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# Processes in Congruence to Emancipate Teachers: Technology Education and Action Research

Tomé Awshar, Mapotse*

*University of South Africa, College of Education, Department of Science and Technology Education, South Africa*

## Abstract

The driving forces behind Technology Education (TE) are teachers themselves. Technology Education across Africa is a key part of improving human resource development. TE offers a variety of benefits for the African continent. These benefits include improving education and knowledge sharing, as well as increasing exposure to innovation in order to improve the living conditions of the continent's residents. If teachers are not equipped to teach TE as a process, the African continent will continue to show unacceptable results unless radical interventions are implemented. It is against this background that action research (AR) comes handy to emancipate TE teachers of five sampled schools from Mk1 Circuit in Limpopo Province of South Africa. AR was used as a means for radical interventions and it was implemented in South African schools. Some of the notable problems that contribute to the education crisis in South Africa are unqualified or underqualified teachers, large numbers of learners from disadvantaged backgrounds, inadequate delivery of infrastructure, incompetent teaching and poor learner results. The AR cycles and spirals activities of observing, planning, acting and reflecting manage to professionally develop TE teachers from low self-esteem of teaching TE to a remarkable increased TE didactic and pedagogic knowledge levels. The study was underpinned by Nash's Equilibrium Theory (NET) and guided by developmental action paradigm (DAP). Reflective questionnaires, non-participative observation and interviews were used to collect data. Action research with technology teachers manages to close the technology pedagogic content knowledge gap.



*Keywords*— Nash Equilibrium Theory, Developmental Action Paradigm, Action Research

## Introduction

Some education stakeholders assume that students perform better when their teachers have received quality education and training in the subjects they teach and at the levels/phases in which they are placed. For many years, South Africa has struggled to deliver an acceptable Mathematics, Science and Technology Education (TE) at primary and secondary schools (Gauteng Department of Education, 2010). This article will focus on the latter mentioned subject TE. The school subject Technology Education (called Design & Technology and/or Science & Technology in some countries) is a vehicle for inculcating creativity, problem solving and innovation because of its hands-on nature in classroom practices (Mapotse, 2013). Technology Education is a latecomer within school curricula both nationally and internationally and therefore, it has posed number of challenges different from other subjects. Amongst the multiple challenges that can be mentioned is the teaching of technology process as the method of teaching TE. Dugger (2010) describes technology as the study of the natural world and is the process by which humans modify nature to meet their needs and wants. It is during the didactic situation that TE teachers need to understand, apply and follow all the steps of the technology process so as to equip their learners with both the design and problem-solving skills. Technology education is the study of the tools, materials, and processes necessary to design and to solve problem (Laufenberg, 2009). An understanding on the TE process by teachers is fundamental to acquiring technology literacy (Mapotse, 2001). A gap has been identified that TE teachers are not rooted in the technology process per se hence involving them in action research (AR) to address that lack. Development, emancipation and empowerment of TE teachers through AR become prominent as TE teachers are placed at the forefront to teach learners this relatively new subject.

Some scholars in the technology field have engaged in research targeting variety of aspects of TE, for instance De Vries (2007), Middleton (2009), Nkosi (2008), Potgieter (2004), Pudi (2005), Stevens (2006) and Williams and Gumbo (2011). The aforementioned scholars belonging to both national and global villages have used some common instruments or similar approaches to gather their data and little has been done in using action research

*All correspondence related to this article should be directed to Tomé Awshar, Mapotse, University of South Africa, College of Education, Department of Science and Technology Education, South Africa
Email: mapotta@unisa.ac.za

approach to emancipate technology teachers and conscientise them with learners supervision process of making the technology product. With this study, I want to attempt to fill that gap by sharing experiences gained through project supervision. I will be sharing those technology teachers' experiences as a critical realist using a developmental action paradigm and also underpinning this study through Nash's Equilibrium Theory (NET). If theory could be applied without any interrogation, its influence on the study might not be noticed.

*Theoretical framework*

*The importance of theory in this study*

In most qualitative studies, theory comes at the beginning and provides a lens that shapes what is looked at and the questions asked especially in a transformative research (Creswell, 2014). Theory in the researcher's thought helps to make research decisions and provide a sense of the world around. Theory is also an explanation that discusses how a phenomenon operates and why it operates as it does. Furthermore, it serves the purpose of making sense out of current knowledge by integrating and summarising this knowledge, and thus theory can be used to guide research by making predictions (Johnson & Christensen, 2004). My choice of using Nash's Equilibrium Theory (NET) was motivated by my intention to emancipate the technology teachers in terms of overcoming the challenges that they faced in their knowledge and teaching of the subject using the technology process. By reflecting critically on their unfavourable status-quo, technology teachers could be helped to think about how they could free themselves from such unfavourable conditions and take action about it – so as to be emancipated. The kind of intervention in such involvement is facilitative rather than instructive, so that those being helped can later be self-reliant and become independent to address their situation. Specifically, the next section explains how NET found relevance in this study.

*The value and application of Nash's Equilibrium Theory in this study*

The study intended to strike a balance between two sets of categories for TE teachers, which are: (a) unqualified or underqualified teachers to teach TE, and (b) technological pedagogic content knowledge. Therefore, it will be conducive to juxtapose the two categories through NET. This theory is named after mathematician John Nash (1950) and is central to game theory. This concept refers to a situation in which individuals participating in a game pursue the best possible strategy while possessing the knowledge of the strategies of other players. The AR participants who are TE teachers take part in the study as individuals who possess different knowledge background pertaining to the themes of TE. As a team of researchers we want to fill those diverse thematic gaps identified during reconnaissance study and pursue the best possible intervention strategy for emancipation purposes.

NET (Bothamley, 2004) is sometimes referred to as the non-co-operative equilibrium because each player chooses his/her own strategy believing it is the best one possible. A player makes his/her own choices without collusion and without thinking about the interests of either his/her opponents or the society in which he/she lives. As a team, we have created an intellectual platform wherein we address the knowledge gaps that have been realised within this TE scholarly community of informants or team members or players or co-researchers or participants. The team members have put aside the interest of their schools where they come from, that is, their schools look down on TE but want to be capacitated by taking turns to lead their colleagues on the TE themes they excel in. In so doing the participants believe that our scholarly engagement will change the TE perception among the learners, their school management teams the Mk1 Circuit.

In the context of this study, NET is a social theory oriented towards balancing and emancipating technology teachers' classroom practices, those are, their limited technological knowledge and how to teach technology. This study would hopefully create enough awareness in these teachers to be able to pass judgement on their teaching of technology process and to evaluate their knowledge base of technology process with the sole purpose of being emancipated from this situation. This aligns well with my understanding of TE that it is fundamentally a hands-on enterprise. Hands-on teaching in technology must be taken to refer to learning through experiences, that is, through practical engagement in investigating, designing, making, evaluating and communicating ideas and plans (Department of Education, 2003). Approaching TE theoretically is unfathomable.

*Research problem*

Technology or the design process is the backbone approach for teaching TE whereas action research is a process with emancipation intended to the participants. This article is an account of the two processes combined within a study; those processes are action research process and technology process. Technology teachers need to expose their learners to all the steps of the technology process and I need to render AR process to these TE teachers. The technology process has the following main steps: investigate, design, make, evaluate and communicate bearing the acronym IDMEC (Department of Basic Education, 2011) and the action research process integrates the following stages: observation, planning, action and reflection, shortened as OPAR. Both TE steps and AR stages are not linear

and targeting to capacitate the participants from both their pedagogy and didactic of technology. The sections that follow highlight the aim of the study.

*Aim of the study and research question*

The main aim of this study is to investigate the use of action research initiative to empower, emancipate and professionally develop TE teachers with the technology process. The action research (AR) study with the senior phase Technology Education teachers at selected schools of Limpopo Province was motivated by the fact that TE is a foreign concept to many teachers and a new learning area in school curriculum both nationally and internationally. Thus, a new curriculum known as Curriculum 2005 (reviewed twice already) was developed in which technology was introduced as a new subject.

*Process within Technology Education*

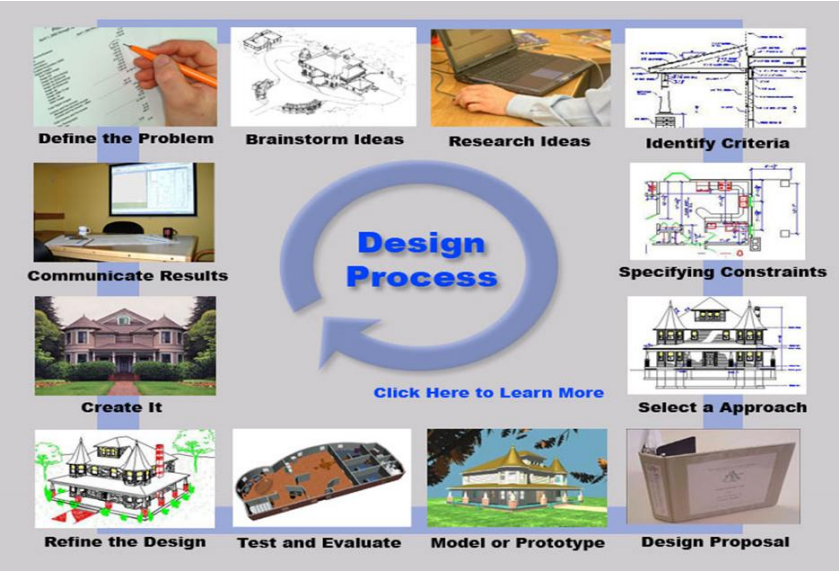
South Africa does not have a recorded best practice experience and a history of TE, which teachers can draw on to, develop learning programmes. This has a direct impact on teachers because they have to contextualise best practice material from literature for the South African (SA) situation.

SA curriculum transformation to introduce technology and thereafter some efforts to improve its quality hails from the fact that South Africa needs to produce engineers, technicians and artisans needed in modern society and develop a technological literate population for modern world (DBE, 2010). For this to be realised, the main players on these are the technology teachers as technology policy (DoE; 2003) reiterate that teaching and learning in technology must be aimed at developing technological literacy to empower learners. Empowering these learners will enable them to cope with the challenges of a technological society. *Design or technological processes* as explained by (DBE CAPS, 2011) are creative human activities of developing technological solutions in order to satisfy human needs and wants (e.g. manufacturing, design, repair, restoration).

*Design process models of teaching Technology*

*Technology is a disciplined process* of using knowledge, skills and resources to meet human needs and wants by designing, making and evaluating products and processes (Heads of Education Committee, 1996). Mapotse (2012, p. 63) stresses that the design process is the method of teaching technology. The design process can have many steps to follow in addressing a human need or want. Picture 1 (below) displays 12 generic steps within the design process.

The 12 generic steps of the design process in picture 1 are circularly ordered as follows: a) Define the problem; b) Brainstorm ideas; c) Research ideas; d) Identify criteria; e) Specify constraints; f) Select an approach; g) Design proposal; h) Model/Prototype/Artefact; i) Test and evaluate; j) Redefine the design; k) Create it; l) Communicate results.




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

Within the current debate on the nature of technology and the appropriate form and content of school curricula for Technology Education, there is recognition that values are a central component, and a sense in which technology, both its products and its processes, represent the embodiment of the culture. People create the things they value, the things they think are beautiful or useful, and devise tools, machines and systems to accomplish the ends they value. Beliefs, values, philosophies, experiences, in short culture, are manifested in part in the artefacts and systems people create (Conway, 1994). Technology offers many opportunities for learners to develop their capability, in particular, to intervene in the human-made world by applying IDMEC on products and systems to solving problems so as to meet people's needs and wants (Western Cape Department of Education, 2011, p.1).

The design process can follow the four distinct model types: linear, interactive, circular or the design loop (Ter-Morshuizen, Thatcher & Thomson, 1997, p. 11-12) each activity in the process needs to be evaluated before attempting the next activity. The design process forms the *backbone* of the technology subject and should be used to structure the delivery of all the learning aims. Learners should be exposed to problems, needs or opportunities as a starting point. They should then engage in a systematic process that allows them to develop solutions that solve problems, rectify design issues and satisfy needs (DBE, 2010).

*Action research process*

*Action research is a process* in which participants examine their own educational practice systematically and carefully, using the techniques of research (Ferrance, 2000, p. 8). Action research is a form of *collective* self-reflective enquiry undertaken by participants in social situation in order to improve rationality and justice of their own social or educational practices, as well as their understanding of these practices and the situation in which these practices are carried out. Groups of participants can be teachers, students, principals, parents and other community members – any group with a shared concern (Kemmis & McTaggart, 1988, p. 6). In line with this definition, the shared concern is TE with teachers in Limpopo Province to improve teacher's educational practices of the subject through AR.

Mill (2000) in Figure 1 displays the practical AR steps which are more circular and if they are repeated they become spiral. The green or outside arrows depict the circular movement of the investigation whereas the yellow or inside arrows signify the spiral intervention of the practitioner. The AR practitioner will first start by identifying an area of focus in my case is TE. The second step will be data collection followed by analysis and interpretation of data. Lastly, the developing of an action plan (addressing identified themes from reconnaissance study) will seal this process.

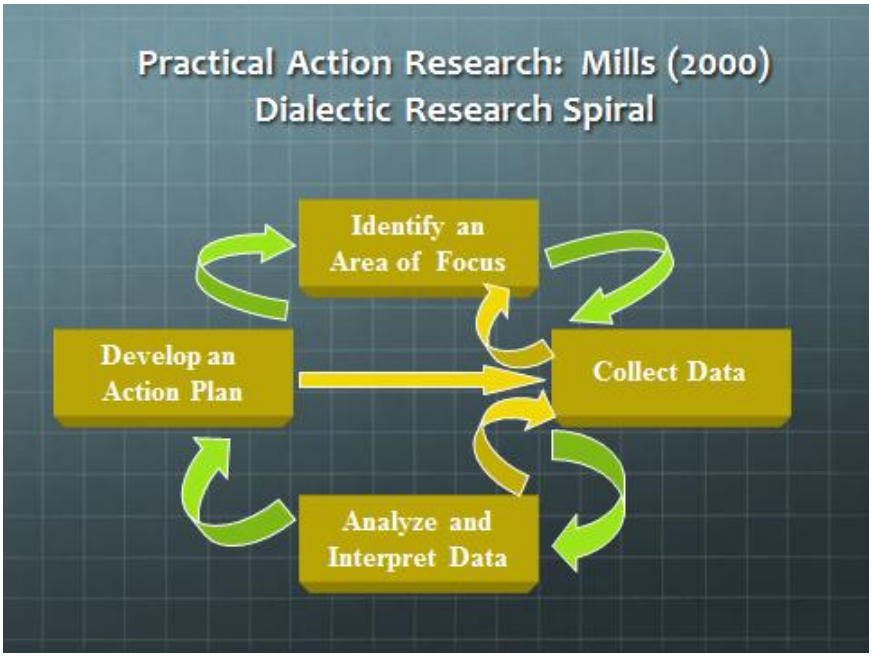



*Figure 1*: Action research cycle
*Source*: Mills (2000)

AR is a cyclical process of reflecting on practice, taking an action, reflecting, and taking further action. Therefore, the research takes shape while it is being performed. Greater understanding from each cycle points the way

to improved actions (Riel, 2010). I tend to display the cycle based on the latter definition of AR. I will abbreviate AR process of observation, planning, action, and reflection as OPAR.

*How TE and AR complement to capacitate teachers*

IDMEC is a teaching process within Technology Education whereas OPAR is the emancipation process within AR as mentioned earlier on. Both processes are not linear as outlined in Table 1 below. AR is more cyclical in nature and continues to be spiral after reflective measures are executed by the AR group. TE process can take any form cyclical or linear depending on the facilitator and the nature of the want or need or problem to be technologically solved. The combination of these two (TE teaching and emancipation through AR) processes within a structured set-up with teachers of selected schools in Mk1 Circuit of Limpopo Province has yielded capacitated teachers. This is evident under findings and discussion, sub-section that promulgate vignette of cycle 1 activities.

These TE teachers can now teach technology with confidence and every chance of success. AR has complemented TE to capacitate these TE teachers because of its relevance as displayed in Table 1.

Table 1:
*The relevance of AR process to TE process*

| Action research | Design process |
|---|---|
| Identify and verify the problem (investigation) | Identify a technological problem |
| Suggest and plan the solution (consult, methods, etc.) | Investigate the problem (scientific methods) |
| Implement the solution (monitoring methods) | Suggest a practical solution<br>Make the solution (artefact or prototype model) |
| Reflect (workability of solution); May be required to repeat the loop → re-plan next cycle | Test and evaluate the solution;<br>May be required to repeat the process – next cycle |
| Market the solution: empowerment strategy, framework or model | Market the solution: product, process or system |
| Follow circular and spiral process | Follow a linear, interactive, design loop or circular process |

Adapted from Mapotse and Gumbo (2013)

Table 1 gives a synopsis of the relevance of AR to TE process. What ensue is the research design and methods of the study. This next section shows the sample and methods used to collect data to make AR process a suitable complementary process for TE.

*Research design and methods*

The sample of five secondary high schools was drawn from Capricorn Region at Mk1 Circuit of Mankweng District. The circuit name has been concealed for ethical reasons. The choice of Mk1 Circuit was prompted by the lack of technology knowledge that the researcher observed previously at the time he was lecturing in one university in Limpopo Province. The aim of delineating the scope of the study was to implement some intervention strategies to a manageable sample of technology teachers teaching Grades 8 and 9. Mk1 Circuit was chosen as a cluster sampling strategy. Cluster sampling groups of Grade 8 and 9 technology teachers were randomly selected (Gay, 1987) in terms of their schools, which were more on semi-urban villages.

The following methods were used to collect data from the participants (technology teachers) and those were: non-participants' observations, structured interviews and reflective questionnaires. The aim of this study was to establish intervention strategies to empower and emancipate senior phase technology teachers from the challenges that they faced in teaching technology. The intervention strategies were implemented through AR spiral and cyclical processes, the principles for such processes are focused on empowerment, professional development and emancipation of technology teachers. The findings of these processes are discussed in the section that ensues.

*Research approach*

The collection of data is an important step in deciding what action needs to be taken. Multiple sources of data were used to understand the scope of what is happening in the technology classroom during technology process better. To address the research problem, an inquiry using a qualitative approach was undertaken to ascertain the opinions and experiences of technology teachers regarding technology process steps in constructing learners' project, with a view to further informing the project making agenda and technology process debates.

Action research can be shaped in such a way that it is able to reach out broadly in society (Gustavsen, 2014). The current study focused on TE teachers as the society of co-researchers. This study was conducted with a small sample of five schools in Limpopo Province, with specific reference to AR and TE processes.

*Sample of the study*

Cluster samples were drawn from five high schools (see Table 2) at Mk1 Circuit. Cluster sampling is characterised by some degree of homogeneity (Maree & Pietersen, 2010; McMillan & Schumacher, 1989). Though the sampled schools are located in varied milieus (rural and urban), they were all secondary (sec) schools. It should also be noted that the focus was on the technology teachers sampled from these schools – a total of 18 teachers. Pseudo names were assigned to the schools to conceal their true identity of both the schools and the circuit.

With the guidance of the circuit manager, the five schools indicated in Table 2 (below) from Mk1 Circuit were chosen for their contextual location, convenience in conducting interviews and ease of convening a common venue for contact sessions of AR cycles and activities.

Table 2:
*Sample of selected schools and technology education teachers*

| SAMPLE SCHOOLS | Total | Non-participative Observations | Structured Interviews | Reflective Questionnaires | SCHOOL MILIEU |
|---|---|---|---|---|---|
| KMK Sec | 7 | 4 | 5 | 7 | Semi-urban |
| VMV Sec | 3 | 3 | 3 | 3 | Urban |
| RMR Sec | 3 | 2 | 3 | 3 | Rural |
| BMB Sec | 3 | 2 | 2 | 3 | Rural |
| WHW Sec | 2 | 2 | 2 | 2 | Urban |
| Total | 18 | 13 | 15 | 18 | |

The schools were chosen within a radius of not more than 100 kilometres from each other. The sampling varied in terms of their milieus, that is, rural, urban and semi-urban, in order to gain biographical information on the need for intervention and degree of challenges they faced in supervising the learners projects. The number of TE teachers and their teaching varied, with some teaching only Grade 8, some only Grade 9. There are many vehicles for the collecting of data but in this case, I had to select those most appropriate for the issue being researched. Sources used during the main AR study were readily available and data collection was systematically organised and logically structured with the participants well in advance. I organised the data in a way that made it useful to identify trends and themes, collecting it from senior phase technology teachers of Mk1 Circuit through non-participant observations, structured interviews and reflective questionnaires. The next section shows how data was analysed.

*Data analysis*

Data analysis of cycle 1 is presented in a narrative form. Tables and figures are used to supplement the analysis information. This process of data analysis focused on understanding the teaching and learning actions and events within the participants' settings and contexts. Data from both interviews and observations were reviewed holistically and important themes noted. The questionnaires had preconceived themes that gave a direction to analyse the data. The themes in the questionnaire were used to guide the analysis even though additional themes were developed from the interviews. The findings will be triangulated as displayed in Figure 2 below:

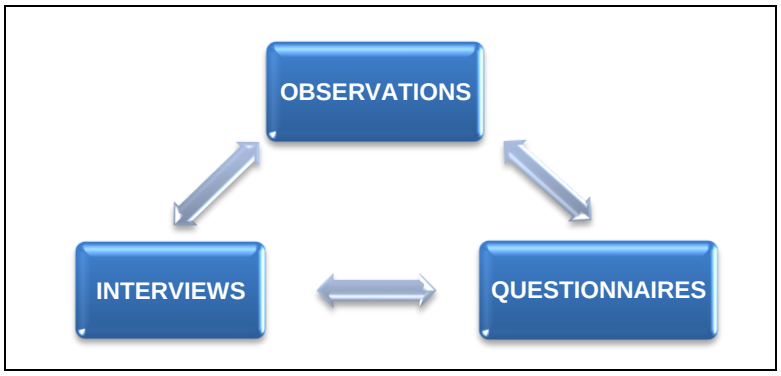



*Figure 2*: Triangulation of findings from the reconnaissance study

Findings from what was observed served as an umbrella to both the interviews and questionnaire. Findings from the interviews sought clarity of the observation and confirmed the themes from the questionnaire. Findings from all the three instruments were integrated since they addressed similar themes; hence, they were triangulated (Kerlinger, 1986; Anderson, 1993) since triangulation is one of the strategies that can enhance the validity of a qualitative research.

The use of multiple methods in an investigation is to overcome the weakness or bias of a single method (Denzin, 1988, p. 511-513). Triangulation techniques attempted to map out and explain more fully the richness and complexity of teaching technology by studying it from more than one standpoint (Manion & Morrison, 2000). In this study, data collected were used for triangulation purposes.

## Research Findings and Discussion

*Vignette of cycle 1 activities*

This was a proposed schedule of the activities that took place each day in a selected secondary school during cycle 1. Data was collected each day of the visit at each school from the participants, using only the three instruments during cycle 1 contact session. Pictures of what I observed within the technology classrooms were taken. Consent forms were signed by both teachers and learners' parents/or guardians. This will serve as observation findings in cycle 1 during phase 1 as I took photographs of all the classes being taught technology in all the selected schools, and observed that they did not have any technology workshop or laboratory. I also found out that the teachers were using their classes for technology tuition and all other subjects are taught from the same class. The section that follows confirms the gap the teachers still have in applying the design process, which is TE theme 1.

This is how technology teachers still respond to policy related questions after more than a decade of technology establishment. It shows that the country still have a long way to go. I will cite one question from the interviews and participants responses. The question has to do with the design process:

Question: *Can you regard Theme 1 as a method of teaching technology? Support your answer …*

Responses: BMBIP – 03 → *Yes, it emphasises working together, finds out from each other that's how they learn from each other.*

VMVIP – 01 → *I don't know what it actually covers since there is no policy document that I have been provided with.*

RMRIP – 01 → *I don't know.*

KMKIP – 06 → *I don't know them by heart, I have to refer*

(NB: The first three letters indicate a school code and IP stands for interview participant number)

With these types of responses, it was clear that TE participants do not have a clue what TE themes entail. Theme 1 from technology policy document covers the technology process. TE teachers from different schools do not even know which theme supports the process. This was a leading question but the teachers responses suggest that AR should be embarked on with the intended goal of making the difference. I trust that at the end of the AR cycles their responses will be different.

There were participants from the five participating secondary schools, nine males and nine females. Eleven participants had less than six years of technology teaching experience while seven had more than five years. Eleven out of the eighteen had no form of technology qualification and seven had some. Thirteen worked in rural areas whereas five worked in urban areas. Ten could plan the technology lessons whereas eight still needed help. Findings from all the three instruments were integrated, triangulated and analysed thematically in the next section.

*Integrating findings from classroom practices*

The themes of focus were selected to cover aspects of technology teaching from policy interpretation to classroom practice. These themes include technology-specific teaching experience, technology lesson planning, technology assessment, level of internal and external support for technology teaching, resources for technology teaching and learning, technology curriculum policy interpretation and implementation, and teacher-learner ratio in a technology class. This study will report on both technology teaching experience and technology planning for teaching.

*Focus 1: Technology teaching experience*

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

*Focus 2: Technology planning for teaching*

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

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

## Recommendations

Carr and Kemmis (in Wilson, 2002) share a description that advocating AR means to act following deliberate planning for strategic action while rigorously observing the effects or consequences during the spiral activities of planning, acting, observing, and reflecting. In this study, the AR description culminates into critically reflecting as a team on the cycles, phases, outcomes and/or process of the research. I have been through the AR spiral but separate cyclical activities with teachers during the enquiry. Together we critically reflected on the outcomes per cycle from cycle 1 to cycle 5. Since during AR activities, data is harvested per cycle. This article will highlight recommendations about cycle 1.

*Emancipation recommendations for technology teachers at district level*

After data analysis and interpretation of findings from cycle 1, I recommend the following to the district officials regarding technology teachers' emancipation:

- The district should build a relationship with other partners interested in advancing and developing TE.
- Technology clusters should be formed in each circuit and each cluster should have a well-established leadership.
- The district should organise MSTE (Mathematics, Science and Technology Education) Expo to motivate both technology teachers and learners
- With sponsors from outside let the district based technology subject advisors build curriculum related competitions, for example, Technology Olympiad, Smart Young Mindz.
- The district should identify technology teachers within a cluster who are good with technological content knowledge on certain core themes and let them be given opportunity to empower their colleagues on cluster level.

- A circuit meeting should be arranged, questionnaires issued out for technology teachers to complete so as to identify gaps in the TE curriculum.
- The questionnaires should be analysed and interpreted together with the cluster leaders.
- A four-week emancipation schedule should be drawn up; that will be a week per term guided by yearly work schedule.
- One week should be used in the beginning of the term so that teachers know what to do in class with the learners and the other weeks should be used to assess the work covered during the terms collectively and plan for the next term.

*Guidelines to develop teachers through action research*

The guidelines to engage in target population discrimination before emancipation are reflected below. The guidelines have been inspired by the teachers' reflection at the end of a cycle starting from cycle 1 of this AR. This confirms Douglas (in Le Roux & Schaller, 2005, p56) statement, which stresses that "all education is continuous dialogue – question and answer that pursue every problem to the horizon", and the action learner facilitator should apply the guidelines in the following manner (this is just a guide; one is free to start anywhere):

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

Since technology is one of the subjects that falls among some scarce skill, it was appropriate to engage senior phase technology teachers with an action research study as an effective way to provide high levels of support in both teaching and learning of technology.

## Conclusions

Technology Education (TE) teachers' were capacitated to implement technology process through action research process. This study was dedicated to outlining how teachers anywhere can teach technology process. TE teachers have been emancipated to follow the technology process through action research process as confirmed generally by many participants that they can now teach TE with confidence. The cycle programme followed the circuit theme as per their work schedule. This study set out to identify the challenges that the senior phase technology teachers at Mk1 Circuit of Limpopo Province faced regarding their knowledge and teaching of technology design process. A reconnaissance study as part of action research was employed to achieve this goal. I made certain assumptions surrounding the problem. However, this was an action research study, TE teachers and I embarked on the reconnaissance study to verify our problem and assumptions.

A reconnaissance study was conducted to confirm the research problem and for fact-finding purposes. Since this action research study was designed from both NET perspective and DAP it helped the participants to realise their gap in technology content knowledge and pedagogy. The challenges highlighted during the initial reflection were turned into action plans of the study. Both the participants as co-researchers and the AR practitioner collaboratively structured a schedule for contact sessions with an intensive plan of action to address the identified challenges. This plan of action included incorporating a variety of instruments to gather data as mentioned under the data collection section. As the plan took shape, it brought forth five cycles of the study. Cycle 1 brought to surface most of the practical problems experienced by technology teachers in their encounter with the learners' teaching progress.

A total of eighteen (18) technology teachers from five (5) secondary schools formed part of a sample population for this action research. There was a definite problem regarding the interpretation of the technology curriculum policy document, programme, schedule and lesson planning, and lack of taking advantage of the available resources. This problem was magnified by other related problems that were revealed by the findings, for instance, lack of internal and external support and what seemed an unmanageable teacher-learner ratio. Hence, by implication this indicated the need for intervention in the challenges that technology teachers faced. The findings confirmed the research problem and assumptions that we had. Thus, the next step was to continue with the action learning study, to intervene in the challenges that the teachers faced as a way of addressing the research problem.

The goal of participatory action research or community based participatory research is a democratic process through which members of a group, often an oppressed group, identify a problem, collect and analyse data, and

formulate solutions to effect social or political transformation (Whitehead & McNiff, 2006). I travelled that AR journey with TE teachers of Limpopo Province in South Africa so as to effect educational transformation.

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