communication skills. This is because during professional development sessions, a learner-centred approach is often utilised as the method of teaching, and usually teachers engage in discussions with one another. Positive attitude is also required in any group work because it assists in meeting the intended outcome (Boyer, 2014:1). Full participation and positive contributions by all concerned are also essential because if all of the members of the group are not involved, it delays the process. It then becomes time consuming to reach the solution of the problem at hand.

5.4 CONCLUSION AND SUMMARY

The final chapter reported on the findings, recommendations, threats and conditions conducive to the implementation of the solutions that were found to be effective. The study aimed to strengthen the teaching of the mini-PAT in a senior phase technology class. The findings of this study revealed that teachers work as individuals at their respective schools. The results were that teachers did not have sufficient content knowledge in technology, which led to spot teaching, resulting in learners progressing from one grade to another with content deficits. The findings further revealed that schools do not have educational resources, including, but not limited to textbooks, hand tools and consumables, such as cardboard, dowels, glue and so

forth. These findings justified the need to devise a plan or strategy that would assist with strengthening the teaching of the mini-PAT.

This chapter concludes by presenting a summary of the plan that the team agreed on to assist in strengthening the teaching of the mini-PAT. The first workshop was conducted at the beginning of term one before the schools reopened.

Term	Grade	Content to be covered	Timeframe	Responsibility
1	7	Discussion on term 1 content, as prescribed in the ATP. Designing and making the jaws of life (rescue system), which is the mini-PAT for the first term. Presentations to the whole group.	2 days (2x 7 hours)	Subject advisors and lead teachers
1	8	Discussion on term 1 content, as prescribed by the ATP. Designing and making the mini-PAT for the first term, which is a structure. Presentations to the whole group.	2 days (2x 7 hours)	Subject advisors and lead teachers
1	9	Discussion on term 1 content, as prescribed by the ATP. Designing and making the mini-PAT for the first term, which is a structure (a bridge). Presentations to the whole group.	2 days (2x 7 hours)	Subject advisors and lead teachers

The workshops will follow the same pattern and continue for terms 2, 3 and 4.

The above plan lays out how the strategy that co-researchers and I collectively agreed upon will be implemented. This strategy will assist with strengthening the teaching of the mini-PAT in technology classes. It was agreed that hands-on or practical workshops should be held. Furthermore, it was decided that the technology content for each term should be dealt with diligently so that the teachers will be able to return to their respective schools knowing exactly what has to be taught and which teaching methodology is suitable for each planned lesson. The schools will be notified timeously about the workshops, which are planned to take place during school vacations. This will be done in line with the Personnel Administrative Measures document, which stipulates that teachers should be notified three months in advance if they will be required to attend professional development sessions.

During school holidays, just before the reopening of the schools, technology teachers will congregate at a common venue for two consecutive days from 8:00 to 15:00. The subject advisors and lead teachers will facilitate the workshops that will aim to improve or strengthen the teaching of the mini-PAT. The first round of workshops is planned to occur before the reopening of the schools in January. The second round will be during the Easter holidays, the third one to be held during the winter holidays and the last one during the spring holidays. At these workshops, teachers will be required to work in small groups and the content of each term, as stipulated in the ATP, will be unpacked. All the enabling tasks that will lead to the designing and making of the mini-PAT of that term will be discussed and completed by the teachers. The teachers will then design and make the artefact for that term. The teachers will also give presentations to the whole group, where they will explain how they reached the output (the model of the mini-PAT). This will also be helpful to teachers because they will be able to engage in discussions, should the need arise. They will also be able to ask questions.

During the initial workshop, co-researchers and I agreed that the clusters should be formed and cluster coordinators should be elected. Clusters will assist teachers because they will meet regularly to plan and assist one another with technology content and other technology-related issues, such as setting formal tasks and working out lesson plans. The subject advisors will work closely with the cluster coordinators to ensure that the clusters are functional and serve their purpose.

Subject advisors will also be in charge of communicating to the clusters in terms of informing the cluster members of the meetings. They will also monitor the progress and make themselves available when the clusters require assistance regarding technology content and the unpacking of the policy.

BIBLIOGRAPHY

Ackerman, E. (2001). *Piaget's constructivism, Papert's constructionism: What's the difference?* Mexico: Future of Learning Group Publication.

Ackerman, E., Gauntlett, D. & Weckstrom, C. (2009). *Defining systematic creativity* LEGO Learning Institute. Retrieved from <https://www.lego.com>

Alesandrini, K. & Larson, L. (2002). Teachers bridge to constructivism. *The clearing-house*, 75 (3), 118-121.

Ampofu, I.F. (2009). The challenges of using English as instruction technology instruction. A study of grade 9 in King Sabata Dalindebo District, Eastern Cape. (Unpublished MTech dissertation, Tshwane University of Technology).

Anderson, T. (2005). Higher education evolution: Individual freedom afforded by educational social software. In Beaudoin, M. (Ed.), *Perspectives on the future of Higher Education in the digital age* (pp. 77-90). New York: Nova Science.

Armitage, A. (2010). Learning dialogue: Towards a critical pedagogy for public finance and accounting management practice. *Journal of Finance and Management in Public Service*, 9, 1-12.

Avalos, B. (2010). Teacher professional development in teacher education over ten years. *Teaching and Teacher Education*, 27(1), 10-20.

Babbie, E. & Mouton, J. (2001). *The practice of social research*. Cape Town: Oxford University Press.

Banks, J. (2000). The social construction of difference and the quest for educational equality. In Bradt, R.S. (Ed.), *Education in a new era* (pp. 21-45). Alexandria, VA: Association for supervision and curriculum development.

Barkely, E.K., Cross, K.P. & Major, C.H. (2005). *Collaborative learning techniques*. San Francisco: Jossey-Bass.

Basit, T.N. (2010). *Conducting research in educational contexts*. London: Continuum International Publishing Group.

- Baum, F., MacDougall, C. & Smith, D. (2006). *Participatory action research*. *Journal of Epidemiology and Community Health*, 60(10), 854-857.
- Berger, P. & Luchmann, T. (1991). *The social construction of reality*. London: Penguin Books.
- Bers, M.U., Ponte, I., Juelich, K., Viera, A. & Schenker, J. (2002). *Teachers as designers: Integrating robotics in early childhood education*. *Information technology in childhood education*, 123-145. New York: United States Association for Advancement of Computing in Education.
- Bertels, T. (2003). *Rath and strong six sigma leadership handbook*. Hoboken, N.J: John Wiley & Sons.
- Bhohkour, B.G. (2006). Communication in interdisciplinary team meetings: What are we talking about? *Journal of Interprofessional Care*, 20, 349-363.
- Bishop, J.W., Scott, K.D. & Burroughs, S.M. (2000). Support, commitment, and employee outcomes in a team environment. *Journal of Management*, 26, 1113-1132.
- Black, I. (2006). The presentation of interpretivists research. *Qualitative Market Research: An International Journal*, 9(A), 319-324.
- Blaikie, N. (2010). *Designing social research*. Place: Polity Press.
- Bolick, C., Berson, M., Coutts, C. & Heinecke, W. (2003). Technology applications in social studies teacher education. A survey of social studies methods faculty. *Contemporary issues in technology and teacher education*, 3(3). Retrieved from <http://www.citejournal.org/vol3/iss3/socialstudies/article1.cfm>
- Boog, B.W.M. (2003). The emancipatory character of action research, its history and the present state of the art. *Journal of Community and Applied Social Psychology*, 13(6), 426-438.
- Bostock, J. & Freeman, J. (2003). No limits: Doing participatory action research with young people in Northumberland. *Journal of Community and Applied Social Psychology*, 16, 464-474.

Boyer, A. (2014). A positive attitude at Work: 10 tips for success. Retrieved from <https://blog.udemy.com>Lifestyle>

Brennan, K. & Resnick, M. (2013). Imagining creating, playing, sharing, reflecting: How online community supports young people as designers of interactive media. In Lavigne & Mouza, C. (Eds.), *Emerging technologies for the classroom: A learning sciences perspective* (pp. 253-268). New York: Springer.

Brijall, M. & Hansraj, K. (2007). *Mechanical technology learner's book*. Stranger: B&H Publishers.

Brown, C., Sithole, V., Hofmeyer, R. (2000). South Africa: Teacher training in the sky. *Teck Knowlogia*, 32-54.

Brydon-Miller, M. (1997). Participatory action research: Psychology and social change. *Journal of Social Issues*, 53(4), 657-666.

Brydon-Miller, M. (2001). *Education, research and action theory and methods of participatory: From subjects to subjective. A handbook of interpretive and participatory methods*. New York: New York University Press

Bryman, A. (2012). *Social research methods* (4th ed.). New York: Oxford University Press.

Burnes, B. (2004). Kurt Lewin and the planned approach to change. A re-appraisal. *Journal on Management Studies*, 41(6), 977-1002.

Burr, V. (2003). *Social constructionism*. London: Sage.

Campbell, T. (2008). The purpose of education. Retrieved from <https://doi.org/10.1111/j.1744-7984.2008.00214x>

Carson, D., Gilmore, A., Perry, C. & Gronhaug, K. (2001). *Qualitative marketing research*. London: Sage.

Carter, S.M. & Little, M. (2007). Justifying knowledge, justifying method, taking action: Epistemologies, methodologies and methods in qualitative research. *Qualitative Health Research*, 17(10), 90-125.

Centre for Public Education. (2005). *Class size and student achievement: Research review*. Retrieved from <https://www.centreforpubliceducation.org/Main-Menu/Organizing-a-school/Class-size-and-student-achievement-Atagance/Class-sizeand-student-achievement-Research-review.html>

Centre for Teaching and Learning. (2006). Team teaching: Benefits and challenges. *Fall Newsletter*.

Chandler, D. & Torbert, B. (2003). Transforming inquiry and action interweaving 27 flavours of action research. *Action Research*, 1, 133-152.

Chapman, E.S. & McGregor, S.E. (2002). Effects of interpersonal attraction on cooperative learning outcomes for Secondary level students. *Current Research in Social Psychology*, 7(18) 1-12.

Chapman, R.A. & Dold, C.J. (2009). *Finding a voice: Results of a youth participatory action research survey*. University of South Florida: Academic Services Faculty and Staff Publications.

Chatterton, P., Fuller, D. & Routledge, P. (2007). Relating action to activism: Theoretical and methodological reflections. In Kindon, S., Pain, R. & Kesby, M. (Eds.), *Participatory action research approaches and methods: Connecting people, participation and place* (pp. 216-222). London: Routledge.

Chevalier, J.M. & Buckles, D.J. (2013). *Participatory action research: Theory and methods for engaged inquiry*. London: Routledge.

Chikasanda, V.K. (2014). Exploring teaching practices of science and technology in Malawi primary schools. *International Journal of Science and Technology Education Research*, 5(6), 67-78.

Chikasanda, V.K., Mtemeng'Ombe, D., Nyirenda, L. & Kopangule, M. (2014). *Exploring teaching practices of science and technology in Malawi primary schools*. Technical Education Department, University of Malawi.

Chilisa, B. (2011). *Indigenous methodologies*. Thousand Oaks, CA: Sage.

- Chisholm, L. (2005). The politics of curriculum review and revision in South Africa in regional context. *Human Science Research Council of South Africa*, 35(1), 79-100.
- Christians, C.G. (2000). Ethics and politics in qualitative research. In Denzin, N.K. & Lincoln, Y.S. (Eds.), *Handbook of qualitative research* (2nd ed. pp. 133-155). Thousand Oaks, CA: Sage.
- Coffin, P. (2013). Identifying needs to develop a PBL staff development program. *Journal of Problem Based Learning in Higher education*, 1(1), 194-209.
- Cole, P.G. & Chan, L. (1994). *Teaching principles and practice*. London: Prentice Hall of Australia.
- Crane, P. & O'Regan, M. (2010). On PAR: *Using participatory action research to improve early intervention*. Department of Families, Housing, community Services and Indigenous Affairs, Australian Government, Canberra.
- Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process*. St Leonards, NSW: Allen and Unwin.
- Crotty, M. (2003). *The foundation of social research: Meaning and perspectives in the research process* (3rd ed.). London: Sage.
- Danley, K. & Langer, E.A. (1999). *A handbook for participatory action researchers*. Boston: Centre for Psychiatric Rehabilitation.
- Darling-Hammond, L. (2006). Conceptualising the knowledge base for teaching. In Darling-Hammond, L. (Ed). *Powerful teacher education lessons from exemplary programmes* (pp. 77-112). San Francisco: Jossey-Bass.
- Davis, J.R. (1995). *Interdisciplinary course and team teaching: New arrangements for learning*. Phoenix: ACE/Oryx.
- De Jager, R. (2011). *Latest changes in the technology education curriculum in South Africa*. Paper delivered at the 25th Annual PATT: CRIPT 8 Conference, "Perspective on Learning in Design Technology Education". (University of London, London. 30 June to 05 July 2011).

De Swart, A.E., Ankiewicz, P. & Engelbrecht, W. (2005). Technology Education in South Africa since 1998: A shift from traditional teaching to outcomes-based education. PATT 15, Conference.

Dearman, C.C. & Alber, S.R. (2005). The changing face of education: Teachers cope with challenges through collaboration and reflective study. *The Reading Teachers*, 58, 634-640.

Department of Basic Education (DBE). (2010). *Curriculum News*, May 1-20. Pretoria: Government Printers.

Department of Basic Education. (2011). *National Protocol for Assessment grades R-12*. Pretoria: Government Printers

Department of Basic Education.(2011a). *Curriculum and Assessment Policy Statement*. Pretoria: Government Printers.

Department of Basic Education.(2011b). *National protocol for assessment*. Pretoria: Government Printers.

Department of Education.(1997). *Policy document for senior phase (Grade 7-9)*. Pretoria: Government Printers.

Department of Education. (2002). *Revised national curriculum statement Grade R-9: School policy technology*. Pretoria: Government Printers.

Deslauriers, L., Schelew, E. & Wieman, C. (2011). Improved learning in large-enrolment physics class. *Science*, 332, 862-864.

Dicamillo, L. & Gradwell, J.M. (2012).Using simulations to teach middle grades U.S. history in an age of accountability.*Research in Middle Level Education Online*, 35(7), 1-16.

Dick, L., Mckee, H.A. & Porter, J.E. (2013). Ethical issues in online course design: Negotiating identity, privacy and ownership. *Selected papers of internet research*, 3.

Downey, D.J. (2009). Institutional activism and community building. Human relations responses to 9/11 in Orange Country, California. *American Behavioural Scientist*, 53, 99-113.

Dube, B. (2016). A socio-religious hybridity strategy to respond to the problems of religious studies in Zimbabwe. (Unpublished doctoral thesis, University of the Free State).

Dugger, W.E. 1997. The next step. *International Journal of Technology and Design Education*, 10(2), 10-18.

Dunn, D.S., Mehrotra, C.M. & Halonel, J. (2004). *Measuring up: Education assessment challenges and practices for psychology*. Washington, DC: American Psychological Association.

Ehrenberg, R.G., Brewer, D.J., Gamoran, A. & Williams, J.D. (2001). Class size and student achievement. *American Psychological Society*, 2, 1-30.

Erickson, P. & Kovalainen, A. (2008). *Qualitative methods in business research*. London: Sage.

Eruera, M. (2010). Ma Te Whānau Te Huarahi Motuhake: Whanau Participatory Action Research Groups. *MAI Review*, 3, 1-9.

Fairclough, N. & Wodak, R. (1997). Critical discourse analysis. In Van Dijk, T.A. (Ed.), *Discourse as social interaction* (pp. 258-284). London: Sage

Fairclough, N. (1992). *Discourse and social change*. Cambridge: Polity Press.

Fairclough, N. (2012). *Analysing discourse: Textual analysis for social research*. Sussex: Psychology Press.

Fals-Borda, O. (1991). Some basic Ingredients. In O.Fals-Borda & M.Anisur Rahman, (Eds.), *Action and knowledge. Breaking the monopoly with with participatory action research*. New York: The Apex Press.

Fals-Borda, O. (2001). Participatory action research in social theory: Origins and challenges. In Reason, P. & Bradbury, H. (Eds.), *Handbook of action research* (pp. 27-37). Thousand Oaks, CA: Sage.

February, F., Ogunniyi, M., Langenhoven, K. & Olufunmilayo, A. (2012). *The impact of professional development programme on classroom practices of technology educators in the intermediate phase*. Cape Town: University of Western Cape.

Fletcher, A.J., McPhee, M. & Dickson, G. (2015). Doing participatory action research in a multi case study: A methodological example. *International Journal of Qualitative Methods*, 14(5), 1-9.

Flicker, S., Maley, O., Ridgley, A., Biscope, S., Lombardo, C. & Skinner, H.A. (2008). E-PAR using technology and participatory action research to engage youth in health promotion. *Action Research*, 6, 285-303.

Frank, M. (2005). A systems approach for the development of technological literacy. *Journal of Technology Education*, 17(1), 10-31.

Freire, P. (1970). *Pedagogy of the oppressed*. New York, NY: Continuum Press.

Freire, P. (1974). Research methods. *Literacy discussion*, 142-153.

Frey, L., Botan, C. & Kreps, G. (2000). *Investigating communication: An introduction to research methods*. Needham Heights, MA: Allyn and Bacon.

Garcia-Iriarte, E., Kramer, J. & Hammel, J. (2009). Who did what? A PAR project to increase group capacity for advocacy. *Journal of Applied Research in Intellectual Disabilities*, 22(1), 10-22.

Gills, A. & Jackson, W. (2002). *Research methods for nurses: Methods and interpretation*. Philadelphia: F. A. Davis Company.

Given, C.M. (2008). *The sage encyclopaedia of qualitative research methods* (1st & 2nd ed., Vol. 1 & 2). London & Thousand Oaks, CA: Sage.

Glewe, P. (2013). *What education policies work to increase student learning: Lesson from three recent views of the evidence*. Health and Education Advice and Resource Team (HEART).

Govender, D. & Muthukrishna, N. (2012). Towards sustainable learning environments. Deconstructing discourses of social justice in English home language classroom. *Communitas*, 17, 21-24.

Govender, D. (2002). *National professional diploma in education: Senior phase technology* (pp. 237). Place: University of KwaZulu-Natal.

Gratton, C. & Jones, I. (2010). *Research methods for sports studies* (2 ed.). Oxon: Routledge.

Greene, J.C. (2008). Is mixed methods social inquiry a distinctive methodology? *Journal of Mixed Methods Research*, 2, 7-22.

Greenwood, D.J. & Levin, M. (1998). *Introduction to action research: Social research for social change*. Thousand Oaks, CA: Sage.

Greenwood, D.J., Whyte, W.F. & Harkavy, I. (1993). Participatory action research as a process and as a goal. *Human Relations*, 46, 175-192.

Grossberg, L., Wartella, E., Whitney, D. & McGregor, W.J. (2006). *Media making: Mass media in a popular culture* (2nd ed.). Thousand Oaks, CA: Sage.

Guba, E. & Lincoln, Y.S. (1989). *Fourth generation evaluation*. Newbury Park, CA: Sage.

Guba, E. & Lincoln, Y.S. (2005). Paradigmatic controversies, contradictions, and emerging confluences. In Denzin, N.K. & Lincoln, Y.S. (Eds.), *Handbook of qualitative research methods* (pp. 191-216). Thousand Oaks, CA: Sage.

Guba, E.G. & Lincoln, Y.S. (2004). Competing paradigms in qualitative research: Theories and issues. In Hesse-Biber, S.N. & Leavy, P. (Eds.), *Approaches to qualitative research: A reader on theory and practice* (pp. 17-18). New York: Oxford University Press.

Gumbo, M.T. & Makgato, M. (2008). *Dealing with the relational aspects of technology education: Study guide*. Pretoria: Ithuthuko.

Gumbo, T.M. & Makgato, M. (2012). The impact of in-service technology training programmes on technology teachers. *The Journal of Technology Studies*, 23-33.

Gumbo, T.M., Makgato, M. & Muller, H. (2012). The impact of in-service training technology training programmes on technology teachers. *The Journal of Technology Studies*, 23-33.

Guskey, T. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press.

Habermas, J. (1992). *Post-metaphysical Thinking: Philosophical Essays*. Cambridge, MA: MIT Press.

Hamm, T. (2010). The benefits of a positive attitude and five ways to get it. Retrieved from <https://www.csmonitor.com>

Hannafin, M., Land, S. & Oliver, K. (1999). Open learning environment: Foundations, methods and models. In Reigeluth, C. (Ed.), *Instructional design theories and models* (Vol 2) (pp. 115-140). Mahwah: Lawrence Erlbaum.

Hardt, H. (1993). Authenticity, communication theory. *Critical Studies*, 10, 49-69.

Harris, R., Holmes, H. & Mertens, D.M. (2009). Research ethics in sign language communities. *Sign Language Studies*, 9(2), 104-131.

Hart, C. (2007). *Critical discourse analysis and conceptualizing mental spaces, blended spaces and discourse spaces in the British national party*. London: University of Hertfordshire.

Hassel, E. (1999). *Professional development: Learning from the best*. Oak Brook, IL: North Central Regional Educational Laboratory.

Heron, J. & Reason, P. (1997). A participatory inquiry paradigm. *Qualitative Inquiry*, 3(3), 274-294.

Hlalele, D. (2013). Sustainable rural learning ecologies – A prolegomenon traversing transcendence of discursive notions of sustainability, social justice and food sovereignty. *TD: The Journal for Trans-Disciplinary Research in Southern Africa*, 9(3), 561-580.

Hoban, G.F., Nielsen, W.S. & Carceller, C. (2010). *Articulating constructionism: Learning Science through designing and making “slow motions”*. Student-generated animations. Queensland: University of Queensland.

Hong, J., Yu, K. & Chen, M. (2008). *Collaborative learning in technological project design to win a contest*. Paper delivered at the 20th Annual Pupil’s Attitudes Towards Technology Conference, Tel-Aviv, Israel, 3-6 November [Online]. Retrieved from <http://www.iteaconnect.org/Conference/pattproceedings.htm>

Hood, S., Hopson, R. & Frierson. (2015). Continuing the journey to reposition culture and cultural context in evaluation. Charlotte, NC: Information Age Publishing. Retrieved from <http://edulibpretoria.files.wordpress.com/2008/08/spadyobeconfusionpaper.pdf>

Huckin, T. (2002). Critical discourse analysis and the discourse of condescension. In Barton, E. & Stygall, G. (Eds.), *Discourse studies in composition* (pp. 155-176). Cresskill, NJ: Hampton.

Huckin, T., Andrus, A. & Lemon, J.C. (2012). Critical discourse analysis and rhetoric and composition. *College Composition and Communication*, 64(1), 107-129.

Isikoglu, N., Basturk, R. & Karaca, F. (2009). Assessing in-service teachers’ instructional beliefs about student centred education: A Turkish perspective. *Teaching and Teacher Education*, 25, 350-356.

ITEEA – International Technology and Engineering Educators Association (2011). *Journal of Technology and Engineering Teacher*. Retrieved from <https://www.iteea.org>

Jasper, M. (2003). *Beginning reflective practice*. Cheltenham: Nelson Thornes.

Johnson, M. & Restall, G. (2010). *Participatory action research: A guide for those who use mental health services*. Winnipeg: University of Manitoba.

Jones, A. & Moreland, J. (2004). Enhancing practicing primary school teachers' pedagogical content knowledge in technology. *International Journal of Technology and Design Education*, 14(2), 121-140.

Jones, A., Bunting, C. & De Vries, M. (2011). The developing field of technology education: A review to look forward. *International Journal of Technology and Design Education*, 23(2), 191-212.

Jordan, S. (2003). Who stole my methodology? Co-opting PAR [1]. *Globalisation, Societies and Education*, 1(2), 185-200.

Jorgensen, M.W. & Phillips, L.J. (2002). *Discourse analysis as theory and method*. London: Sage.

Juujarvi, S. & Lund, K.L. (2008). Participatory action research. A way to increase empowerment in deprived communities. 41st Association for Moral Education Conference. 5-7 November 2015, Santos-Brazil.

Kansanen, P. (2009). The curious affair of pedagogical content knowledge. *Orbis Scholae*, 3(2), 5-18.

Karaman, A. (2012). *The place of pedagogical content knowledge in teacher education*. The Department of Secondary Science and Mathematics Education, Canakkale Onsekiz Mart University, Canakkale, Turkey.

Keilhofner, G. (2006). *Research in occupational therapy: Methods of inquiry for enhancing practice*. Philadelphia: FA Davis Company.

Kelly, P.J. (2005). Practical suggestions for community interventions using participatory action research. *Public Health Nursing*, 22, 65-73.

Kemmis, S. & McTaggart, R. (2000). Participatory action research. In Denzin, N.K. & Lincoln, Y.S. (Eds.), *Handbook of qualitative research* (2nd ed., pp. 567-607). Thousand Oaks, CA: Sage.

Kemmis, S. (2008). Critical theory and participatory action research. *The Sage Handbook of Action Research: Participative Inquiry and Practice*, 2, 121-38.

Kemmis, S. (2013). *The action research planner: Doing Critical Participatory Research*. Dordrecht: Springer

Kent, A.M. (2004). *Improving teacher quality through professional development*. Education: Spring. Retrieved from http://findarticles.com/o/articles/mi_qa3673/is_3_124/

Khan, C. & Chovanec, D.M. (2010). Is participatory action research relevancy in the Canadian workplace? *Journal of Contemporary Issues in Education*, 1, 34-44.

Khanlou, N. & Peter, E. (2005). Participatory action research: Considerations for ethical review. *Social Sciences and Medicine*, 60(10), 2333-2340.

Khumalo, H.B. (2004). Implementation of technology education as a learning area. (Unpublished DEd thesis, Tshwane University of Technology).

King, K.P. (2005). *Bringing transformative learning to life*. Malabar, FL: Krieger.

Kingdon, S.L., Pain, R. & Kesby, M. (2007). *Routledge studies in human Geography*, 22. London: Routledge. Retrieved from <http://www.worldcat.org/oclc/152559184&tab=details>

Kobola, M.W. (2007). The role of the school principal in the implementation of the revised National Curriculum Statement. (Unpublished MEd dissertation, University of South Africa).

Kurtzberg, T.R. & Amabile, T.M. (2001). From Guilford to creative-synergy: Opening the black box of team-level creativity. *Creativity Research Journal*, 13, 285-294.

KZN DoE E-Learning Solution.n.d. *Curriculum Support Material*. Retrieved from kznfunda.kzndoe.gov.za

La France, J. & Crazy Bull. (2009). Researching ourselves back to life: Taking control of the research agenda in Indian country. In Mertens, D.M. & Ginsburg, P.E.

(Eds.), *Handbook of social research ethics* (pp. 135-149). Thousand Oaks, CA: Sage.

Labonte, R. & Laverack, G. (2001). Capacity building in health promotion part 2: Whose use and with what measurement? *Critical Public Health*, 11, 129-138.

Lather, P. (1992). Critical frames in educational research: Feminist and post-structural perspectives. *Theory into Practice*, 3(2), 1-13.

Laufenberg, V. (Ed.). 2009. *About technology* (Online). Retrieved from <mhtml:file://B\TEKIT\AboutTechnology.mht>

Leachy, K. & Gaughran, W. (2007). *Transferring design rich ideations within the technologies*. Paper delivered at the 18th Annual Pupils Attitude Towards Technology Conference. (Glasgow, Scotland, 21-22 June). Retrieved from <http://www.iteaconnect.org/conference/pattproceedings.htm>

Leedy, P.D. & Ormrod, J.E. (2000). *Practical research: Planning and design* (10th ed.). Boston: Pearson.

Leowenson, R., Laurell, A.C., Hogstedt, C., D'Ambruso, L. & Shroff, Z. (2014). Participatory action research in health systems. International Development Research Centre: EQUINET, Canada. Retrieved from <http://www.equinet africa.org/bibl/docs.PAR%20Methods%20Reader2014%20for%20web.pdf>

Levin, M. & Greenwood, D. (2011). Revitalising Universities by reinventing the social sciences: Bildung and action research. In Denzin, N.K. & Lincoln, Y.S. (Eds.), *The Sage handbook of qualitative research* (4th ed. pp. 27-44). Thousand Oaks, CA: Sage.

Levitt, R. (2008). Freedom and empowerment a transformative pedagogy of educational reform. *Journal of the American Educational Studies Association*, 44, 47-61.

Levitt, R. (2008). Freedom and empowerment: A transformative pedagogy of educational reform. *Educational studies. Journal of the American Educational Studies Association*, 44, 47-61.

Lewis, P. & Thorndale, A. (2003). *Research methods for business students* (3rd ed.). London: Prentice Hall.

Leykim, L., Pugh, A.J., Lanham, J.H., Harmon, J. & McDaniel, R.R. (2009). Implementation research designs: Integrating participatory action research into randomised controlled trails. *Implementation Science*, 4(2), 7-80.

Lincoln, Y.S. (Ed.). (2005). *Handbook of qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.

Lind, C. (2007). The power of adolescent voices: Co-researchers in mental health promotion. *Educational Action Research*, 15, 371-383.

Locke, T. (2004). *Critical discourse analysis*. London: Cromwell Press.

Lombard, B.J.J. & Grosser, M.M. (2004). Critical thinking abilities among prospective educators: Ideal versus reality. *South African Journal of Education*, 24(3), 212-216.

Lucock, M., Barber, R., Jones, A. & Lovell, J. (2007). Service user's views of self-help strategies and research in UK. *Journal of Mental Health*, 16(6), 795-805.

Lybech, E.R. (2010). The critical theory of Lewis Mumford. *International Journal of Interdisciplinary Social Science*, 5(1), 91-102.

Macaraan, W.E.R. (2012). Basic ecclesial community and economics of compassion. *Journal of Dharma*, 38(2), 7-26.

MacDonald, C. (2012). Understanding participatory action research: A qualitative research methodology option. *Canadian Journal of Action Research*, 13(2), 34-50.

Madisaotsile, B.M. (2012). The failing standard of basic education in South Africa. *Policy Brief Africa Institute of South Africa*, 72, 1-8.

Maguire, P. (1991). *Doing participatory action research: A feminist approach*. Massachusetts: University of Massachusetts Press.

Mahlomaholo, S. & Morris, M. (2002). *Participatory research and action: A guide to becoming a researcher for social change*. Ottawa: Canadian Research Institute for Advancement of Women.

Mahlomaholo, S. & Netshandama, V. (2010). Sustainable empowering learning environments: Conversations with Gramsci's organic intellectual. In Basov, N. & Oleksandra, N. (Eds.), *The intellectual: A phenomenon in a multidimensional perspective* (pp. 73-83). Oxford: Inter-Disciplinary Press.

Mahlomaholo, S. & Nkoane, M. (2002). Quality in qualitative research: The case for critical emancipatory research. Reflection on assessment of quality. *Journal of Education as Change*, 6(1), 69-84.

Mahlomaholo, S. (2009). Critical emancipatory research and academic identity. *Africa Education Review*, 6, 224-237.

Mahlomaholo, S.G.M. (2009). Critical emancipatory research and academic identity. *Africa Education Review*, 6(2), 224-237.

Mahlomaholo, S.M. (2013). Problem based learning and sustainable postgraduate learning environment: A South African higher education perspective. In Krogh, L. & Jensen, A.A. (Eds.), *Visions, challenges, and strategies: PBL principles and methodologies in a Danish and global perspective*. Aalborg: Aalborg Universitetsforlag.

Makgato, M. & Mji, A. (2006). Factors associated with high school learners 'poor performance: A spotlight on mathematical and physical science. *South African Journal of Education*, 26(2), 177-319.

Makgato, M. (2013). *The challenges of teaching and learning technology subject at schools in South Africa. A case of INSET teachers in Mpumalanga Province*. Department of Education Studies. Tshwane University of Technology.

Maksimovic, J. (2010). Historical developments of action research in social sciences. *Philosophy, Sociology, Psychology and History*, 9(1), 119-124.

Malhotra, A. (2010). *The causes, consequences and solutions to forced marriages in developing world*. Washington: International Centre for Research on Women.

Mansell, W., James M. & the Assessment Reform Group.(2009). *Assessment in schools. Fit for purpose? A commentary by the teaching and learning research programme*. London: Economic and Social Research Council.

Mapotse, T.A. & Gumbo, M.T. (2012).Identifying grade 8 and 9 technology teachers' areas of need for intervention in Limpopo Province.*Journal of Social Science*, 36(1), 19-28.

Mapotse, T.A. (2012). The teaching practice of senior phase technology education teachers in selected schools of Limpopo Province: An action research study. (Unpublished DEd thesis, University of South Africa).

Mapotse, T.A. (2014). An emancipation framework for technology education teachers: An action research study. University of South Africa.

Marie, K. (2007). *First steps in research*. Pretoria: Van Schaik.

Marumo, K.N. (2013). *Challenges facing FET teachers in the implementation of technology in the further education and training band in North West, in Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE)*. Proceedings of the 21st Annual meeting on "Making Mathematics, Science and Technology Education-Socially and Culturally relevant in Africa" South Africa, University of Western Cape, Cape Town, 14-17 January.

Mattson, E. (2006). *Field-based models of primary teacher training: case studies of student Support Systems from Sub-Saharan Africa*. London: Department for International Development

Mawson, B. (2007). Factors affecting learning in technology in the early years of school.*International Journal of Technology and Design Education*, 17(3), 253-269.

McMillan, J.H. & Schumacher, S. (2014). *Research in education evidence-based inquiry* (7th ed.). Boston: Pearson.

- McNiff, J. & Whitehead, J. (2006). *All you need to know about action research: An introduction*. London: Sage.
- McNiff, J. (1998). *Action research: Principles and practices*. London: McMillan Education.
- McTaggart, R. (1991). Principles to participatory action research. *Adult Education Quarterly*, 41(3), 168-187.
- McTaggart, R. (1997). *Participatory action research: International contexts and consequences*. New York: SUNY Press.
- Mertens, D.M. & Wilson, A.T. (2012). *Programme evaluation theory and practice*. New York, NY: Guilford.
- Mertens, D.M. (1995). Identify and respect differences among participants in evaluation studies. In Shadish, W.R., Newman, D., Scheirer, M.A. & Wye, C. (Eds.), *The American evaluation association's guiding principles* (pp. 91-98). San Francisco: Jossey-Bass.
- Mertens, D.M. (1998). *Research methods in education and psychology: Integrating diversity with quantitative and qualitative approaches*. Thousand Oaks, CA: Sage.
- Mertens, D.M. (2005). *Research and evaluation methods in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods* (2nd ed.). Thousand Oaks, CA: Sage.
- Mertens, D.M. (2009). *Transformative research and evaluation*. New York, NY: Guilford.
- Mertens, D.M. (2010). Philosophy in mixed methods teaching: The transformative paradigm as illustration. *International Journal of Multiple Research Approaches*, 4, 9-18.
- Mertens, D.M., Bledsoe, K., Sullivan, M. & Wilson, A. (2010). Utilisation of mixed methods for transformative purposes. In Teddlie, C. & Tashakorri, A. (Eds.), *Handbook of mixed methods research* (2nd ed.). Thousand Oaks, CA: Sage.

Mertens, D.M., Farley, J., Madison, A.M. & Singleton, P. (1994). Diverse voices in evaluation practice: Feminists, minorities, and persons with disabilities. *Evaluation Practice*, 15(2), 123-129.

Miller, M.B. & Maguire, P. (2008). Participatory action research. Contributions to the development of practitioner inquiry in education. *Educational Action Research*, 17(1), 79-93.

Mishra, P. & Koehler, M.J. (2006). Technological pedagogical content knowledge: A new framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054.

Moalosi, R. & Molwane, O.B. (2008). Challenges facing teachers in the teaching of design and technology education in Botswana's primary schools. *Design and Technology Education: An International Journal*, 13(3), 27-36.

Modisaotsile, BM. (2012). The failing standard of basic education in South Africa: Policy Brief. *Africa Institute of South Africa*, 72, 1-8.

Mokoena, M.M. (2013). Problem-based teaching and learning in senior phase technology education in Thabo-Mofutsanyana District. (Unpublished MEd dissertation, University of South Africa).

Moloi, T.J. (2014). Enhancing problem-solving skills in Grade 10 mathematics classroom by using indigenous games. (Unpublished DPhil thesis in Education, University of Free State).

Momoh, M.A.J. (2010). Effects of instructional resources on students' performance in West Africa School Certificate Examinations (WASCE). *International Journal of Inclusive Education*, 6(2), 113-126.

Morgan, D. (2007). Paradigm lost and paradigm regained: Methodological implications of combining quantitative and qualitative methods. *Journal of Mixed Methods Research*, 1, 48-76.

Morris, M. (2002). *Participatory research and action: A guide to becoming a researcher for social change*. Ottawa: Canadian Research Institute for the Advancement of Women.

Moss, S. (2016). Constructionism. Retrieved from <https://www.sicotests.com>psyarticle>

Moss, S. (2016). *Simple slopes analysis*. Retrieved from <https://www.Sicotests.com>psyarticle>

Mounton, J. (1996). *Understanding social research*. Pretoria: Van Schaik.

Mulryan-Kyne, C. (2010). Teaching larger classes at college and university level: Challenges and opportunities. *Teaching in Higher Education*, 15(2), 175-185.

Muthukrishna, G. (2012). Towards sustainable learning environment: Deconstructing discourses of social justice in English home language classrooms. *Communitas*, 17(1), 21-44.

Myende, P.E. (2014). Improving academic performance in a rural school through the use of an asset-based approach as a management strategy. (Unpublished doctoral thesis, University of the Free State).

Nasir, H.S.B. & Xiaoyong, W. (2013). Critical discourse analysis and educational research. *IOSR Journal of Research and Methods in Education*, 3(1), 9-17.

Nelson, G., Ochocka, J. & Griffin, K. (1998). Nothing about me, without me. Participatory action research with self-help/mutual and organisations for psychiatric consumer/survivors. *American Journal of Community Psychology*, 26(6), 881-912.

Netshandama, V. (2010). Sustainable empowering learning environments: Conversations with Gramsci's organic intellectual. In Basov, N. & Oleksandra, N. (Eds.), *The intellectual: A phenomenon in a multidimensional perspective* (pp. 73-82). Oxford: Inter-disciplinary Press.

Nkoane, M.M. (2010). Listening to voices of the voiceless. A critical consciousness for academic industrial complex. *South African Journal of Higher Education*, 24(3), 317-341.

Nkoane, M.M. (2012). Critical emancipatory research for social justice and democratic citizenship. *Perspectives in Education*, 30(4), 98-104.

Noss, R. & Clayson, R. (2015). Reconstructing constructionism. *Constructivist Foundations*, 10(3), 1-3.

Nwazor, J. (2012). Capacity building, entrepreneurship and sustainable development. *Journal of Emerging Trends in Educational Research Policy Studies*, 3(1), 51-54.

O'Regan, P. (2003). Accountability and financial control as patriotic strategies. Accountants and public accounts committee in late 17th and early 18th century Ireland. *The Accounting Historians Journals*, 105-131.

Ochocka, J., Janzen, R. & Nelson, G. (2002). Professional and mental health consumer/survivor researchers working together in participatory action research project. *Psychiatric Rehabilitation Journal*, 25(4), 379-387.

Ogbonaya, C. (2011). Evaluation and supervision of instruction in Nigeria schools. In Beson, E.A. & Nwokocha, L.K. (Eds.), *Educational administration and management in Nigeria: The salient issues* (pp. 51-54). Owerri: Solotech Press.

Ohio Department of Education. (2007). *What is technology Education? Technology education at the Ohio State University*. Retrieved from <mhtml:file://BTEWhat is TechnologyEducation.htm>

Oliver, M. (1992). Changing the social relations of research production? *Disability, Handicap and Society*, 7(2), 101-114.

Omorogbe, E. (2013). The challenge of effective science teaching in Nigerian secondary schools. *A Journal of Interdisciplinary Studies*, 2(7).

Orakwe, I.T.C. (2000). *Social studies (education basics) for tertiary institutions*. Onitsha: Desvic Printers.

- Oxford Advanced Learner's Dictionary. (2010). London: Oxford University.
- Ozanne, J.L. & Saatcioglu, B. (2008). Participatory action research. *Journal of Consumer Research*, 35(3), 423-439.
- Pain, R., Finn, M., Bouveng, R. & Ngobe, G. (2013). Productive tensions. Engaging geography students in participatory action research with communities. *Journal of Geography in Higher Education*, 37(1), 28-43.
- Pant, L.P. & Odame, H. (2009). The promise of Positive Deviants: Bridging Divides between Scientific Research and Local Practices in Smallholder Agriculture. *Knowledge Management for Development Journal*, 5(2), 160-172.
- Papert S. & Harel I. (1991). *Constructionism: Research reports and essays, 1985-1990*. Norwood, NJ: Ablex.
- Papert, S. & Harel, I. (1991). Situating constructionism. In Harel, I. & Papert, S. (Eds.), *Constructionism* (pp. 1-11). Norwood, NJ: Ablex.
- Park, P. (1993). What is participatory research? A theoretical and methodological perspective. In Park, P., Brydon-Mill, M., Hall, B. & Jackson, T. (Eds.), *Voices of change: Participatory research in the United States and Canada* (pp. 1-19). Westport, CT: Bergin & Garvey.
- Park, P. (2003). What is participatory research? A theological and methodological perspective. In Park, P., Brydon-Miller, M., Hall, B. & Jackson, T. (Eds.), *Voices of change: Participatory research in the United States of Canada* (pp. 1-19). Westport, CT: Bergin & Garvey.
- Partington.(2003). Why indigenous issues are an essential component of teacher education programs. *Australian Journal of Teacher Education*, 27(2), 39-48.
- Peacock, L. (2010). *Grounded globalism: How the US South embraces the worlds*. Atlanta, GA: University of Georgia Press.
- Pearce, C.L. (2004). The future of leadership: Combining vertical and shared leadership to transform knowledge work. *Academy of Management Executive*, 18, 1.

Peng, W. (2013). Examining pedagogical content knowledge (PCK) for business English teaching: Concept and model. *Polyglossiva*, 25, 83-94.

Personnel Administrative Measures. (2003). GN.267 of 2003. *Government Gazette* No. 24948, 21 February 2003.

Ponterotto, J.G. (2005). Qualitative research in counselling psychology. *Journal of Counselling Psychology*, 52(2), 126-136.

Qhosola, M.R. (2016). Creating sustainable learning environments for a Grade 10 accounting classroom: A critical accounting approach. (Unpublished doctoral thesis, University of the Free State).

Quinn, S. & Kanter, S. (1984). Team teaching: An alternative to lecture fatigue. *Innovation Abstracts*, 6(34), 159.

Rauscher, W. (2010). The technological knowledge used by technology education students in capability tasks. *International Journal of Technology and Design Education*, 21, 291-305. Netherlands: Kluwer.

Reason, P. & Bradbury, H. (2001). *Handbook of action research participative inquiry and practice*. London: Sage. Retrieved from <http://www.Worldcat.org/oclc/50303325>

Reason, P. & Bradbury, H. (2006). *A handbook for action research*. Thousand Oaks, CA: Sage.

Reason, P. & McArdle, K. (2004). Brief notes on the theory and practice of action research. In Becker, S. & Bryman, A. (Eds.). *Understanding research methods for social policy and practice*. London: Polity Press.

Reason, P. (1994). *Participation in human enquiry*. London: Sage.

Reason, P. (1994). Three approaches to participatory inquiry. In Denzin, N.K. & Lincoln, Y.S. (Eds.), *Handbook of qualitative research* (pp. 324-339). Thousand Oaks, CA: Sage.

Reason, P. (2004). *Action research: Forming communicative space for many ways of knowing – Response to Anisur Rahman*. Paper presented at the International workshop on Participatory Action Research. Dhaka, Bangladesh.

Reason, P. (2006). Choice and quality in action research practice. *Journal of Management Inquiry*, 15(2), 187-203.

Reeves, D.B. (2010). The 90/90/90 schools: A case study. In Reeves, D.B. (Ed.), *Accountability in action* (2nd ed. pp. 185-196). Denver, CO: Advanced Learning Press.

Regner, I., Loose, F. & Dumas, F. (2009). Students' perceptions of parental and teacher academic involvement. Consequences on achievement goals. *European Journal of Psychology of Education*, 24(2), 663-277.

Reimers, E.V. (2003). *Teacher professional development: An international review of the literature*. Paris: International Institute for Educational Planning. Retrieved from www.unesco.org/iiep

Rempfer, M. & Knott, J. (2005). Participatory action research: A mode for establishing partnerships between mental health researchers and persons with Psychiatric disabilities. In Brown, C. (Ed.), *Recovery and wellness: Models of hope and empowerment for people* (pp. 151-165). Binghamton: The Haworth Press.

Reza, M. (2012). Participatory action research (PAR): Revisiting the history, concept and ethics. *BRAC University Journal*, 4(2), 27-34.

Rogers, R., Malancharuvil-Berkes, E., Mosley, M., Hui, D. & Joseph, D. (2005). Critical discourse analysis in education: A review of literature. *Review of Educational Research*, 75(3), 365-417.

Rollnick, M. (2009). *Key challenges in science education: Education in South Africa Today*. Retrieved from <http://www.sabceducation.co.za>

Saunders, M., Lewis, P. & Thornhill, A. (2012). *Research methods for business students* (6th ed.). Place: Pearson Education Limited.

Schein, E.H. (1995). *Kurt Lewin's change theory in the field and in the classroom: Notes towards a model of managed learning*. SOL working paper.

Schroeder, C. (2013). The conference of United State catholic bishop's doctrinal elements of a curriculum framework for the development of catechetical material for young high school age. Pedagogical and theological perspectives of the religious studies teaching in the United States Schools. (Unpublished PhD thesis, University of San Francisco).

Schwandt, T.A. (2003). Three epistemological stances for qualitative inquiry: Interpretivism, hermeneutics and social constructionism. In Denzin, N.K. & Lincoln, Y.S. (Eds.), *The landscape of qualitative research: Theories and issues* (pp. 292-331). Thousand Oaks, CA: Sage.

Seido, M.Z. (2013). Educators' interpretation and implementation of the intended technology education curriculum in the general education and training band. (Unpublished MEd dissertation, University of Pretoria). Retrieved from <https://repository.up.ac.za/handle/sed>

Selenger, D. (1997). *Participatory action research and social change*. New York, NY: Cornell University.

Shallwami, S. & Mohammed, S. (2007). Community based participatory research. A training manual for community based researchers. *Ecology and Society*, 12(2), 11.

Sherman, L. (2008). Shared displays to support collaborative exploration of ocean Summits. (Unpublished Master of Science dissertation, University of British Columbia).

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15, 4-14.

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1-22.

Small, S.A. & Uttal, L. (2005). Action-orientated research: Strategies for engaged scholarship. *Journal of Marriage and Family*, 67(4), 936-948.

- Smith, A.C. (2007). *Implementation of the LA technology in secondary schools of Middelburg, Mpumalanga*.(Unpublished MTech dissertation, Tswane University).
- Spady, W. (2001). *It's time to end the decade of confusion about OBE in South Africa*. Retrieved from [http://www. Cite journal.org/vol3/s_coail_studies/article1.cfm](http://www.Citejournal.org/vol3/s_coail_studies/article1.cfm)
- Sparks, S.D. (2010). Class size shows signs of growing. *Education Week*, 30, 11-16. Retrieved from <http://www.edweek.org/ew/articles/2010/11/24/13>
- Spaull, N. (2013). *South Africa's education crisis: The quality of education in South Africa 1994-2011*. Johannesburg: Centre for Development and Enterprise.
- Spreen, C. & Valley, S. 2010. Outcomes based education and its (dis)contents: Learner-centred pedagogy and the educational crisis in South Africa. *Southern African Review of Education*, 16(1), 39-58.
- Stevens, A. (2004). *Technology teacher education in South Africa*. Retrieved from <http://www.iteaconnect.Org/Stevens.PDF>
- Stringer, E. & Genat, W. (2004). *Action research in health*. Jersey: Pearson Education Inc.
- Stringer, E.T. (1999). *Action research second edition*. Thousand Oaks, CA: Sage.
- Tagum, R.S. (2013). *Participatory research and participatory action research*. Retrieved from <http://www.slideshare.net/reynantetagum/participatory-action-research-16414937>
- Tenorio, E.H. (2011). Critical discourse analysis. *Nordic Journal of English Studies*, 10(1), 183-210.
- Thornburg, D.D. (2009). *Five challenges in science education*. Thornburg Centre for Space Exploration. Retrieved from <http://www.tcse-k12.org/pages/sciencepdf>
- Tooley, J. (2010). Moving from educational equality to improving the education of the least advantaged. In Haydon, G. (Ed). *Educational Equality*. London: Continuum Publishing.

- Udofia, V.I. & Ikpe, U.N. (2012). Administration of in-service training and teacher attitude to work in private secondary schools in Gross River State of Nigeria. *International Journal of Academic Research in Business and Social Sciences*, 2(10), 305-311.
- Vakalisa, N.C.G. & Gawe, N. (2011). Participative teaching. In Jacobs, M., Vakalisa, N.C.G. & Gawe N. *Teaching learning dynamics* (4th ed.). Cape Town: Pearson.
- Van Dijk, T.A. (2008). *Discourse and power*. Hampshire: Palgrave Macmillan.
- Van Dijk, T.A. (2011). Discourse and Ideological. In Van Dijk, T.A. (Ed.), *Discourse studies: A multidisciplinary Approach* (pp. 379-407). London: Sage.
- Van Dijk, T.A. (2012). Critical discourse studies: A socio-cognitive approach. In Wodak, R. & Meyer, M. (Eds.), *Methods of critical discourse analysis*. London: Sage.
- Van Rensburg, J.L.J. (2008). *Modern technology, module 8*. Bloemfontein: University of the Free State.
- Viera, A., Bers, M.U., Ponte, L., Juelich, K. & Schenker, J. (2002). Teachers as designers: Intergrading robotics in early childhood education. *Information Technology in Childhood Education*, 123-145.
- Voccarino, F. (2007). Action Research Reflections: The Wanganui Adult Literacy and Employment Project.
- Vollman, A.R., Anderson, E.T. & McFarlane, J. (2004). *Canadian community as partner*. Philadelphia, PA: Lippincott, William & Wilkins.
- Wadkins, T. Miller, R.L. & Wozniak, W. (2006). Team teaching: students' satisfaction and performance. *Teaching of Psychology*, 22(2), 118-120.
- Wadsworth, Y. (1998). *What is participatory action research? Action research international*. Retrieved from <http://www.scu.edu/schools/gem/ar/ari/p-ywadsworth98html>

- Wadsworth, Y. (2001). The mirror, the magnifying glass, the compass and the map. Facilitating participatory action research. In Reason, P. & Bradbury, H. (Eds.), *Handbook of action research: Participatory inquiry and practice*. London: Sage.
- Watters, J. & Comeau, S. (2010a). *Participatory action research. An educational tool for citizen-users of community mental health services*. Winnipeg: University of Manitoba.
- Watters, J. & Comeau, S. (2010b). *An educational tool for citizen-users of community mental health services. Getting started on your journey to create change*. London: Sage.
- Watters, J. & Comeau, S. (2014). Participatory action research. An educational tool for citizen-users of community mental health services. Retrieved from <https://cpsi.sharepoint.ms/>.
- Watters, J., Comeau, S. & Restall, G. (2010). *An educational tool for citizen-users of community mental health services*. Winnipeg: University of Manitoba.
- Wenger, E. (2000). *Communities of practice and social learning systems organisation*, 7, 225-246.
- Whyte, W.F. (1991). *Participatory action research*. Thousand Oaks, CA: Sage.
- Wilson, V. & Harris, M. (2003). Designing the best: A review of effective teaching and learning of design and technology. *International Journal of Technology and Design Education*, 13, 223-241.
- Wodak, R. (2001). *What is critical discourse analysis about? A summary of its history, important concepts and its development*. London: Sage.
- Wodak, R. (2008). Introduction: Terms and concepts. In Wodak, R. & Krzyzanowski, M. (Eds.), *Qualitative discourse analysis in the social sciences* (pp. 1-42). Basingstroke: Palgrave.
- Wodak, R. (2009). Critical discourse analysis: History agenda, theory and methodology. In Wodak, R. & Meyer, M. (Eds.), *Method for critical discourse analysis* (2nd ed., pp. 1-33). London: Sage.

Ziyambi, N.D. (2009). Teaching and learning technology in the senior phase: Constraints and challenges in Ladysmith Othukela District (KwaZulu-Natal). (Unpublished DEd thesis, Tshwane University of Technology).

APPENDICES

Appendix A: Informed consent

Strengthening the teaching of Mini-Practical Assessment Task in a senior phase Technology class.

Principal Investigator Pretty Kubheka [MD]

Phone number: 072 960 7847

INFORMED CONSENT:

Dear co researcher

I would like to invite you to participate in a study that I will be conducting. The title of the research is: Strengthening the teaching of Mini-Practical Assessment Task in a senior phase Technology class.

The aim of this study is to: Develop a strategy that will assist Technology teachers in teaching the Mini-Practical Assessment Task.

OBJECTIVES that inform this study are:

- To identify and justify the need to develop a strategy for strengthening the mini Practical Assessment Task in Technology classes.
- To identify the components for a strategy that is mini Practical Assessment Task in Technology classes.
- To determine the conditions conducive for the strategy to strengthen the mini Practical Assessment Task in a Technology classes.
- To identify and circumvent the threats for strengthening the mini Practical Assessment Task in a Technology class.
- To find and test the strategy for strengthening the mini Practical Assessment Task in a Technology Class.

You are regarded as the key informant based on your first-hand experience of the central phenomenon. You will therefore be able to purposefully inform an understanding of the research problem of the study. All steps will be taken to uphold confidentiality during this study.

Free Attitude Interviews will be approximately 30 min in duration, utilizing prepared open ended questions. The discussions will be conducted at a mutually agreed venue where you as potential participant will feel safe and secure.

Your participation is entirely voluntary and you are under no obligation to participate in this study. You will not suffer any consequences or loss for choosing not to participate. Participants will not be rewarded for participating. It is also your right to withdraw at any time with no repercussions.

Yours Sincerely

Pretty Kubheka

Please fill in and return this page. Keep the letter above for future reference

.....
.....

Researcher:

- I hereby give free and informed consent to participate in the above mentioned research study.
- I understand what the study is about, why I am participating and that I can withdraw from the study at any time.
- I give the researcher permission to make use of the data gathered from my participation.

Signature: _____

Date:

Appendix B: Ethical clearance number



Faculty of Education

26-Jun-2017

Dear Ms Pretty Kubheka

Ethics Clearance: Strengthen the teaching of “Mini Practical Assessment Task” in a Senior phase Technology class

Principal Investigator: Ms Pretty Kubheka

Department: School of Education Studies (Bloemfontein Campus)

APPLICATION APPROVED

With reference to your application for ethical clearance with the Faculty of Education, I am pleased to inform you on behalf of the Ethics Board of the faculty that you have been granted ethical clearance for your research.

Your ethical clearance number, to be used in all correspondence is: **UFS-HSD2016/1177**

This ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the ethics office to ensure we are kept up to date with your progress and any ethical implications that may arise.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours faithfully

Dr. MM Nkoane
Chairperson: Ethics Committee

Education Ethics Committee
Office of the Dean: Education
T: +27 (0)51 401 9683 | F: +27 (0)86 546 1113 | E: NkoaneMM@ufs.ac.za
Winkie Direko Building | P.O. Box/Posbus 339 | Bloemfontein 9300 | South Africa
www.ufs.ac.za



Appendix C: Permission to conduct research in the KZN DoE institutions



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma

Tel: 033 392 1004

Ref.:2/4/8/864

Mrs P Khubeka
PO Box 14376
Madadeni
2951

Dear Mrs Khubeka

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: "A STRATEGY TO STRENGTHEN THE TEACHING OF "MINI PRACTICAL ASSESMENT TASK" AT SENIOR PHASE TECHNOLOGY CLASS", in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 25 July 2016 to 01 December 2017.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehologile at the contact numbers below
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

Amajuba District

Adv. MB Masuku
Acting Head of Department: Education
Date: 29 July 2016

KWAZULU-NATAL DEPARTMENT OF EDUCATION

POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa ...dedicated to service and performance
PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004 beyond the call of duty
EMAIL ADDRESS: kehologile.connie@kzndoe.gov.za / Phindile.Duma@kzndoe.gov.za
CALL CENTRE: 0860 596 363; Fax: 033 392 1203 WEBSITE: www.kzneducation.gov.za

Appendix D: Discussions between the researcher and the co-researchers

During the discussions, the secretary mostly focused on capturing the resolutions on all the points of discussion.

The second meeting was held. Mr Sangweni was the chairperson for the day.

Mr Sangweni started by asking Mr Dlamini to open with a prayer. He then led the discussion by posing the following question:

We would agree, colleagues, that most of us have challenges during our daily teaching of technology. What challenges do you face in our schools in technology?

Mr Mkhize: “We experience challenges in graphic communication and making models. Most of us did not specialize in Technology hence we struggle a lot with 2D, 3D drawings; Perspective drawings both single and double point and first angle orthographic projections.”

Ms. Msimanga interrupted and said: “The drawing part is important in design processes because learners are expected to design their models and all these drawing skills are required.”

Miss Ndlela agreed with Ms Msimanga and said: “I fully agree with you Mkhize.”

Mr Dlamini could not contain himself and added: “Now if drawing is a challenge to us as teachers it is transferred to the learners and they also struggle to do the Mini-PAT because they are not guided properly by us as teachers.”

Mr Mkhize further pointed out: “Teaching systems and control is a problem to me. If for example in my grade 7 class learners have to design and make a ‘JAWS OF LIFE’, pneumatic and hydraulic systems are the mechanisms that have to be used there.”

Mrs Zulu responded by saying: “True most of us did not specialise in Technology so teaching 2d and 3d drawings is a problem.”

Mr Sangweni said: “I hear your concerns colleagues and I share the very same sentiments with you.” He then asked: “What are other challenges you have in your schools colleagues?”

Mrs Nukeri highlighted that unavailability of required material is problematic in their school: “I am teaching technology in grade7 and it is difficult to get these materials from learners. I ask them to bring material for a project and a few learners bring the material. If the School Management Team (SMT) can help by providing required material to use on a Mini-PAT.”

Mr Dlamini concurred: “Without adequate resources, we can’t have expected results from both parties because Technology goes hand in hand with resources. For example how can you build a model of the bridge without pliers?”

Mrs Nagel also emphasised that she teaches in a former Indian school and painted the following scenario: “Learners don’t come with models or they come with bad models while some come with good models because of resources and parent involvement.”

Mrs Zulu indicated: “Most of us are teaching approximately 65 learners per class which makes it difficult for us to do justice in teaching the Mini-PAT.”

Ms Ndlela agreed: “Yes, the floor space is a problem because learners are you can’t even move in between the desks. You can’t even control the learners because of the numbers.”

Mrs Zulu added: “What makes matters worse is that one is always berated and told that your classroom is making a lot of noise because it is not easy to control the learners. When you try to raise this issue of large numbers in the staff meetings, you are told that other subject teachers are not complaining because even the SMT’s do not understand the nature of the subject.”

Mrs Nagel indicated: “I really don’t have a problem with overcrowding because in my school we have an average of 33 learners per class.”

Mr Mkhize indicated: “It becomes difficult for him as a teacher to teach, assess and give immediate feedback due to the number of learners per class. Furthermore he highlighted that it is difficult to give individual assistance and attention to learners. Moreover the large numbers prohibits the differentiation process in class.”

Mr Dlamini: “I studied marketing at tertiary and I also did PGCE therefore I need support in Technology content and how to teach Technology successfully.”

“Technology is a new subject in our curriculum,” **Miss Msimanga** pointed out. She further explained: “I have been teaching for 20 years but I must confess that I am still struggling with teaching Technology especially the practical part and drawing which carries a lot of weight in the learners term mark.”

Mrs Nukeri: “I end up teaching some topics and leaving other topics because i am not well developed in Tech.”

Mrs Mkhize pointed out: “Most of us were not exposed to skills that Tech develops because they were seen to be male subjects.”

SOLUTIONS

Mrs Nukeri highlighted: “Content workshops can be of great assistance in this aspect as well.”

Mr Rambrij added: “We use clusters for planning of lessons and formal task development.” He further elucidated that during cluster meetings teachers’ work collaboratively in planning lessons and if one is encountering a challenge in a particular aspect those challenges are addressed on the spot.

Mr Msimanga agreed with Mr Rambrij and highlighted: “Sometimes we are unable to attend the cluster meetings because the SMT does not allow us to leave the school earlier and others are also teaching other grades.”

Mrs Mkhize contributed to the discussion by pointing out: “In my school more than one teacher teaches Technology. We usually work together by specialising in the one aspect that one teacher is excellent in teaching.”

Mrs Nagel agreed and said: “Ohhh that results in adequate coverage of all the technology content and learners benefit in all the aspects that are to be covered.”

SUGGESTED SOLUTIONS TO EDUCATIONAL RESOURCES

Mr Khanyile: “If all schools can be in possession of data projectors, integrating ICT where you use your phone on a data projector to beam the content from the internet can be done.”

All the co-researchers spoke simultaneously and said: “Weeee we don’t think that will happen. First and foremost most of us are not familiar with the gadgets that are used.”

Mr Khanyile interjected: “It’s very easy colleagues once you get these gadgets you can always ask someone to show you how they work.”

They said: “Ohhhhhh that could work we did not think it that way.”

Mrs Zulu said: “If you could elaborate on how this works, Mr Khanyile.”

Mr Khanyile started explaining. He said: “Colleagues most of us use smart phones. So if the school has a data projector and WIFI you can connect your smart phones to WIFI and you get internet connection. You can then download stuff like the workbooks, you tube videos and beam the activities from the workbooks and sometimes play you tube videos.”

“Ohhhhhh, now I see,” **Mr Sangweni** replied.

Mrs Nagel concurred with Khanyile and said: “The money used for purchasing textbooks can be redirected and used for buying tools such as data projectors laptops etc.”

Mr Sangweni agreed with Khanyile and added: “Even the workbooks can be downloaded and used during teaching.”

The co researchers agreed with Mr Khanyile s suggestion and they said it could work and it could really solve the challenge of the lack of resources.

TEACHER LEARNER RATIO

Mr Dlamini: “What I usually do is to take the independent learners to the classroom that is not occupied and they continue with their work. This allows me to move around freely and focus on the struggling learners.”

Mrs Zulu interjected and said: “That is not possible in our case because we don’t even have extra classrooms in our school.”

Mr Dlamini replied and said: “I am not trying to make a dialogue chair. I meant for those colleagues who have space in their schools because in some schools the problem is the number of teachers.”

Mr Ramrij: “Giving learners clear instructions preferably in writing so as to make sure that all the members of the group have a clear understanding of what has to be done also make group work effective for me.”

Ms Msimanga pointed out: “What I do is to group learners equally. I make sure that each group has both male and female learners with different abilities.”

Mr Mkhize said: “That is a good idea.” He continued: “I grouped learners as well but I never thought of it that way”. I think I will have to reconsider the way I group learners.”

Mr Dlamini added: “I use a raffle for learners to select their responsibilities so that they are all involved.”

The researcher asked Mr Dlamini how he does that.

Mr Dlamini explained and said: “I write the responsibilities of the groups like the group leader, the scribe, the time keeper, presenter and I ask the learners to pick any.”

TEACHER DEVELOPMENT

Mrs Nukeri indicated: We need to have workshops which will be hands on every term where it will deal diligently with the content and Mini- PAT of the following term.”

Mr Khanyile suggested that the workshops can be held during weekends in order to have a full day. He said: “Colleagues we have a challenge of running workshops during school hours as we are not allowed to take teachers out of class and we usually start at 13:00 and it’s impossible to run a hands on workshop.”

The whole team agreed and **Mrs Nagel** stood out and said: “Even us we usually have commitments after school hours.”

Mr Khanyile agreed and said: “This means Saturdays can work better for all of us.”

The team agreed but **Mrs Nukeri** brought to the attention of the house: “Saturdays for some of us is not ideal because most of the time we use them to attend to family functions such as funerals. Some of us also go to church on Saturdays.”

Mr Msimango replied: “That is true, so colleagues, this leaves us with school vacation time.”

The team spoke in one voice that workshops could assist in trying to solve the issue of professional development. However other team members brought forward another aspect that can be a solution to the issue of discussion.

Mr Mkhize and **Mr Sangweni** agreed with each other: “If the department can provide bursaries for technology teachers so that they can upgrade themselves in technology content and methodology.”

CONDITIONS CONDUCIVE FOR SUCCESSFUL IMPLEMENTATION

The team agreed: “Working together in harmony as a team during the implementation of the plans to strengthen teaching Mini-PAT is important”. Mrs Nagel said: “Dedication and thoughtfulness should be demonstrated by all.”

The researcher added and mentioned that it is very important that teachers who teach Technology work collaboratively so that they can share their strategies and good practices that work in favour of improving learner performance.

Mr Dlamini commented. He started agreeing with the former speaker and added to say: “Working in teams can benefit all of us because we will plan together, and help each other with problematic aspects and everyone will be confident.”

GOOD COMMUNICATION SKILLS

Mr Sangweni indicated in our group discussion: “Good communication skills are central to any successful project.”

Mr Mkhize added: “If there is communication breakdown in anything that has to be done by a group of people there is a high possibility that it will not succeed.”

AVAILABILITY OF EDUCATIONAL RESOURCES

Mrs Zulu pointed out: “The availability of the resources will make it easy for us to understand exactly what needs to be done by learners during the execution of the Mini-PAT. It will help in ensuring that the hand on nature of the subject is adhered to.”

THREATS

Mr Mkhize commented: “I do not feel comfortable teaching while there is someone watching me.”

Mr Khanyile pointed out the following: “Colleagues we need to be enlightened that team teaching is an instrument that can assist in alleviating the challenge of content knowledge because you will help each other. We also need to know that this works both ways meaning that your colleague will teach your learners in your presence and you will also do the same.”

ABSENCE OF EDUCATIONAL RESOURCES

Miss Ndlela indicated: “Although the department has tried to supply the districts with resources this doesn’t help us because they are used during teacher training. Schools still do not have resources to teach Technology.”

Miss Msimanga pointed out: “The lending of material from the centre does not cater for all schools.”

PEDAGOGICAL APPROACHES

Miss Ndlela commented: “It is difficult to control these learners when learner centred approach is used.”

Mr Dlamini agreed with **Miss Ndlela** and added to say: “The learners take too much time to complete tasks.”

Time and Financial Constraints

During our discussion, **Mr Msimanga** commented: “The problem that we have is that our workshops start at 13:00-15:00. We don’t get enough time to be hands on.”

Ms Dlamini agreed with Mr Msimanga: “Yes we are no longer allowed to interfere with contact time.”

Appendix E: Proof of language editing

Kroonstad

BA, BA(Hons), MA, DLitt et Phil

Member of South African Translators' Institute – No. 1003545

Cell no: 079 193 5256

Email: larizahoffman@gmail.com

DECLARATION

To whom it may concern

I hereby certify that the English language of the following dissertation meets the requirements of academic publishing. This dissertation was linguistically edited and proofread by me, Dr. L. Hoffman.

Title of dissertation

STRENGTHEN THE TEACHING OF MINI-PRACTICAL ASSESSMENT TASK IN A
SENIOR PHASE TECHNOLOGY CLASS

Candidate

Pretty Kubheka



Lariza Hoffman

Kroonstad

1 June 2018

Appendix F: Turnitin report