EXPLORING GRADE SIX EDUCATORS' UNDERSTANDING OF THE INTEGRATION OF THE NATURAL SCIENCES AND TECHNOLOGY INTHE MAFUKUZELA – GHANDI CIRCUIT, ETHEKWINI REGION

by

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This thesis is submitted in fulfilment of the requirements for the degree of Master in Technology Education, in the Cluster of Science and Technology Education, University of KwaZulu-Natal, Durban, South Africa

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ABSTRACT

This qualitative study sought to explore Intermediate Phase Natural Sciences and technology educators' understanding of the integration of Natural Sciences andtechnology. This was donein order to ascertain whether there wasa relationship between their understanding of this integration and their classroom practice. The exploration was guided by the following three main research questions:

1. What understanding do Grade 6 educators have regarding the integration of Natural Sciences and technology?
2. How is their understanding enacted in their classroom practice?
3. What informs these educators' practice in the classroom?

A descriptive, explorative, qualitative research design was employed, and the data were generated from the following three phases:

- Phase I (questionnaire): finding out the Grade 6 educators' understanding of the term "integration".
- Phase II (class observation): finding out how this understanding of integration was enacted in their classroom practice.
- Phase III (focus group): finding out what informed the educators' practice in the classroom.

The theoretical framework thatguided the analysis of the data was Activity Theory. This framework allowed for aspects of the context and historicity within which teaching and learning in the classroom occurs to be brought to the fore.

With respect to the first question, this study revealedthat Grade 6 educators' understanding of the term 'integration'within the Natural Sciences and technology curriculum may be divided into two sections: a) General, and b) Curriculum based. In terms of the former understanding of the term integration, it was noted that a general understanding of the term 'integrate'was agreed upon amongst the participants. Five out of six participating educators

pointed to the idea of integration as being about “merging”; “joining”; “combining” and “linking” two or more “things” or aspects. Only one educator used the terms “integration” and “inclusion” interchangeably. However, with regard to the latter, the Grade 6 educators referred to cross-curricular integration as well as the integration of Natural Sciences and technology, and hence the following six perceptionswere revealed:

Perception1: Integration allows for technology LA to support the Natural Sciences.

Perception 2: Integration allows for the Natural Sciences to support technology.

Perception 3: Integration requires an understanding of both Content Knowledge (CK)and Pedagogical Content Knowledge(PCK).

Perception 4: The integration of Natural Sciences and technology is a way to motivate the populace.

Perception 5: The integration of Natural Sciences and technology is a way to integrate Skills.

Perception 6: A lack of integration - Natural Sciences cannot be linked to technology.

In terms of the second question, this study found that theGrade 6 educators found it difficult to integrate Natural Sciences and technology in their classroom practice. All of the Grade 6 educators in the six participating schools treated Natural Sciences and technology as separate subjects. Furthermore, Natural Sciences was the main subject taught in all of the lessons observed. As a result, there was no proper integration of Natural Sciences and technology in their teaching despite the fact that there was evidence in the interviews of a proper understanding of the term integration.

Thus, with regard to the third research question,the results show that the Grade 6 educators’ classroom practice was informed by the chalk-and-talk and textbook approaches. The participants gave a multitude of reasons for this practice ranging from a lack of funding to a lack of learning and teaching support materials (LTSM) about integrating Natural Sciences and technology Content Knowledge (CK).

The findings of this study point to the enormous challenge faced by the Department of Education inlevelling the playing field so that the integration of Natural Sciences and technology can be implemented smoothly at classroom level. Taking into consideration such challenges, the recommendations and possible solutions to these problems are discussed at length in the last chapter of this dissertation.

DECLARATION

I hereby declare that the study ***"Exploring Grade 6 educators' understanding of the integration of the Natural Sciences and Technology in Mafukuzela-Ghandi circuit, Ethekwini region"***, is my own work and has never been submitted before to this or any other academic institution. All the resources I have used or quoted have been indicated and acknowledged by means of complete references.

Researcher: Peter Dumisani Khanyile

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04 July 2016

Mr Peter Khanyile (902478000)
School of Education
Edgewood Campus

Dear Mr Khanyile,

Protocol reference number: HSS/0058/014M
Project title: Exploring Grade Six educators' understanding of the integration of Natural Sciences and Technology in Mafukuzela-Ghandhi Circuit, Ethekwini Region

Full Approval – Expedited / Amendment Application

With regards to your response received to our letter of 25 September 2014 and your amendment made on 01 July 2016. The documents submitted have been accepted by the Humanities & Social Sciences Research Ethics Committee and **FULL APPROVAL** for the protocol and amendment as follows:

- Change in Research Sites / Research Methodology

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

Please note: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)

/ms

cc Supervisor: Dr BP Alant
cc Academic Leader Research: Dr SB Khoza
cc School Administrator: Ms Tyzer Khumalo

DEDICATION

This thesis is dedicated to my late father and mother, Caiphus and Josephine Khanyile, for their tireless effort to keep us together and united as a family.

Rest in peace Ngwane, you will always be remembered!

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I would like to extend my sincere gratitude and appreciation to:

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- My friend, Dagago Williams, who kept on encouraging me to push through all the difficulties and hardships.
- The Grade 6 educators from the Mafukuzela-Ghandi circuit forgivingtheir time and giving me a space in their busy schedule to fill in questionnaires, inviting me into their classrooms for class observation and for taking part in the focus group interviews. This study would not have been possible without their contributions and insight.
- Department of Education, Superintendent Education Managers and principals for giving me permission to visit the selected schools in the Mafukuzela-Ghandi circuit.
- The parents of the Grade 6 learners, who trusted me to work with their children.
- The Grade 6 learners, who participated enthusiastically during the classroom observations.
- My dear wife, Sindisiwe B. Khanyile for her sacrificial love, always being there for me with support and understanding during demanding situations.
- My children, Siyathokoza, Londeka and Amahle for making our home a place of remembrance.
- Other members of the family for their contribution in making life worth living, and seeing the completion of this study.
- To my late father and mother for a job well done in raising me with Christian values.

ACRONYMS

DoE	Department of education
RNCS	Revised National Curriculum Statement
CAPS	Curriculum Assessment Policy Statement
SMT	School management Team
PCK	Pedagogical content knowledge
CK	Content knowledge

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CONTEXTUAL BACKGROUND TO THE STUDY

When the first democratically elected South African government came into power in 1994, it was important to restructure the education system in an attempt to eradicate the imbalances created by the Apartheid government. The new government placed more emphasis on skills development in order to empower the disadvantaged sections of South African society. In order to accomplish these transformational endeavours, the new government embarked on a series of transformational programmes in all sectors from social security to economic development, policing to education, health to industry, and many more. Among the changes that were affected were curricula policy transformations. The South African Department of Education (DoE) engaged in a process of extensive curriculum transformation as there was a need to develop a curriculum that emphasises equality for all learners within the new democratic dispensation. The old apartheid curriculum, which focused on completing the syllabus, had to change to a new curriculum that focused on achieving measurable outcomes. This marked the introduction of the learner-centred Outcomes Based Education (OBE) approach in 1995.

In 1998,the subject of technology was introduced for the first time in the school curriculum (C2005) as an independent learning area and was among the eightlearning areas to be covered in Grades R-9. The rationale for including technology among the science subjects was based on the promotion of skills development. This was necessary as the country had been experiencing a shortage of skills in the field of science and technology. It washoped that the focus on science and technology skills (particularly high level skills and knowledge) to promote economic development would benefit South Africa and allow it to compete internationally (Singh-Pillay & Alant, 2015). The National Curriculum Statement (NCS) was then implemented in all grades in 2004. More emphasis was thus placed on core developmental learning areas like maths, science and technology.

After a revision,the NCSbecame the Revised National Curriculum Statement (RNCS), which was implemented in the Foundation Phase and Intermediate Phase in 2004, the Senior Phase in 2005, and in the Further Education and Training (FET) band in 2006. Again,technology as a separate learning area was maintained in the streamlined curriculum as a compulsory

learning area within the General Education and Training (GET) band and was presented as an elective in the Further Education and Training (FET) band. This demonstrated that technology is without doubt an ideal and significant learning area in the South African National Curriculum.

However, there were uncertainties regarding whether technology should be implemented as an independent learning area or whether it should be integrated into other learning areas such as science and mathematics due to the commonalities that they share. These uncertainties were caused by the fact that technology was a completely new subject at the time - which was not a concern only in South Africa but in many other countries as well. According to Buck, Alant, Ellis and Sherwood (2014, p.42), "as a result of problems in implementation, the RNCS, like C2005 and the NCS, was reviewed and replaced by a single comprehensive Curriculum and Assessment Policy (CAPS) document, which came into effect in January, 2012". The authors further argue that the change from C2005 to theNCS – RNCS, and thereafter the Curriculum and Assessment Policy Statement (CAPS) clearly indicates the government's willingness to address what has been perceived as a crisis in the implementation of the curriculum.

In this regard, CAPS was introduced to strengthen the RNCS and to achieve quality education for all. Natural Sciences and technology have now been integrated into the Intermediate Phase but remain separated in the Senior Phase. This was done due to South African learners'poor performance in internationally benchmarked assessments.

From the viewpoint of CAPS, integration is the process of using different themes or knowledge strands to form one complete and coherent curriculum that is reflected in all lesson planning and presentation. Integration therefore promotes or enhances the process of holistic teaching and learning. This is demonstrated by the integration of Natural Sciences and technology in the Intermediate Phase, thus demonstrating the crosscutting nature of Natural Sciences and technology education.

It is a fact that within the context of formal education, integration plays an important role in the achievement of learners. It is for this reason that this study identifiedthe integration of Natural Sciences and technology as an area that needed careful planning and well-thought-out research. This study therefore mapped out the understanding of Grade 6 educators with regard to the integration of Natural Sciences and technology, and explored what informs this

understanding. This chapter is designed to explore this issue by presenting the significance of the study; offering the rationale and purpose of the study; as well as articulating the intended objectives and the critical research questions, research methods, and a brief background and overview of the study.

1.1 PROBLEM STATEMENT

According to Welman and Kruger (1999, p.2), a research problem refers to a particular difficulty that the researcher experiences in the context of either a theoretical or practical situation, and to which the researcher seeks to obtain a solution. This then forms the basisfrom which the objectives of the research and research questions are derived. According to Behr (1973, p.11), the identification and clear definition of the problem are vital for gaining the maximum value from any research.

The biggest challenge that continues to plague the South African education system is that "mediation of policy continues to be the 'just in time once off' professional development offered by subject advisors to practicing teachers for enrolment and enactment of new policies" (Singh-Pillay & Alant, 2015, p.13). Educators are expected to implement new curricula without having been adequately trained in the content and instructional methodology. Due to financial constraints and political influences, few workshops are organised whereby educators are trained to carry on with the training of other colleagues. By so doing, the quality and effectiveness of the workshops in terms of content are affected negatively. In support of this idea, Engelbrechtet al. (as cited in Imenda & Kok, 2010, p. 7) state that in the place of a properly organised curriculum orientation programme for teachers, new policy documents are simply dumped on the doorsteps of schools with an instruction to implement the new curriculum which has replaced the old one. Many of the affected teachers find themselves in a very difficult situation. In particular, often the implementation of the new curriculum implies a shift from traditional individualistic approaches where each teacher is responsible for his/her own subject to a situation where a teacher may not be an expert on all the subject matter to be facilitated in the curriculum (Imenda &Kok, 2010). Many educationalists agree that the educator is the single most important factor in translating the integrated Natural Sciences and Technology curriculum into practice. Therefore, extensive formal training and practical experience are imperative for the successful integration of Natural

Sciences and technology at all levels of education. The best strategy for curriculum integration is to put this integration into the hands of well-trained educators.

It is against this background, therefore, that this research sought to explore the understanding and enactment of an integrated Natural Sciences and technology curriculum by Grade 6 educators.

1.2 RATIONALE FOR THE STUDY

My interest in this area of study arose from my experience as an educator in the uMngeni Circuit over the past 15 years, teaching first both Natural Sciences and technology as separate learning areas, and at the time of this study, as an integrated subject. The primary school at which I teach is a rural school located 50km from Pietermaritzburg in the province of KwaZulu-Natal. What prompted me to conduct this study was the teaching challenges that my colleagues and I had experienced as a result of the new integrated curriculum, both in terms of dealing with the new content knowledge, as well as utilising a different approach to pedagogy. In an attempt to cope with these curricular demands, I observed during our cluster meetings that some of the Grade 6 educators talked about the integrated Natural Sciences and technology subject intermittently, while others avoided it by using only one method of teaching that favoured either Natural Sciences or technology. As a consequence, the integration of these subjects had been reduced to a meaningless activity. This was viewed as a clear indication that many Grade 6 educators in South Africa have an "under-developed" understanding of teaching the integrated Natural Sciences and technology subject. As further argued by Maposte (2012, p.57), "To date, some teachers are still grappling with the pedagogy of Technology with regard to classroom practice and planning." I was therefore keen to carry out a systematic study to find out how Grade 6 educators engage with and make sense of the new integrated curriculum that was being implemented in the Intermediate Phase at the time of this study.

Scholars, such as Lyons (1996) and Hurlin-Austin (1990), argue that educators frequently resort to learning by trial and error and, in so doing, develop coping strategies that help them to survive in the classroom. Without support and assistance, these coping strategies crystallise into teaching styles that will be utilised throughout the educator's career. This study was thus carried to provide the necessary support and assistance to Grade 6 teachers. This was done by

identifying the kinds of challenges that these educators face when teaching Natural Sciences and technology as an integrated subject in the Intermediate Phase.

The second factor that aroused my interest in this field wasan observation made by Berlin (1991) regarding the lack of sufficient documents and research on curriculum integration. Researchers raising the same concern include Loepp (1991) and Palmer (1995). It is in this regard that Custer (2000) argues that little progress has been made in this field. Since there appears to be a dearth in the research and literature in the field of integrated Natural Sciences and technology, I hope that this study will stimulate research activity in this field. By so doing, it will therefore add to the existing limited literature available regarding the integration of Natural Sciences and technology in the GET band.

1.3 SIGNIFICANCE OF THE STUDY

The significance of this research is linked to four aspects: Firstly, this study aimed to shed some light on the contextual accounts of practising educators' experiences of the integration of Natural Sciences and technology as they moved from policy to classroom practice. This was done in order to understand the relationship between educators' understanding of the integration of Natural Sciences and technology and their classroom practice.

Secondly, it was hoped that this study would add to the existing limited literature available regarding the integration of Natural Sciences and technology in the Intermediate Phase. According to Vars (1991, p.74), discussions and research about the integration of science and applied sciences go as far back as 1940. However, these have been unable to provide a clear direction for future endeavours because different perspectives on the meaning of integration dominate the scientific community. As a result,a lot of time is spent clarifying the meaning of integration rather than focusing on classroom practice. Thus, this study is a response to this state of affairs.

Thirdly, this study could be used as a springboard to increase the understanding of integration for both senior and newly qualified practitioners and could assist them to adopt an integrated approach to teaching Natural Sciences and technology in the Intermediate Phase. This will, in turn, allow educators to effectively and competently play their roles as mediators in presenting an integrated subject. In this regard, this study also aimed tohelpGrade 6 educators to

gain an understanding of the integrated curriculum, which could better equip them to deal with the integration of these two subjects in the Intermediate Phase.

Although this study was based on a review of the integration of the Natural Sciences and technology curriculum, it highlightedserious problems that could surface in other new learning areas that make new demands on educators and introduce new areas of emphasis. Lastly, on a broader scale, this research is of value to curriculum developers and specialists, as well as to textbook writers who prepare learning and teaching materials to be used in classroom practice. This study applies equally to national and regional policy makers, who design learning area policies for the integration of Natural Sciences and technology, and plan professional development programmes for educators.

1.4 AIMS AND OBJECTIVES OF THE STUDY

The main aim of this study was to explore Grade 6 educators' understanding of the integration of Natural Sciences and technology. In order to achieve this overall aim, I further divided the aim into the following specific objectives:

- To explore Grade 6 educators' understanding of the integration of the Natural Sciences and technology curriculum.
- To understand whether this understanding is enacted in practice and if so,
    - To what extent is this understanding enacted in practice?
    - How is this understanding enacted in practice (i.e. in the classroom)?
    - Why is this understanding enacted in thisparticular way?

1.5 FOCUS AND PURPOSE OF THE RESEARCH

The purpose of the study was to explore Grade 6 educators' understanding of the integration of Natural Sciences and technology in order to interrogate whether there is a relationship between their conceptual understanding and their classroom practice. To this end, the study focused on Grade 6 educators in the Mafukuzela-Ghandi district of KwaZulu-Natal. This purpose of this studywas addressed through the following research questions:

Research Question 1:*What understanding do Grade 6 educators have in relation to the integration of Natural Sciences and technology?*

Research Question 2:*Is this understanding enacted in practice? If so,*

Sub question 1:*To what extent and how is their understanding enacted in their classroom practice?*

Sub-question 2: *What informs these educators' practice in the classroom?*

1.6 RESEARCH METHODS /APPROACH TO THE STUDY

1.6.1 Qualitative inquiry

This was a qualitative study which explored Grade 6educators' understanding of the integration of Natural Sciences and technology. Qualitative methods afford the researcher the opportunity to understand the participants, their experiences and perspectives (Huysamen, 2001). Qualitative researchers believe that human behaviour and action "is best understood as it occurs without external constraints and control" (McMillan & Schumacher, 2010, p. 322). In this regard, the inquiry aimed to:

> *Understand, and also explain in argument, by using evidence from the data and the literature, what the phenomenon or phenomena that we are studying are about. We do not wish to place this understanding within the boundaries of an instrument that we designed beforehand because this will limit the data to those very boundaries. In this way our understanding will also be dependent on those very boundaries*(Henning, 2004, pp. 3-4).

According to Hemming (2004), qualitative research denotes a type of inquiry in which the qualities, characteristics or properties of a phenomenon are examined to gain a better understanding and explanation thereof (2004, p.5). Within this type of inquiry, in order to solicit an understanding and an explanation of the participants' views or actions, a variety of data needs to be generated, then documented and analysed through the use of data generation methods used in qualitative research. Decisions on the type of data sources to be used are to be informed by the purpose of the study, and the research questions in particular.

1.6.2 Research protocol

All necessary procedures and protocol were observed in line with the University of KwaZulu-Natal's ethical requirements to conduct this study.

1.6.3 Instruments for data collection

In order to provide answers to the critical research question(s) asked in this study, the process was carried out in three phases. The first phase aimed to answer Critical Research Question 1, which sought to explore Grade 6educators' understanding of the integration of Natural Sciences and technology. A survey approach was used in this phase to collect the data. One hundred Grade 6 educators who were teaching this subject within the schools in the Mafukuzela-Ghandhi circuit at the time of this study formed the sample population.

The second phase aimed to answer the first two sub-research questions, which sought to establish the extent to which the educators' understanding was enacted and how this understanding was enacted in the classroom. Classroom observation was used to collect the data to answer these questions. Six Grade 6 educators were purposefully selected from the 100 educators who participated in the questionnaire in the first phase.

The third phase aimed to answer the last sub-research question, which sought to establish what informed the practice of Grade 6 educators in their teaching of the integrated Natural Sciences and technology subject. Focus group interviews were used to gather the data required in this phase. The same six Grade 6 teachers who participated in Phase II above were selected for the focus interview.

1.6.4 Data analysis

Thematic analysis was employed in the study. In other words, the data collected for this study was analysed based on the type of themes generated in the different phases of the study. The presentation and analysis were carried out in three phases.

Phase I: In this phase, different forms of the participants' understanding were identified and
juxtaposed.

Phase II: In Phase II,the data collection involved the analysis of the classroom observations,
educator reflections and researcher reflections.

Phase III: The final phase of the process involved two stages. Stage 1 involved ananalysis of the focus group discussion of the results from Phase I. Stage 2 involved an analysis of the focusgroupdiscussion of the results from Phase II.

1.7 OUTLINE OF THE STUDY

This study consists of five chapters, which are arranged as follows:

Chapter 1: Contextual background to the study

This chapter outlined the context and research background, the rationale for the study, its purpose, objectives, the critical research questions and the significance of the study. It also presented the research methodologyof the study.

Chapter 2: Literature review

This chapter provides the literature review, indicating the debates and issues raised by scholars both locally and globally, and the potential role these have towards promoting meaningful Natural Sciences and technology teaching and learning. This was done to not only acknowledge the work of the researchers and authors who have written about this problem, but to further ground and give context to this study.

Chapter 3: Theoretical framework

Activity Theory was the overarching framework of this study and Grounded Theory guided this study at a theoretical and conceptual level, which is discussed in this chapter.

Chapter 4: Research methodology

This chapter addresses the research design and methodology used to answer the critical research questions posed in this study.

Chapter 5: Presentation and analysis of data

Chapter 5 deals with the presentation and analysis of the data obtained in this study. The results gathered from each data source are analysedand discussed individually and as a whole in order to answer the research questions asked in this research.

Chapter 6: Discussion of findings

This chapter commences with a summary of the study, which is then followed by a discussion regarding the findings individually, as well as holistically.

Chapter 7: Conclusions and recommendations

The conclusions and recommendations derived from this study are presented in this chapter. The implications of this study, as well as recommendations for further research are then provided, where after the dissertation is brought to a close.

CHAPTER 2

LITERATURE REVIEW

The purpose of this chapter is to review the literature on integration in order to determine and possibly to identify any gaps in knowledge. Reviewing the meaning and models of integration of Natural Sciences and technology is pertinent to this study. In this regard, the chapter engages critically firstly with the meaning of integration. Secondly, it explores the implementation models of integration. This exploration encompasses research conducted both within local and international contexts that focus on the integration of science, indigenous knowledge, and other learning areas.

Firstly, a discussion is presented regardingwhat integration is and what its value in the school curriculum is. This is followed by an exploration of the different implementation models of integration. Thirdly, integration in the South African curriculum is interrogated by looking at the CAPS document. Fourthly, local and international literature is explored to highlight the different perspectives held by different scholars on the phenomenon of integration. Lastly, I conclude the chapter by looking at the limitations or barriers to integration.

2.1 WHAT IS INTEGRATION?

According to Vars (1991, p.74), discussions and research about the integration ofscience and applied sciences go as far back as 1940. However, these have been unable to provide a clear direction for future endeavours because different perspectives on the meaning of integration dominate the scientific community. As a result,a lot of time is spent clarifying the meaning of integration rather than focusing on classroom practice. Furthermore, in terms of the clarification of meaning, Wringe (1971, p.83) argues that a copy of an educational journal that attempts to show integration at work is enough to indicate some of the confusion over the meaning of the term “integration”. He further illustrates that it consists of articles as diverse as integrated studies, the integrated community, the integrated day, and the integrated personality. Other scholars go on to speak of technology integration or curriculum integration. It is in this regard that Wringe (1971) feels that we obtain clarification on what might be meant by integration when applied to the curriculum. Lloyd (as cited in Wringe, 1971, pp.83-84) recommends a cautionary measure in how we define integration, as illustrated below:

To integrate means to make up a whole form from separate parts, to combine separate elements. The implication behind a desire to integrate therefore is that the parts lack something. So before we are justified in using the word in any context we must establish whether what is before us are really parts at all.

In support of this idea,Shelly, Caslman, Gunter & Gunter (2004, p. 339) define integration as bringing different parts together to create a whole. Ornstein (1988, p.244) defines curriculum integration as the linking of all types of knowledge and experiences contained within the curriculum plan. This definition is derived from the integration of a curriculum on the basis of subject content, which is referred to as horizontal integration.

Klein (2006) states that the term curriculum integration refers to the various forms of disciplines emerging in the educational sector. According to Klein (2006), inter-disciplinarity, multi-disciplinarity and cross-disciplinarity were the central forms of disciplinary collaborations. Integration, as Klein (2006) describes, thus indicates the collaboration of different disciplines within the school curriculum and includes the transference of content knowledge, skills and values across and between disciplines.

2.2 WHAT IS THE VALUE OF INTEGRATION IN THE SCHOOL CURRICULUM?

In his address, Bean (1991, p. 294) advocated an integrated curriculum that provides wholeness and unity rather than separation and fragmentation as this could provide a curriculum that motivates learners. On the same score, Frykholn and Glasson (2007, p.186) clearly indicate that inter-disciplinary or integrated curricula provide an opportunity for more relevant, less fragmented, and more stimulating experiences for learners. Commenting specifically on the integration of mathematics and science, Furner and Kumar (2007, p.188) maintain that these two subjects are integrated in order to enrich the learning context by motivating and engaging students in meaningful learning. This is done through overlapping concepts and principles.

Cennamo, Ross and Ertmer (2010,p.57) view integration as an opportunity to provide holistic activities that are more challenging and could be incorporatedin the real world. Furthermore, the authors argue that authentic learning, which results in helping learners become scientifically self-directed, independent and lifelong learners, is the result of integrated

curriculum and instruction (2010, p.315). Berlin (199, p.73) believes that integration and teamwork contribute to the quality of teaching and learning. This is done by ensuring that all disciplines have an input regarding both the internal and external nature of the integrated curriculum to ensure a balance of information. He also believes that such a balanced curriculum could help all students become scientifically and mathematically literate, which is the goal that most reform documents advocate.

2.3 IMPLEMENTATION MODELS OF INTEGRATION - WAYS OF INTEGRATING SCIENCE AND OTHER DISCIPLINES INTO THE SCHOOL CURRICULUM

The literature points to different scholars' frameworks or models for the development of integrated curriculum. The following five models are elaborated upon in this vein.

2.3.1 School specialist/shared model of disciplinarity

According to Verville, Wallance, Leone and Malone (1998, p.297), schools may specialise in agriculture, for instance, and to contextualise their lessons, teachers may use an agricultural theme, integrating it with science, technology and Social Sciences. Fogarty (1991, p.63) also maintains that different disciplines may overlap, using concepts as organising elements, thus being a shared model.

Selwyn (2003), in favour of schools that specialise in isolation, argues that there exist schools that are 'fixed' with regard to the way teaching and learning of disciplines occur. This implies that specialist disciplines have a more marked role in society than integrated discipline with regard to the type of education that learners receive. As a result, people have obtained degrees in specific disciplines, i.e. history or geography, and not in integrated disciplines such as Social Sciences.

Reason (1994) and Selwyn (2003), in support of Verville et al. (1998), have noted the significant dynamic of disciplines in that it is difficult to restrict the acquisition of knowledge without drawing on other disciplines. Hence, over the years, there has been an integration of various disciplines, which is aimed at expressing how knowledge can be shared between disciplines and how these relate to each other. This model is illustrated in the following drawing:

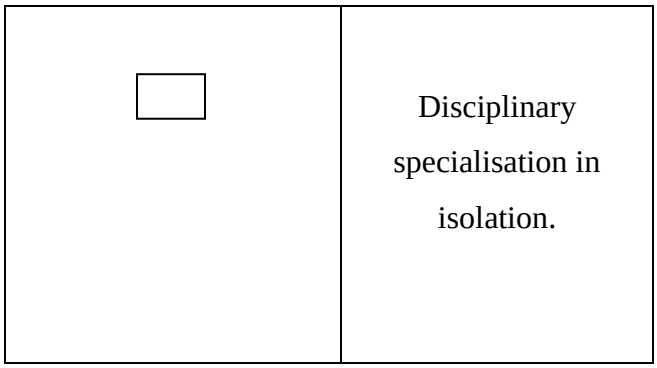


Figure 2.1: Disciplinary model

Source: Jantsch (1972, p.15 as cited in Iyer, 2011, p.14).

2.3.2 Thematic / webbed model of multi-disciplinarity

In his research on science and maths, Beane (1992, p.186) identified a central theme, then invited other subject area teachers to develop programmes of work that were complementary to but still in support of the main theme. This approach is referred to as a webbed model by Fogarty (1991, p.63).

In support of the above model, Jantsch (1972) argues that disciplines can integrate through multi-disciplinarity, which involves a range of disciplines that have no distinct relationship to one another. According to Weech and Pluzhenskaia (2005), multi-disciplinarity merely involves the addition of knowledge from different disciplines. In other words, this type of integration is not discipline-specific, but rather adds substance to any topic being taught. The drawing below illustrates this model.

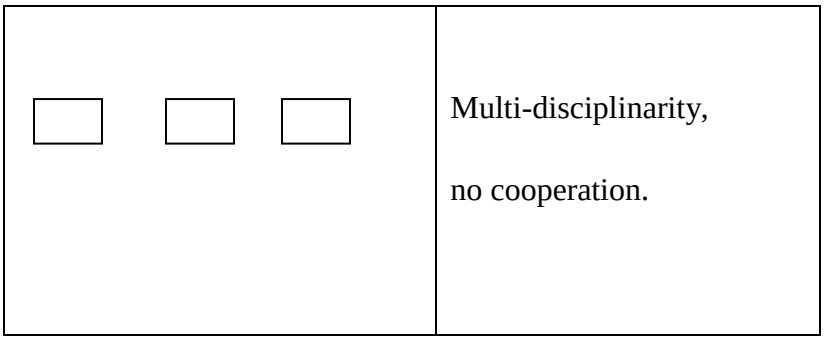


Figure 2.2: Multi-disciplinarity

Source: Jantsch (1972, p.15, as cited in Iyer, 2011, p. 14).

2.3.3 Integrated subject approach of pluri-disciplinarity

According to Audigier (2006), pluri-disciplinarity occurs when one theme, topic, or idea is analysed within integrated subjects. This allows for a holistic understanding of the ideas, topic or themes being discussed due to a broadening of knowledge. Mapotse (2012, p.42) came up with a broader approach to integration whereby several subjects wereintegrated into a framework that provides an understanding of the discipline of technology and its interrelatedness with others, e.g. science and mathematics. This model is illustrated in the drawing below:

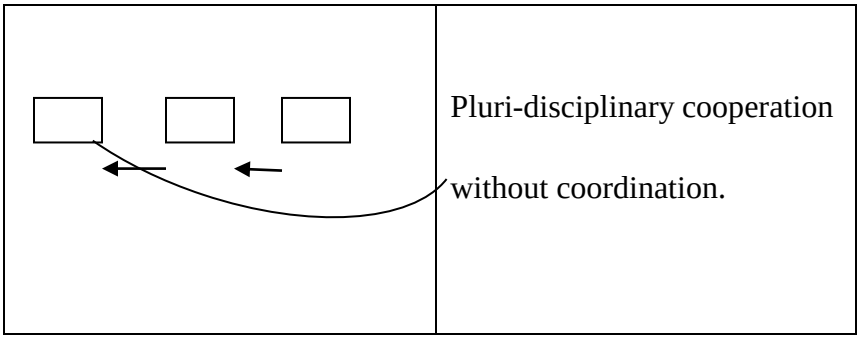


Figure 2.3: Pluri-disciplinarity

Source: Jantsch (1972, p.15, as cited in Iyer, 2011, p.14).

2.3.4 Cross-curricular / threaded model of cross-disciplinarity

According to Jantsch (1972), cross-disciplinarity occurs when the content knowledge from one specific discipline is used to enhance the teaching of another discipline. This gives rise to a hierarchal development of disciplines, thus projecting a sense of polarisation. Evidence of cross-disciplinarity can be seen during debates and discussions where learners are asked to review their personal opinions and views. In effect, learners draw from a dominant discipline rather than from one that does not lend itself to a vast range of perspectives. This model is illustrated in the drawing below:

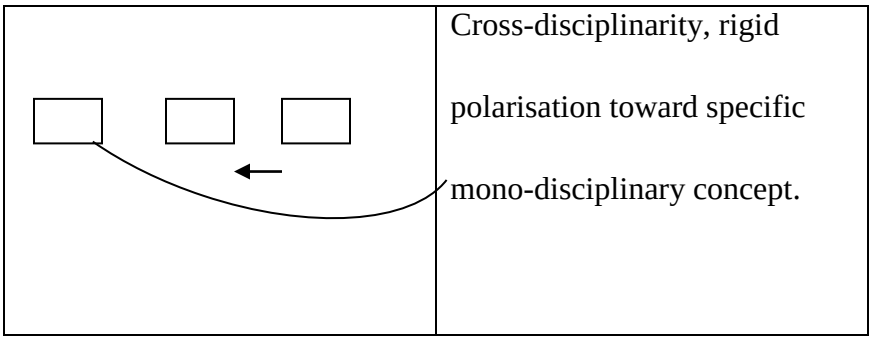


Figure 2.4:Cross-disciplinarity

Source: Jantsch (1972, p.15, as cited in Iyer, 2011, p.14).

2.3.5 Inter-disciplinarity

According to Jantsch (1972), inter-disciplinarity entails gaining insight into concepts from integrated subjects. Resweber (1981, as cited in Audigier,2006) has identified five characteristics of inter-disciplinarity:

- It looks deeply into the theme that is to be taught, as well as the methods of teaching.
- It requires its users to refer back to the foundations of the disciplines being combined.
- It is a collection of examined facts that have been clearly presented by specialists in the particular field or discipline.
- It is a combination of methods and practices that can be used in the classroom to teach these disciplines.
- Lastly, it seeks to ensure a mutual relationship between the combined disciplines so as to ensure that no one discipline claims more attention than the other. Thus,in Audigier's (2006) opinion, inter-disciplinarity entails the composition of various aspects of the pedagogical arena without compromising the integrity of any of these aspects.

This idea is supported by Frykholn and Glasson (2007), who indicate that an interdisciplinary or integrated curriculum provides an opportunity for more relevant, less fragmented, and more stimulating experiences for learners. The drawing below illustrates this model.

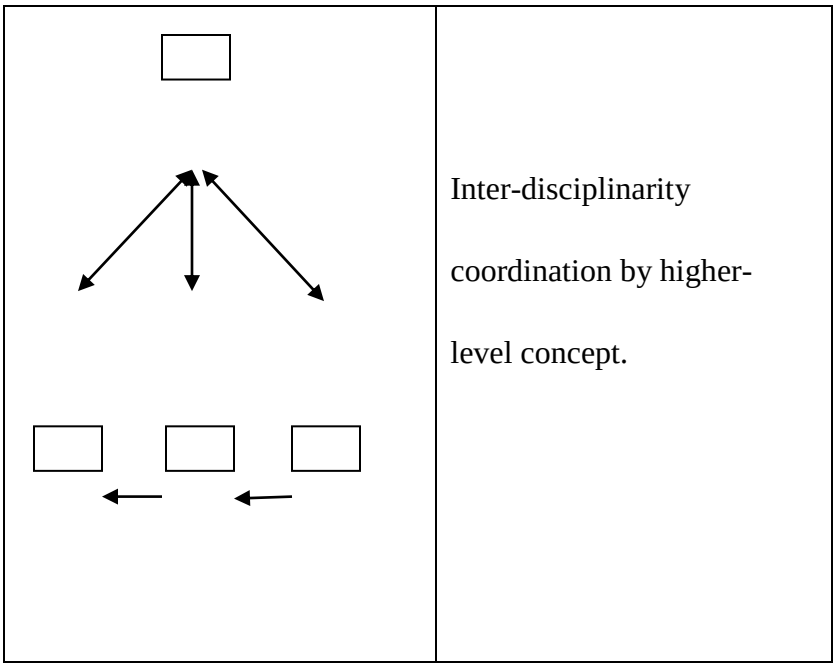


Figure 2.5: Inter-disciplinarity

Source: Jantsch (1972, p.15, as cited in Iyer, 2011, p. 14).

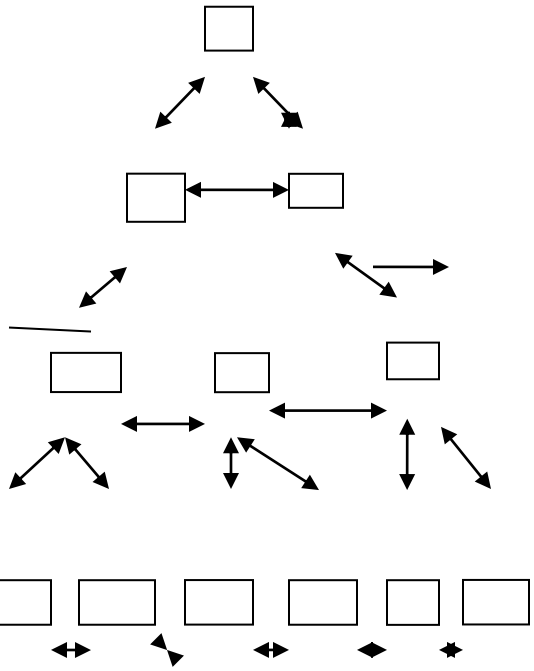
2.3.6 Collaborative consulting model (an alternative model) trans-disciplinarity

Godemann (2006) states that trans-disciplinarity refers to concepts or situations that require academics or experts to work together with non-academics to analyse and solve challenges. An example of trans-disciplinarity is the fact that teachers (who in a schooling context could be considered as the experts) who, together with the learners (the non-experts), are engaged in several activities that require analysis, interpretation and problem solving skills.

As one form of evaluation, it is important to note that the structure of the above forms of discipline vary, especially with regard to the type of knowledge, skills and values that these allow learners to acquire and the way in which the learning process occurs. The main difference between the forms of disciplinarities lies in the use of bodies of knowledge. The relationships between the bodies of knowledge greatly differ with regard to the forms of integration that occur. One advantage of multi-disciplinarity is that it allows for teachers of integrated subjects to draw on examples outside of each discipline being taught, which may result in the general overview of sections being taught. This is due to the fact that when teaching an integrated subject, the teacher

should have the ability to make learning as relevant as possible for the learners to have a holistic understanding of what is being taught.

Pluri-disciplinarity, cross-disciplinarity and inter-disciplinarity have proved to be valuable simple because they encourage learners and teachers to think out of the box. By drawing on specific topics from other learning areas (as in the case of cross-disciplinarity), and analysing each of the associated and relevant topics (which comprises pluri-disciplinarity), learners and teachers will not only be able to scaffold their understanding, but they will also be able to critically examine the content. Teachers, in particular,could enhance their pedagogy when applying inter-disciplinarity in their classrooms as it presents an opportunity to create a borderless environment where learners can relate to associated topics without giving less attention to the original subject. Also, teachers could employ different teaching strategies to ensure that learners receive a well-rounded education. This model is illustrated in the drawing



Trans-disciplinarity multilevel coordination of the entire education/innovation system.

below:

Figure 2.6: Trans-disciplinary model

Source: Jantsch (1972, p.15, as cited by Iyer, 2011, p.14).

No matter which model is selected, there are several common factors that tend to emerge,for example, they all use subject content or themes and depend on trained educators. The seriousness of the problem of integration is exacerbated by the fact that, among other things, the effects of a lack of understanding regarding this integration are more detrimental than any other aspect of the teaching and learning process. Therefore, there is a crucial need to explore educators' understanding of integration, their views on the role played by integration in their practices, as well as what informs their practice as this enhances meaningful teaching and learning processes within the South African educational system.

2.4 THE CONCEPT OF INTEGRATION IN THE SOUTH AFRICAN CURRICULUM

Since South Africa embarked on transformationalteaching and learning programmes, which was initially attempted through Outcomes Based Education (OBE), these programmes have been contextualised, and integration across curricular themes or topics has had to be implemented in the Senior Phase. The principle of integrated learning was central to this

curriculum, and was achieved within and across learning areas through sets of learning outcomes. Integration ensures that learners experience the learning areas as linked and related. By doing so, integration supports and expands learners' opportunities to attain skills, acquire knowledge and attitudes and values encompassed in the curriculum. Educators have had to shift from specialist teaching to teaching that spans the curriculum in a short space of time. This is in line with Fogarty's (1991, p. 64) integrated where he uses the cross disciplinary approach and blends disciplines by finding overlapping skills, concepts and attitudes.

In the Revised National Curriculum Statement (RNCS), content is emphasised. Learners were expected to deal with integrated assessment standards. The achievement of an optimal relationship between integration across learning areas and learning outcomes from grade to grade was central to this curriculum as integration seemed to extend beyond the classroom to include all educational activities and everyday life (Department of Education, 1997, p.31). In support of the above statement, Van Dyk and Van Dyk (1998, p. 10) look at integration in terms of content. They believe that technology and science complement each other and are therefore inseparable. For the authors, scientific knowledge and skills are used to solve technological problems.

The second revision of the South African National curriculum resulted in the Curriculum and Assessment Policy Statement (CAPS) in 2011. This new curriculum has 5 learning areas that were created by integrating Natural Sciences and technology, arts and culture, and life orientation and economic and management sciences in the General Education and Training GET) band. CAPS seems to favour the cross-curricular or threaded model, as discussed above. This integrated curriculum is viewed as a means to prepare learners for life-long learning. Furthermore, the integrated curriculum aims to ensure that discrete subjects are treated as connected rather than being compartmentalised (Department of Basic Education, 2011).

2.4.1 The organisation of the Natural Sciences and technology curriculum

It is important to note that Natural Sciences and technology are complementary**,** as shown in Table 2.1. In doing so, they promote the integration of these two subjects.

Table 2.1: How Natural Sciences and technology complement each other

Natural Sciences	**Technology**

Goal	Pursuit of new knowledge and understanding of the world around us and of natural phenomena	The creation of structures, systems and processes to meet people's needs and improve their quality of life.
Focus	The focus is on understanding the natural world.	The focus is on understanding the need for human-made objects and environments to solve problems.
Departmental methods	Discovery through carrying out investigations.	Making products though design, invention and production.
Major processes	Investigative and logical processes: • Planning investigations; • Conducting investigations and collecting data; • Evaluating data and communicating findings.	Practical solution-orientated processes: • Identifying a need; • Planning and designing; • Making (construction); • Evaluating and improving products; • Communication.
Evaluation methods	Analysis, generalisation and creation of theories.	Analysis and application of design ideas.

Source: Excerpt from the Natural Sciences and technology Curriculum and Assessment Policy Statements (CAPS), (DoBE, 2011, p. 9).

2.4.2 Using the knowledge strands in Natural Sciences and technology as uniting tools

The Natural Sciences and technology National Curriculum Statement (DoBE, 2011, p.10) emphasises that these two subjects must be combined into one subject, which is compulsory for all learners. To this end, knowledge strands are used as tools for integrating the two subjects, as well as for organising the content of the integrated subject. The table below presents the knowledge strands that assist in doing so.

Table 2.2: Natural Sciences and technology content and integration through knowledge strands in the Grade 6 curriculum

Grade 6 Curriculum							
Strands **NS & Tech**		**Strands** **NS & Tech**		**Strands** **NS & Tech**		**Strands** **NS & Tech**	
Life and Living	**Processing**	**Matter and Materials**	**Processing**	**Energy and change**	**Systems and control**	**Planet Earth and Beyond**	**Systems and control**
Photosynthesis.	Food processing.	Solids, liquids and	Processes to purify water.	Electric circuits. Electrical	Systems to solve problems.	The solar system.	Systems for looking

Nutrients in Food. Nutrition. Ecosystems and foodwebs.	gases. Mixtures. Solutionsas special mixtures. Dissolving. Mixtures and water resources.	conductors and insulators. Mains electricity.	Movements of the Earth and planets. The movement of the moon.	into space. Systems to explore the Moon and Mars.

2.5 LOCAL AND INTERNATIONAL RESEARCH ON INTEGRATION

The focus of this section is on providing a review of both local and international literature regarding Grade 6educators' understanding of the integrated Natural Science and technology curriculum, as set out in the CAPS document. The literature review therefore focuses on selected local and international studies. The experiences of different scholars in favour of integration, locally and internationally, are also found in the case studies carried out by Mhlongo (2006), Nnadozie (2009), Berlin (200), Thompson and Balshweid (1999), as well as Thompson and Schumacher (1998). On the one hand, common practice points to the fact that local researchers tend to focus on the integration of Science and Indigenous Knowledge Systems (IKS). On the other hand, international researchers tend to focus on the integration of Science and other learning areas.

2.5.1 Local Review

Nnadozie (2009) explored educators' understanding of the integration of indigenous knowledge with their teaching of the conservation of biodiversity and natural resources. The participants were Grade 10 Life Sciences educators in several high schools in the Pine Town District in KwaZulu-Natal. This work was a response to the fact that indigenous knowledge is still not always recognised in Western perceptions as a product of the holistic system of relationships and organisational arrangements. Nnadozie concluded that most educators included indigenous knowledge in their integration with Natural Science.

Emeaguali (2003, p.3) argues for the value and worth of indigenous knowledge in Africa on the basis that it is important psychologically, intellectually, and economically, as revealed

from the revolution of historical processes on the continent. Fernandez (1994 p.6) also notes the developmental contributions of indigenous knowledge, but denounces the negative connotations that have been associated with it. He goes on to say that indigenous knowledge has been under attacked for being backwards, static, and a hindrance to modernisation.

The focus on technology integration reflects the most current phase in the movement towards the use of digital techniques as an integral part of the teaching and learning environment. Mhlongo (2006), using a case study, looked at the integration of computer technology into the South African curriculum, and concluded that most teachers do not have previous knowledge of computers as these were not offered at their high school level, therefore they were not able to integrate computer technology into their learning areas or curriculum. The purpose of the research was to explore the integration of computer technology into the curriculum by teachers from the previously disadvantaged high schools in the Umlazi Township in the KwaZulu-Natal province.

2.5.2 International review

The literature also reveals that international scholars such as Berlin (2000) and Belshiwick (1999) have a tendency to emphasise the integration of Natural Sciences with other learning areas. These learning areas include agriculture, mathematics, English, music,and technology.

In Berlin's (2000) study, using a survey of science and mathematics educators, it was found that both mathematics and science teachers were ready to integrate these two disciplines with the aim of reforming science and mathematics education. The purpose of the research was to integrate these two subjects to improve science education. The participants were educators in pre-college education. Some of the findings were that thescience and mathematics educators were considered well qualified in making connections between science and other disciplines, and integrating subjects. Although this study was based on the integration of science and mathematics, its findings may concur with and still be applicable to the findings of the current study concerning the integration of science and technology.

In Thompson and Balschweid's (1999) study,the students who were taught by integrating agricultural and scientific principles demonstrated higher achievement than the students taught

using traditional approaches alone. The purpose of the research was to determine how the Oregon Agricultural science and technology teachers perceived the impact of science on their agricultural education programmes. The participants were the Oregon Agricultural science and technology teachers employed during the 1997-98 school year. A survey method with an integrating science survey instrument developed by Thompson and Schumacher (1998, p.23) was used in the study. The research findings were in favour of science integrating with other learning areas. In conclusion, the majority of the respondents supported the claim that the integration of science into the Agricultural curriculum was a more effective way to teach science. The findings of this research will enhance the current research on science and technology integration, but it should be noted that these studies do not originate from a common background.

2.6 CHALLENGES OR BARRIERS TO INTEGRATION

The ongoing development of teachers, school management teams, and departmental support personnel is an important factor in an integrated curriculum. This is in line with the collaborative consulting model designed by Berlin (1991), whereby both external and internal factors need to be considered for an integrated curricula. Alternatively, educators in general and school management teams often experience difficulties in conceptualising ways in which traditional teaching can be converted to modern integrated approaches. This may be attributed to the fact that with all change comes barriers, and the integration of Natural Sciences and technology is no exception.

Mawson (2003) regards the teaching of integrated technology as a shift from the traditional design process. He therefore regards this approach to teaching technology as an alternative approach. From the notion that people manage well what they know, Mawson concluded that most of the managers in his study were not experts in the teaching of an integrated curriculum. Due to a shortage of qualified educators, educators who are not necessarily qualified or have experience are given managerial positions. This goes against Mawson's belief that alternative approaches require good management and the provision of necessary materials in order to succeed.

Another contributing factor to barriers to integration is that technology education is a new learning area in the school curriculum. For a long time, there has been considerable confusion

about the place of technology in the school curriculum. It is interesting to note that a similar debate has been going on in other countries, which has resulted in the limited amount of literature on integration. This dearth in international literature has failed to provide ways to integrate the different disciplines in the design of each country's learning programmes. On the same note,the lack of knowledge and skill in terms of integration is only discussed in terms of tertiary level rather than on the basis of methodologies that could be used to facilitate integration.

Shelly et al. (2004) regard a lack of teacher support, a lack of administration support, limited time for teacher planning, budget constraints, and basic resistance to change by many educators as barriers that could hinder the integration of Natural Sciences and technology in many schools.

Due to insufficient workshops and training, this study could serve as a medium through which the necessary information could be provided to the relevant stakeholder. This could bring about a paradigm shift in the teaching of integrated curricula.

2.7 CONCLUSION

Integration is a concept that indicates the collaboration of disciplines, with particular reference in this study to Natural Sciences and technology. Fundamentally, integration comprises different ideas for different people, at different times, thus affecting the way in which Natural Sciences and technology is taught and the respective pedagogy that teachers engage their learners with. No matter what model is selected, there are several common factors that tend to emerge, for example, all of the models use subject content or themes, and are dependant on the use of trained educators. The seriousness of the problem of integration is exacerbated by the fact that, among other things, the effects of a lack of understanding of integration are more detrimental than any other aspect of the teaching and learning process.

In the next chapter, I briefly discuss the theoretical framework that underpinned this study.

CHAPTER 3

THEORETICAL FRAMEWORK

This chapter sets out to briefly outline the theoretical framework underpinningthis study, namely Activity Theory (AT). The theoretical framework provides the theoretical insights that informed the analysis of theGrade 6 educators' understanding and practice of the integration of Natural Sciences and technology.

3.1 WHY ACTIVITY THEORY WAS CHOSEN FOR THIS STUDY

Activity Theory is used in this study because it provides a descriptive theory that explains the teaching of an integrated curriculum as an activity. Activity Theory also provided an understanding of the various factors that influence integration. This understanding acted as a lens through which I could better review and understand the Grade 6 teachers' classroom practices.

3.1.1 What is Activity Theory in a nutshell**?**

In a narrow sense,Activity Theory is a research framework or a set of perspectives that originated in Soviet psychology. In a broader sense, Kuutti (1996, p.25) defines it as a philosophical and cross disciplinary framework for studying the different forms of human practices as development processes, with both individual and social aspects being interlinked at the same time. In this regard, Activity theory is construed as a systematic whole with all elements having a relationship to the other elements.

The foundation of Activity Theory was laid by Vygotsky (1896-1934) during the 1920s and early 1930s as part of a cultural-historical school of psychology. His triangular model of subject, object and mediating tool illustratesActivity Theory. His ideas were then further developed by his colleagues Leont'ev and Luria, who started to use the term activity. This theory is portrayed in Figure 3.1 below.

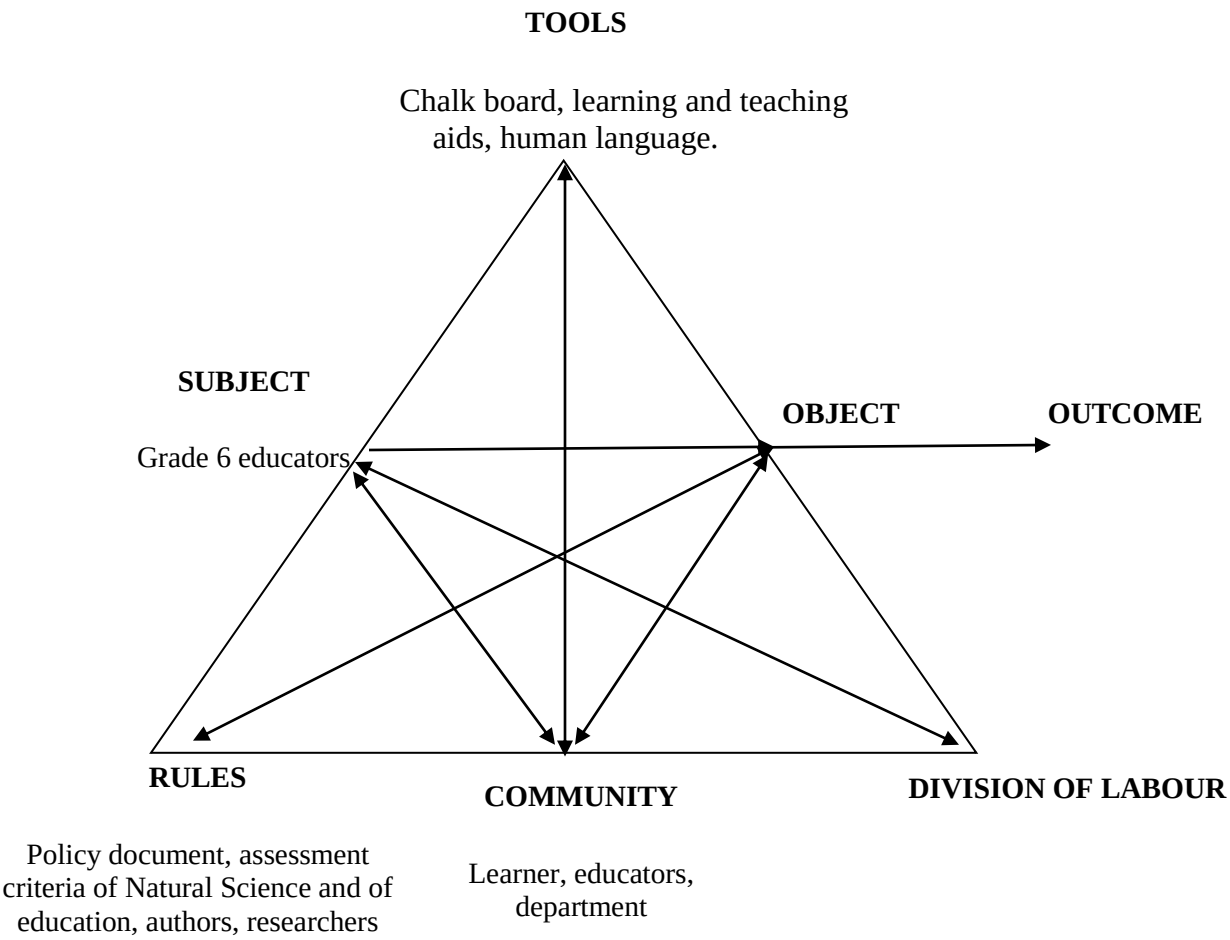


Figure 3.1: The structure of the activity system

3.1.2 The structure of an activity

The structure of activity theory may involve the following elements:

Subject**:**this is an individual (or group) who presents his or her ideas or beliefs that form the basis of their analysis of the activity. There are two relationships that connect with the subject which are the subject-community and the subject-object. On the one hand, the subject–community relationship is mediated by rules, while on the other hand, the subject–object relationship is mediated by tools.

Object:this is the actual activity that leads to an outcome. It is regarded as the basic unit of the activity,is held by the subject, and motivates the activity, giving it a specific direction. The

object– community relationship, which is mediated through the division of labour, is the possible relationship that may exist at this level.

Tools: refer to the internal and external artefacts that are integral and inseparable components of the activity or transforming process, and have a mediating role. Their importance lies in assisting in achieving the outcomes of the activity. Tools may be in the form of instruments, signs, procedures, machines, methods and laws. They mediate between the subject and the object of the activity. By doing so, the subject in the activity is empowered to manipulate the object. Tools have a restrictive element in that an object is only manipulated within the limitations set by the tool or instrument.

Rules: are norms, conventions and social relations within the community and they regulate actions and interactions within the activity system. They may be explicit as laws and part of an organisation. They may also be implicit as part of the general working culture or developed as ateam works together. They may have constraints and specification functions as they assist the learner to move from not knowing to the point of knowing or clarification. The subject is subjected to these rules.

Community: is the minimal meaningful environment or context in which the activity or action is being carried out by an individual, which results in collective objectivity. This refers to individuals or groups that share the same object with the subject and also benefit from the object. The relationship between the community and the subject is mediated by rules. Alternatively, the relationship between community and object is mediated by division of labour. These are two relationships that may exist at this level.

Division of labour: refers to the manner in which the subject engages with the object for the benefit of the community. This engagement involves the different roles and responsibilities of different members of the community with different power and status. This stretches from the commencement up until the outcome is reached. Division of labour should be understood as the result of a collaboration between the subject and community in realising the outcome.

Outcome: is the result of the activity or object within the transformation process.

3.1.3 How does the structure of activity fit into this study?

In trying to examine the Grade 6 educators' understanding of the integrated Natural Sciences and technology curriculum, Activity Theory shaped this study. This was motivated by the fact that Activity Theory focuses on practice or practical needs, which is at the core of this study in examining the practical application of Grade 6 educators' understanding of the integrated Natural Science and technology curriculum. Furthermore, technology is known for being activity based, using a problem solving approach. Activity Theory is also useful and flexible as theGrade 6 educators wereconsidered to be the subjects in this study because they were actively involved in the activity by passing information to their learners.

In the following section, I show how the terms used in the Activity Theory structure were directly related to this study. In terms of this study, the terms discussed above are as follows:

Subject: concerns the interrogation of Grade 6 educators' understanding of the integrated Natural Science and technology curriculum.

Object: is the interrogation of Grade 6 educators' understanding of the integrated Natural Science and technology curriculum.

Tools: refer to two types of artefacts that dominated the transformation process. They are:

(a) Physical tools, such as the chalk board, and teaching and learning aids.
(b) Signs system such as human language.

These tools were used for mediating or facilitating the interaction between Grade 6 educators and the interrogation of their understanding of the integrated Natural Science and technology curriculum.

Rules: were covered by

(a) The assessment criteria of Natural Sciences and technology.
(b) The expectations of the learners.
(c) The assessment committee of the school.
(d) The school curriculum.
(e) Policy documents.

The Grade 6 educators were subjected to these rules as I, and they, interrogated their understanding of the integrated Natural Sciences and technology curriculum.

Community: community was represented by:

(a) The learners;
(b) The educators;
(c) The Department of Education;
(d) Authors; and
(e) Researchers.

This refers to the people who may end up benefiting from the research.

Division of labour: is seen from the perspective of the roles and responsibilities of the following stakeholders in the transformation process of the object into the outcome.

(a) Learners and educators of Grade 6.
(b) HODs and the principals of the participating schools.
(c) Support of the subject advisors of Natural science and technology.
(d) The role of the subject committee.
(e) School Education Managers.
(f) Curriculum developers.

Outcome: is the understanding and realisation of the integrated Natural Science and technology curriculum. This is where the learner has moved from a point of not knowing to a point of knowing or clarification in terms of the integrated Natural Science and technology curriculum.

Based on the above, we can conclude that theActivity Theory of learning holds that in order to learn successfully and effectively, you have to remain as active as possible. This is achieved by introducing activities that involve reasoning, problem solving and complex processes of learning that are goal directed. In the following section, I turn to social constructivism to show how this complements Activity Theory.

3.2 SOCIAL CONSTRUCTIVISM

According to Uddin (as cited in Brown & Green, 2006), the roots of constructivism are based in the educational theories of Dewey and Piaget. Dewey set the foundation of constructivism by finding inquiry to be a fundamental part of learning. Piaget's theories also helped to shape constructivism with the key concepts of assimilation, accommodation, and schema. These two theorists' ideas constituted the beginning of the constructivist learning process by focusing on how learning is processed and structured(Uddin, as cited in Neo, 2007).

3.2.1 Defining constructivism

According to Brooks and Brooks (1993, p.vii), "Constructivism is not a theory about teaching, it is a theory about knowledge and learning. The theory defines knowledge as temporary, developmental, socially and culturally mediated, and thus, non-objective". Learning is assumed to occur as learners are actively involved in the process of knowledge construction and meaning, instead of passively receiving information. Furthermore, it is assumed that during learning, the construction of knowledge happens at both individual and collective levels.By so doing, it brings about a shift from the traditional methods of teaching (teacher-centred) to learning methods (learner-centred) in teaching and learning. In this regard, "each learner is seen to have a tool kit of concepts and skills with which he or she must construct knowledge to solve the problems presented by their environment. The role of the community (other learners and educators) is to provide the setting, pose challenges, and offer the support that will encourage mathematical construction" (Davis, Maher & Noddings, 1990, p.3).

3.2.2 The role of language

According to Vygotsky, language serves as a psychological tool that causes a fundamental change in mental functions. According to him, speech serves not only as a way for children to communicate about their actions, but it also serves to direct active learning. His way of thinking has challenged educators to reconsider the critical role of language in the teaching and learning process.According to Vygotsky (as cited in Wersh, 1985), signalling, significative, social, individual, communicative and indicative are all terms related to functions of spoken language.

Vygotsky extended the emphasis on culture and society in his argument that all higher mental functions are socially originated and embedded in the context of the socio-cultural setting.According to him, learning is best understood in the light of others within an individual world. He further described the continual interplay between the individual and others as the zone of proximal development (ZPD). He defined the zone of proximal development as the intellectual potential of an individual when provided with assistance by a knowledgeable adult or advanced child. Vygotsky referred to this as scaffolding.

3.3 CONCLUSION

This chapter sought to explore the theoretical framework used to guide this study. Further, it gave a detailed presentation ofconstructivism, particularly social constructivism, as a lens that could complement the use of Activity Theory in the analysis of the phenomenon explored in this study. In the following chapter, the methodology used in this study is presented.

CHAPTER 4

RESEARCH METHODOLOGY

This chapter presents in detail the research design used to explore the Grade 6 educators' understanding of the integrated Natural Sciences and Technology curriculum and whether this understanding was enacted in practice. In trying to situate this chapter within the broader spectrum of qualitative research, I begin this chapter with a brief background on qualitative inquiry. This is followed by an outline of the design that was purposefully adopted in this study to address the following research questions:

ResearchQuestion 1: What understanding do Grade 6 educators have in relation to the integration of Natural Sciences and technology?

Research Question 2: Is this understanding enacted in practice? If so,

- *To what extent and how is their understanding enacted in their classroom practice?*
- *What informs these educators' practice in the classroom?*

The various stages of the research are presented and discussed, paying particular attention to the research site, data sources, the recruitment of the participants, the data generation process, and the data analysis process. Furthermore, the steps taken to ensure the validity and reliability of the findings and techniques used to analyse and interpret data are presented. Finally,the ethical considerations and limitations of this study are identified.

4.1 WHAT IS A QUALITATIVE INQUIRY?

As pointed out in Chapter 1, this was a qualitative study that explored Grade 6 educators' understanding of the integration of Natural Sciences and Technology. Qualitative methods afford the researcher the opportunity to understand the participants, their experiences and perspectives (Huysamen, 2001). Qualitative researchers believe that human behaviour and action "is best understood as it occurs without external constraints and control" (McMillan & Schumacher, 2010, p. 322). In this regard, this inquiry aims to:

> *Understand, and also explain in argument, by using evidence from the data and the literature, what the phenomenon or phenomena that we are studying are about. We do not wish to place this understanding within the boundaries of an instrument that we designed beforehand because this will limit the data to those very boundaries. In this way our understanding will also be dependent on those very boundaries*(Henning, 2004, pp. 3-4).

According to Henning (2004), qualitative research denotes a type of inquiry in which the qualities, characteristics or properties of a phenomenon are examined for better understanding and explanation (2004, p.5). Within this type of inquiry, in order to solicit, understanding and explain the participants' views or actions, a variety of data needs to be generated, documented, and analysed through the use of data generation methods. Denzil and Lincon (1998), p.383) concur with Hemming that qualitative research has a multi-method focus as it uses more than one method of data collection.The multi-method approach employed in this study allowed for a variety of data to be gathered to address the above research questions. In addition, the decisions regarding the type of data sources to be used were informed by the purpose of the study, and the research questions in particular.

4.2 RESEARCH DESIGN

According to du Plooy (2002, p.81), a research design is a plan of how the research is going to be conducted, who or what is involved, and where and when the study will take place. However, according to Durrheim (2004, p.29), a research design is a strategic framework for action that serves as a bridge between objectives and research questions in terms of the execution or implementation of the research.

In order to provide answers to the critical research questions asked in this study, this research was conducted in three phases. In the first phase, a questionnaire was used to answer Research Question 1, which sought to explore Grade 6 educators' understanding of the integration of Natural Sciences and technology. In the second phase,observation was used to answer Research Question 2, which sought to establish how this understanding is enacted in the classroom. In the third phase, focus group interviews sought to establish what informs the

practice of Grade 6 educators in their teaching of the Natural Sciences and technology curriculum. Each of the three phases are described below.

4.2.1 Phase I

Instrument: Questionnaire

Research Question 1: What understanding do Grade 6 educators have in relation to the integration of Natural Sciences and technology?

A survey approach was conducted in the initial stage of this study to address critical Research Question 1to establish Grade 6 technology educators' understandingof, and intention to use the integrated Natural Sciences and technology curriculum. According to Babbie and Mouton (2001, p.232), a survey may be used for descriptive, explanatory and exploratory purposes. Surveys focus on determining the opinions, attitudes and preferences of persons (McCloskey (1969, p.2). Therefore, the questionnaire became the principal data collection method in this study. A questionnaire is a type of data collection tool where the participants are given questions on paper to complete on their own. According to Mason and Bramble (1997 p.316), one advantage of using questionnaires is that a large sample can be reached within a short space of time. It was therefore most suitable for this study since 100 schools were involved. A purposive sampling procedure was used to ensure that only Grade 6 educators teaching the integrated Natural Sciences and technology curriculum at the time of this study were selected.

The office of the SEM was used to distribute the questionnaire. This was done in order to cut down on the costs involved in mailing questionnaires to the various schools. The collected data underwent a preliminary analysis to identify the respondents' different forms of understanding of integrated Natural Sciences and technology education. The different forms of understanding were interpreted as themes and presented to the Grade 6 educators for comment and refinement (see Phase 3, stage 1 below). OneGrade 6 technology educator was selected to represent each theme in the second phase of the study. This produced six Grade 6 educators, who were observed in the second phase of the study.

4.2.2 Phase II

Instrument: Class observation

Research Question 2, sub-question 1: Is this understanding enacted in practice? And if so, to what extent and how is their understanding enacted in their classroom practice?

According to Mouton (1985, p.157), observation may be defined as a form of behaviour by which a researcher is able to register the information given. Once an observation schedule has been structured, the researcher observes the environment under study and records this using his/her observation schedule.

Class observation was most suitable for this study as it directly demonstrated the Grade 6 technology educators' understanding and actual use of integration in the classroom. The classroom observation focused on the Grade 6 technology educators' actions in the classroom. Participant observation was adopted in this study. According to Vos, Strydom, Fouche and Delport, (2001), participant observation is of special importance in cases wherethe attitudes and behaviour patterns of the respondents in their natural situation is under study. It allowed me to participate fully in the class activities and thus I became a member of the group. According to Vos et al. (2001), the one advantage of this method is that it allows an in-depth investigation of a problem and is of a qualitative nature. Furthermore, it afforded me the opportunity to engage in analytical and evaluative reflections on the processes in which I was involved.

Fraenkel and Wallen (993, p.383) state that in a qualitative study, the researcher can continually collect data by observing people, events and occurrences, and may often supplement his/her observations with the relevant documents and records. Ten Grade 6 technology educators were purposively selected from one reflection on what had transpired. This amounted to 20 observations, 20 educator reflections, and 20 researcher reflections of the initial 100Grade 6technology educators representing the various themes of integrated Natural Sciences and technology education; these were developed in Phase 1 of the study. Each Grade 6 educator was observed twice. The lesson presentations and observations were followed by the educators' reflections, as well as my own reflections. A preliminary analysis was done before moving onto the third phase of the study.

4.2.3 Phase III

Instrument: Focus group interview

Research Question 2, sub-question 2: What informs these educators' practice in the classroom?

Focus group interviews were used to explore what informed theseGrade 6educators' classroom practice in their teaching of the Natural Sciences and technology curriculum. Focus group interviews are a form of interviews that is based on the interaction within the group, discussing a topic supplied by the researcher and yielding a collective rather than an individual view (Cohen, Manion & Morrison, 2011). Some advantages offocus groupsinclude that a lot of data is collected within a short space of time, different views are expressed, and there is a greater opportunity for probing. It creates data that is rich in ideas, and provides opinions and attitudes from the subjects' point of view. In this sense, the focus group interview supplemented the questionnaire to obtain information that was not obtainable from the questionnaires as I was able to ask questions to gain clarity. According to du Plooy(2002), focus group interviews are used in multi-method studies that combine two or more means of gathering data in which no one primary method determines the use of the others. The focus group interviews in this study were conducted in two stages:

Stage I. This stage involved the validation of the data gathered in the first phase of the study using a questionnaire. A discussion unfolded regarding the various themes identified. In doing so, the Grade 6 educators were in a position to talk about and refine their explanation of their understanding of integration, as gathered from the questionnaire.

Stage II. The second stage involved the validation of the data gathered in the second phase of the study. The aim was to ascertain whether the Grade 6educators' understanding (as gathered through the questionnaire) was enacted in the classroom and if so, how this understanding was enacted and why it was enacted in a particular way.

The focus group interviews provided the most direct evidence of the Grade 6educators' understanding, practice, and reasoning. Interview guidelines maximised the limited interview time (45-90 minutes), ensuring a more systematic and comprehensive interview, and keeping the

interaction focused.Video and audio recording was usedas this preserves the emotional and vocal character of the responses. The recordings were then transcribed.

4.3 SAMPLING

Sampling refers toa selection from a concrete list of elements in a population in order to identify the people or issues to be included in the research. (White, 2005). Leedy and Ormrod (2005, p.145) maintain that how you identify your sample must depend on what research questions you want to answer.

4.3.1 Target population and Sampling Frame

According to du Plooy (2002, p.101), the target population is the actual population to which we want to generalise the findings. The target population for this study was the Mafukuzela Ghandhi circuit. The target frame of the study was the 100 Grade 6 primary school educators within the circuit. The Mafukuzela-Ghandi circuit was selected because of its convenience and accessibility to me as I live in Durban but work in Pietermaritzburg. The Department of Education was consulted for a list of schools in the circuit as it was difficult to identify the number of schools present in the Mafukuzela-Ghandi circuit.

The Mafukula-Ghandi circuit is one of the biggest circuits in the Ethekwini Region and the schools involved in the study were located in rural and urban settings. Pooran (2011, p.52) citing Chetty (2007) explainsthat “the Mafukuzela-Gandhi circuit was launched on the 24th July 2007 as a result of the KwaZulu-Natal Department of Education bringing together two education circuits: the KwaMashu circuit which serves a predominantly African area comprising of Inanda, Ntuzuma and KwaMashu; and the Phoenix circuit which serves a predominantly Indian area comprising of Phoenix, Verulam and Tongaat”. The circuit is characterised as a high poverty area with poor housing, extreme poverty, and the absence of parents from homes (Pooran, 2011, p.52).

4.3.2 Sample size

The major criterion to use when deciding on sample size is the extent to which the sample is representative of the population. In my study, 100 participants was a large sample, therefore,it

gave a sufficient number to provide a credible result and was representative of the population,although it was costly. This study also drew its data from a homogeneous population, therefore 100 participants was a reasonable sample to cover the characteristics of the population, reflecting what is referred to as maximum variation sampling (Bungum, 2003). It is important to note that this variation in sample was not intended to reflect the profile of some of the population of educators to make statistical inferences or statistical generalisations. Instead, the current study was concerned with analytical generalisation. The phenomenonobserved and categories developed on the basis of this qualitative study may apply to a larger sphere than the one being studied, yet without any anticipation of its prevalence. This in turn contributed to the external validity of the findings (Bungum, 2003).

4.3.3 Sampling method

For the purposes of this study, purposive sampling was chosen. Purposive sampling serves the purpose of providing the researcher with those people who are likely to have information that is relevanttothe study. By so doing, the researcher uses his judgement based on the research questions to select a sample.

Phase I. 100 Grade 6 educators who were teaching integrated Natural Sciences and technology at the time of the study formed the sample. The schools in the Mafukuzela-Ghandhi circuit were reached through the assistance of the School Education Managers (SEM). The questionnaire and the observation schedule were piloted in schools that were not selected for the study.

Phase II. Ten Grade 6educators were purposefully selected from the 100 educators who participated in the questionnaire in Phase I. These educators were visited at their schools with the aim of observing their classroom practice.

Phase III. The same teachers as in Phase I were selected for the focused interview. The selection was made in the following manner:

- Grade six educators who participated in Phase II automatically formed part of the focus group interview.

4.4 DATA ANALYSIS

Thematic analysis was employed in thisstudy. In other words, the data collected for this study was analysed based on the type of themes generated in the different phases of the study. The data analysis was an ongoing process throughout the entire study. The presentation and the analysis of the data was done in three phases.

4.4.1 Phase I

In Phase I, different forms of the Grade 6 educators' understanding of integrated Natural Sciences and technology involved analysis in the sense that various themes were identified.

4.4.2 Phase II

In Phase II, the data collection involved the analysis of the Grade 6 educators' classroom observations, educator reflection, and researcher reflections.

4.4.3 Phase III

The final phase of the process involved two stages. Stage 1involved the analysis of the focus group discussion of the results from Phase I. Stage 2 involved the analysis of the focus group discussion of the results from Phase II.

4.5 VALIDITY AND RELIABILITY ISSUES

4.5.1 Validity issues

According to Bless and Higson-Smith (2000, p. 130),validity means measurement techniques actually measure the things that they are supposed to be measuring. In this study, validity was ensured in the following manner:

- This study used two researchers in the focus group interview to ensure the smooth running of the interview process. This is in line with the belief that the use of multiple researchers is one way to enhance validity.
- The main method of collecting data for Research Question 2 was through classroom observation. Classroom observation was used as a way of validating the information

gathered through the questionnaire, and for the purpose of personally experiencing how the Grade 6 educators integrated Natural Sciences and technology in their practice.

- The recorded interviews were transcribed before the analysis was done. The data were read over and over to gain a better understanding thereof, and in order to identify key ideas. The key ideas were then organised and sorted into categories to highlight the themes. The themes that emerged were then validated by the participating educators, as well as by my supervisor.

4.5.2 Reliability issues

According to McMillan and Schumacher (2006, p. 130), instrument reliability refers to the consistency of measurement, or the extent to which the scores are similar over different forms of the same instruments or occasions of data collection. In this study, reliability was enhanced in the following manner:

- The participants were allowed to listen to the recorded data, read the transcribed data, and make comments and corrections where necessary. This is a way of verifying the data and is in line with the belief that findings are considered to be true when the researcher explains what is true for the participants (Toma, 2006).
- The data and findings were discussed with my research group, as well as with my supervisor in order to ensure that the my interpretation of the findings were not different from the ideas of others in the field. This is in line with the belief that credibility can be ascertained if other participants understand and interpret the findings of a study in the same way as the researcher (Toma, 2006).
- Credibility was ensured in this study throughthe use of triangulation. Triangulation is the method of using two or more methods of data collection in a study (Cohen et al., 2007). The multiple sources of data collection methods used in this study included a questionnaire, interviews, and observation. The data collected from the different methods were used to check the research findings before conclusions were made. The following diagram illustrates the use of triangulation.

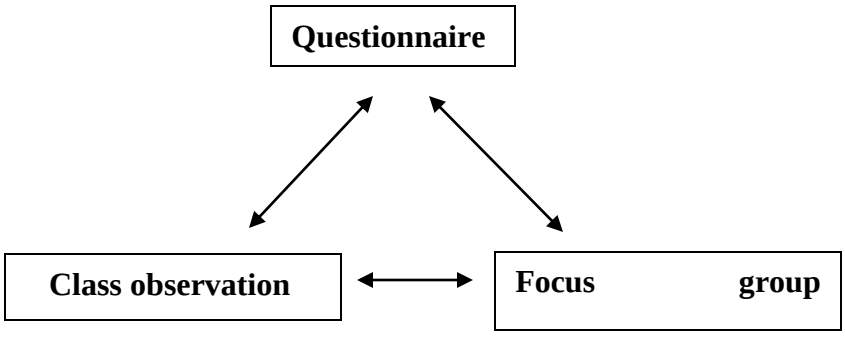


Figure 4.1: Triangulation

4.5.3 The benefits of triangulation

Triangulation is advantageous "when a more holistic view of educational outcomes (are) sought" (Iyer, cited in Cohen et al., 2007, p.143) or when a concept being researched needs clarification, which in this case would be integration. Hence, three data collection methods were engaged with, which included a questionnaire, class observation, and an interview. "Triangulation is used when the strengths of one method offset the weaknesses of the other, so that together, they provide a more comprehensive set of data. To the extent that the results from each method converge and indicate the same result, there is triangulation and thus greater credibility in the findings"(McMillan & Schumacher, 2006, p. 28). The use of more than one method also helps to indicate data collection error.

4.6 ETHICAL CONSIDERATION

As Pooran (2011, pp.64-65) points out, when conducting research, the researcher has an obligation to the participants to protect their right to informed consent, anonymity and confidentiality. The researcher has to ensure that the participants participate voluntarily after being briefed on the research idea and procedure. In this study, I clearly explained the purpose of the study and the research procedure to the Grade 6 educators before asking them to sign the relevant consent forms (Appendices 3.2). Furthermore, the participants voluntarily agreed to participate in the research study and were given the option to withdraw at any time.

As mentioned in Chapter 1, all protocol was observed in gaining permission to conduct the study, for example, before beginning with the study, I sought written permission (Appendix 3) from the KwaZulu-Natal Department of Education in Pietermaritzburg, as well as from the principals and educators of the selected schools. Ethical clearance was obtained from the University of KwaZulu-Natal to carry out the study.

4.7 LIMITATIONS OF THE STUDY

- The study was limited to schools in the Mafukuzela-Ghandi circuit and only the Grade 6 educators presenting integration participated in the study. The findings cannot therefore be generalised as they are only applicable to Grade 6 educators.
- In the first phase of sending questionnaires to the schools, a posting method was used, relying on the addresses provided by the circuit office. Surprisingly, some of the schools had not updated their addresses in the circuit office, and as a result, some of the schools did not receive the questionnaire. In the second phase, I decided to visit certain schools physically and also approached the principals during cluster meetings in order to send them the questionnaire. This had an impact on this study as I had to extend the date for returning the questionnaires. Despite sending the questionnaire out to 100 schools, the sample for the study was reduced to 50. Although 50 is a low number, Cohen, Manion and Morrison (2000) find that a sample of 30 respondents can be used to probe an educational phenomenon.
- The educators were observed once in their teaching practice. The researcher initially wanted to observe each educator teaching twice, but was forced by time constraints to make only one observation of each educator in their respective environments.
- Much of my time was spent negotiating dates and times for observation because some educators felt uncomfortable being observed.

4.8 CONCLUSION

This chapter presented the route that I took to obtain the data for my study. The type of research and the research methods were discussed in detail, and the decisions regarding the use of a purposive sample were justified. The processes that I engaged with at each stage of the research were explained with the intention of allowing the reader to understand how the data in

this study were constituted and analysed. The measures taken to ensure that the data and the findings of this study are valid and reliable were also addressed as part of this chapter. The limitations of this study were acknowledged and the ethical issues considered throughout the research process were explained.

Chapter 5 presents the results of the first research question that was addressed in this study.

CHAPTER 5

DATA ANALYSIS AND PRESENTATION OF RESEARCH QUESTION 1

This chapter presents the data analysis and is organised in terms of the first researchquestion of the study, as reflected in Chapter 1:

- **What understanding do Grade 6 educators have in relation to the integration of Natural Sciences and technology?**

The data analysed was generated through the questionnaire that was used to answer the first research question.

In keeping with the qualitative nature of the study, the data obtained from the questionnaire attemptedto highlight the collective responses of the six participants that emerged from the data gathered through the questionnaire.The data were therefore analysed thematically.

The purpose of presenting the collective responses of the six Grade 6 participants in this study is to ensure that emerging themes from the entire set of data are without comparison as this can only exist in terms ofGrade 6 educators' understanding of the integration of Natural Sciences and technology with their practice in the context in which they operate.

The way in which the analysis of the data is presented allows me to identify the Grade 6 educators' understanding of integration. This understanding is then evaluated against the educators' classroom practice. The next section presents the analysis and research findings.

5.1 DATA ANALYSIS AND PRESENTATION OF RESEARCH QUESTION 1

5.1.1 What are Grade 6 educators' understanding of the term integration in general?

As mentioned in the introduction, the data source that was used to address the first research question was a semi-structured questionnaire, which focused on five questions. Four out of the five questions asked aimed to provide an understanding of the educators' perceptions.

It was significant to note that a general understanding of the term ‘integrate’ was agreed upon amongst the participants. Twelve out of the 13 participating educators’ pointed to the idea of integration as being about “merging”; “joining”; “combining” and “linking” two or more “things” or aspect, as reflected in the excerpts below:

*E5: “… knowledge of **merging** two or more aspectstogether.”*

*E6:“… **joining** together or connecting different parts to make one or more.”*

*E8:“… **join** two or more things together so that they work together to become one thing, e.g. NST.”*

*E10:“… **combining** the two learning area in order to achieve a certain goal or to form one part.”*

*E13:“… **combination** of two learning areas which are Natural Sciences and technology.”*

*E7: “… **linking** of an Natural Sciences and technology with other subjects, such as mathematics etc.*

*E3: “…when a concept of one subject is **linked** with the topics in another subject.”*

*E4: “… across the curriculum teaching **linking** all subjects together.”*

As can be noted from the above excerpts, the educators’ perceptions of the term integration ranged from general (for example E5 and E6) to curricular (for example, E2, E3, E4, E7, E8, E10 and E13) application. With regard to the latter, these Grade 6 educators referred to cross-curricular integration and the integration of Natural Sciences and technology.However, with regard to the one participant who presented a different definition, it would appear that the terms integration and inclusion were used interchangeably, as can be seen in the excerpt below:

E1: “… integration would be teaching learners of mixed ability groups (different intellectual groups).”

It is clear from the above excerpt that the educator seemedto confuse the term ‘integration’ with the term ‘inclusive education’.

5.1.2 What understanding do Grade 6 educators have in relation to the integration of Natural Sciences and technology?

With regard to the above research question, the following six conceptions were foregrounded:

Perception 1: Integration allows for technology to support Natural Sciences.

Perception 2: Integration allows for Natural Sciences to support technology.

Perception 3: Integration requires an understanding of both Content Knowledge (CK) and Pedagogical Content Knowledge (PCK).

Perception 4: The integration of Natural Sciences and technology is a way to motivatethe population.

Perception 5: The integration of Natural Sciences and technology is a way to integrateskills.

Perception 6: A lack of integration means that Natural Sciences cannot be linked to technology.

Furthermore, variations within these six perceptions were observed, as illustrated in Table 1 below. It should be noted that in this context, variation refers to the different ways in which the data was experienced or understood by the participants, which resulted in the specific way that the data was perceived and described by the researcher.

Table 5.1: Perceptions of the Grade 6 educators' understanding of the integration of Natural Sciences and technology

Perceptions	Variations
1. Integration allows for technology to support Natural Sciences.	a) A technological process is used to understand Natural Sciences teaching. b) Technology is used to support Natural Sciences learning.
2. Integration allows for Natural Sciences to support technology.	a) Natural Sciences acts as a base for problem posing and technology acts as a base for problem solving. b) The significance of integration. c) The man-made world needs knowledge of science to operate. d) The man-made world is derived from nature. e) Teaching science as an application of technology.
3. Integration requires an understanding of both Content Knowledge (CK) and Pedagogical Content Knowledge(PCK).	a) Integratingscience and technology requires Content Knowledge understanding of both disciplines. b) Pedagogical Content Knowledge promotes the integration of Natural Sciences and technology.
4. The integration of Natural Sciences and technology is a way to motivate the population.	a) The focus is on the reason (interest) for integration. b) The focus is on the reason (enjoyment and curiosity) for integrationto help us to understand the world and natural phenomena.
5. The integration of Natural Sciences and technology is a way to integrate skills.	a) Skills as a common factor.
6. A lack of integration means that Natural Sciences cannot be linked to technology.	a) Do not see a connection.

In the following section, the above six perceptions are further unpacked.

5.2 UNPACKING GRADE 6 EDUCATORS' PERCEPTIONS OF THE INTEGRATION OF NATURAL SCIENCESAND TECHNOLOGY

5.2.1 Conception 1: Integration allows for Technology to support the natural sciences

This perception was held by two participants out of a total of six (33%). Within this first perceptions, two variations were observed, namely:

a) A technological process is used to understand Natural Sciences teaching, and
b) Technology is used to support Natural Sciences learning.

Of significance in these two variations is the fact that the first foregrounds teaching, whilst the latter foregrounds learning, as illustrated in the excerpts below:

E1: "Learners use the methods of technology, planning, designing, making and evaluating the teaching of Natural Science" [emphasis added].

E2: "The technological part is taught in support of what is learnt in Natural Sciences to show how they work together"[emphasis added].

5.2.2 Perception 2: Integration allows for Natural Sciences to support technology

This perception was held by five participants out of the total six(83%). Five variations were observed here, namely:

a) Natural Sciences acts as a base for problem posing, and technology acts as a base for problem solving.
b) The significance of integration.
c) The man-made world needs knowledge of science to operate.
d) The man-made world is derived from nature.
e) Teaching science as an application of technology.

What is significant about the above five variations is the fact that the first, third and fifth variations foreground theory (why) and practice (how), the fourth one foregrounds the point of origin, whilst the second one promotes science, as further illustrated in the excerpts below:

E3: "In the Natural Sciences, the knowledge obtained gives one an understanding of the

world. This knowledge highlights problems and the need to create structures or processes to solve these problems which are addressed through Technology thereby improving the quality of life."

E4: "Both learning areas deal with similar topics and can be explained scientifically therefore integration is important.

E5: "Appliances and machinery need the knowledge of science in order to operate e.g. warm air rises and air conditioners are positioned to effectively do its work."

E7: "Technologist took the ideas from nature to do the technology eg they use the idea of a finger print to make a vehicle tyre, also they copied from dandelion seed to make a hot balloon together."

E9: "Whenever you teach science automatically you need to apply technology and produce the material, equipment or apparatus that would enable science to take place.

5.2.3 Perception 3: Integration requires an understanding of both Content Knowledge (CK) and Pedagogical Content Knowledge(PCK)

This perception was held by two participants out of the totalsix (33%). Within this third perception, two variations were observed, namely:

a) To integrate science and CK requires an understanding of both disciplines.

b) PCK promotes the integration of Natural Sciences and technology.

Of significance in these two variations is the fact that the firstforegrounds Content Knowledge, whilst the latter foregrounds Pedagogical Content Knowledge, as further illustrated in the excerpt below:

E6: "I don't have a clear understanding of integration because I did not teach technology. I have no idea about it, so I think to integrate with something you do not understand is impossible."

E8: "Careful selection of content, use of variety of teaching and learning science and technology should promote understanding technology […] requires of science and technologyas activitiesthat sustain enjoyment and curiosity about the world and natural phenomena."

5.2.4 Perception 4: The integration of Natural Sciences and technology is a way to motivate the population

This perception was held by two participants out of the total six (33%).Within this fourth perception, two variations were observed, namely:

a) The focus is on the reason (interest in) for integration.
b) The focus is on the reason (enjoyment and curiosity) for integrationto help us to understand the world and natural phenomena.

What is significant about these two variations is the fact that the first foregrounds interest, whilst the latter foregrounds enjoyment and curiosity, as further illustrated in the excerpt below:

E10: "The task of Natural Science and technology it help us to develop a greater interest in science and technology It shows us the skills and knowledge, e.g. Ecosystem: in science it talks about living and no-living things, (b) Technology living things."

E11: "In the history of science and technology, it sustain enjoyment and curiosity about the worldand natural phenomena."

5.2.5 Perception 5: The integration of Natural Sciences and technology is a way to integrate skills

This perception was held by one participant out of the total six (17%).Within this fifth perception, one variation was observed, namely: the integration of science and technology involves skills, as further illustrated in the excerpt below:

E13: "It is that while doing practical investigation and designing and making solutions, it involves
a specific range of skills."

5.2.6 Perception6: A lack of integration means that Natural Sciences cannot be linked to technology

This perceptionwas held by one participant out of the total six (17%).Within this sixth perception, one variation was observed, namely:

a) There is no connection between Natural Sciences and Technology.

The fact that it foregrounds a lack of connection between Natural Sciences and Technology is significant, as illustrated in the excerpt below:

> *E12: "I don't have any understanding but according to my knowledge it must be separated into two learning areas."*

5.3 CONCLUSION

This chapter provided an analysis of the findings by addressing the first research question in terms of the general understanding of 'integration'. It showed that most of the participatingGrade 6 educators did have an understanding of the term 'integration'. However, some of them understood integration in general terms,whilst the others understood it in terms of the curriculum, cross-curricula, and more specifically, in terms of integrating Natural Sciences and Technology.The participating Grade 6 educators' understanding of the term 'integration' was categorised into six perceptions, which were unpacked in this chapter. The next chapter addresses the second research question, which sought to explore whether this understanding wasenacted in these Grade 6 educators' classroom practice.

CHAPTER 6

DATA ANALYSIS AND PRESENTATION OF RESEARCH QUESTION 2

In this chapter, the Grade 6 educators' understanding of the integration of Natural Sciences and Technology that was identified in Chapter 5 is evaluated against their classroom practice. The data obtained and analysed was generated through observing their classroom practice in order to answer the second research question and its sub-questions: Is this understanding enacted in practice? If so, to what extent and how is their understanding enacted in their classroom practice? What informs these educators' practice in the classroom? This chapter therefore highlights the collective responses of the six participants who were observed from the six Primary Schools in the Mafukuzela Ghandhi circuit, Ethekwini region. The next section presents the analysis and research findings.

6.1 DATA ANALYSIS AND PRESENTATION OF RESEARCH QUESTION 2, SUB-QUESTION 1

- ***Is this understanding enacted in practice? And if so, to what extent and how is their understanding enacted in their classroom practice?***

As seen in Table 6.1 below, none of the six Grade 6 educators enacted their understanding of integration in their classroom practice.

Table 6.1: Summary of findings of research questions

School	**A** (B)	**B** (La)	**C** (Q)	**D** (W)	**E** (S)	**F** (B)
Educator	**E1**	**E4**	**E6**	**E7**	**E8**	**E13**
Perceptionof integration in general			J***oining*** *together or connecting different parts to make one or more,*			An application of integration of skills,
Perception of integration of Science and Technology	Technology is used to support Natural Sciences (curricula).	Natural Sciences is use to support Technology (curricula).	Integration requires CK understanding (across).	Natural Sciences is used to support Technology (curricula).	Integration requires PCK understanding (across).	An integration of skills.
Enactment of integration (Y/N)	No	No	No	No	No	No
Observation	No	No	No	No	No	No
If yes, how?	N/A	N/A	N/A	N/A	N/A	N/A
If no, why?	There is very little information on integration from the books. Other sections of the learning area do not allow integration, e.g. Food processes.	Integration was not possible in the present lesson, food groups. It will be accommodated in the next lesson on diseases and food processes.	There was no response.	It is not possible to integrate in the other lessons because of ashortage of materials and resources.	It is very difficult to integrate some of the sections of the learning area.	I have attempted general integration, but I find it difficult to integrate Natural Sciences and Technology.
Post observation Interview	No	Possible in the next lesson.	No	No	No	General integration.
Focus group	**Lack of guidance from the textbooks.**	**Lack of material and resources.**	**Ineffectiveness of the workshops.**	**Lack of content knowledge in Technology.**	**Lack of incentives.**	**Lack of funds.**
	E1& E4	**E7**	**E7 & E8**	**E8**	**E6**	**E13**

In a nutshell, it can be observed that participant 13 had a general understanding of the term ‘integration’, while participants 1, 4, 6, 7 and 8 understood the term ‘integration’ in relation to the curriculum. However, the findings from this study revealed that the integration of Natural Sciences and Technology never took place in the participants’ observed lessons.

In Activity Theory it is important for teaching and learning to be studied, to understand the subject, the object and the outcome. The Grade 6 educators (subject) failed to implement an

integrated Natural Sciences and Technologycurriculum (outcome) for the learners (object) to gain a deeper understanding of the integrated curriculum. This demonstrates that their understanding of the term integration does not necessary mean that they will succeed in implementing the integrated curriculum in their classrooms. The table above clearly reveals that the Grade 6 educators did understand the term integration, however, there was no evidence of the integration of Natural Sciences and Technology in their teaching. Thus they failed to enact their understanding of integration in their classroom practice.

Furthermore, the post interview and focus group discussion seem to have raised more problems concerning the integration of Natural Sciences and Technology. It is important to note that this integration never took place during the classroom practice, as observed during this study. Therefore, seeing as none of the Grade 6 educators enacted an integrated Natural Sciences and Technology lesson, I then mapped out what actually transpired during their teaching. The following is a summary of what transpired during my observation of the participants' lessonsin the six different schools in theMafukuzela-Ghandi circuit.

6.2 THE STRUCTURE OF ACTIVITIES IN SIX OF THE SCHOOLS IN THE MAFUKUZELA–GHANDHI CIRCUIT

A summary of what transpired during my observation in the six different schools at Mafukuzela-Ghandi circuit follows. The following elements of the theoretical framework were used: subject, object (activity), tools, rules, community, and division of labour, as reflected in the third generation model of Activity Theory by Engestrom (1999).

6.2.1 The structure of activity in school A

School A wasa large primary school (GradesR -7) situated in a calm residential area of Newland East. The staff compriseda high percentage of experienced educators. The Grade 6 educator was a middle aged female who was full of enthusiasm. This was evident from her introduction to the lesson.

The topic of the lesson was on *Food-web*. The educator introduced her lesson by issuing handouts that used terms such as decomposer and scavenger. The educator expected the learners to know the meanings of these terms after having gone through it together with the class. The

lesson presentation was done traditionally, which meant that there was no assessment during the presentation and no clear cut activity. The educator used the chalk and talk method in presenting this lesson. She had done her preparation well by organising handouts that gave the definition of terms such as predator, decomposer, and carnivores. This comprised her introduction, where after she presented the lesson combining the definition of these terms.During herpresentation, these terms were arranged in such a way that they allowed for the flow of ideas from the introduction to the conclusion. The educatorfleshed out the structure that was created by these terms. The contextualisation of the lesson was emphasised using the school environment, for example, mentioning ants, rats and other elements in certain parts of the lesson.

The second activity was based on the diseases that are caused by eating unbalanced food such as rickets and diabetes. The textbook was read from pages 35-39 to consolidate this part of the lesson.An assessment was done at the end of the lesson in the form of the learners answering the questions on page 40.There was no hint of integrating Natural Sciences and Technology. English was used as the medium of instruction in presenting the whole lesson, and handouts were used throughout the lesson. The question and answer method dominated the lesson presentation.

The CAPS rules were not honoured, instead, the educator resorted to her own teaching strategies. Verbal instructions from the educator sustained discipline in the classroom.The school wassituated in asemi-urban area with an enrolment of 950 learners, and the classroom was fully packed with 45 learners. The seating arrangement was laid outin four rows.

The role of the educator was to provide handouts and activities, expecting the learners to respond in writing and, at times, verbally.

The content of the lesson was mastered by the learners, however, the integration of Natural Sciences and Technology was never implemented; hence the blame was shifted onto the quality of the textbook.

6.2.2 The structure of activity inschool B

School B was a medium sized primary school (Grades 1 – 7) situated in a rather prosperous area close to Verulam. The school was still under development at the time of this study. The educator was a young lady who was moderate in her approach to the lesson. She

mentioned alack of resources as one of the reasons for not enacting the integration of Natural Sciences and Technology.

During her preparation, the textbook *Natural Sciences and Technology solutions for all* was used, and the topic of the lesson was *Ecosystems*. The educator introduced her lesson by revising the previous lesson on photosynthesis.The lessonwas then presented usinga chart with two columns: A and B. In column A, she had written the types of ecosystems and in column B, she had written the names of inhabitants. The learners were expected to match column A to column B.

To consolidate the lesson; the same activity was given to learners in groups of five and they were given time to discuss their answers, where after they had to give feedback to the whole class.

There was no clear-cut integration of Natural Sciences and Technology. The assessment was continuous throughout the lesson presentation, and English was the medium of instruction used in her presentation.

Class rules were used to guide the lesson proceedings. At this school, the prefect system was effective inside and outside of the classroom.The role of the educator was to display the chart and learners were expected to match column A and column B.

The integration of Natural Sciences and Technology was never mentioned or attempted. The lesson was well presented, but the learners were only exposed to one side of the story, in this case, Natural Sciences.Technology was never explored.

6.2.3 Thestructure of activity in school C

School C wasa medium sized primary school (GradesR – 7) situated in Inanda, a rural area close to the Roman Catholic Coventry. The school was undergoing renovations at the time of the study. The school was situated along the coast, and as a result, they enjoyeda sea breeze. The school enrolment at the time of this study was estimated at 400 learners.

The lesson was presented by a well experienced woman; this was evident from the way she handled her lesson. She promised to demonstrate integration in the next lesson since the present lesson did not cater to integration.

She used the*Platinum Natural Sciences and Technology* textbook in her preparation. The topic of her lesson was food groups, and she introduced her lesson by asking learners about the type of food that they had enjoyed over the weekend.

The first activity was focused on balanced diet; she gave a list of unbalanced food and expected the learners to add their own list in order to make it balanced.The second activity was on the provision of a list of fruits and vegetables, and learners were expected to respond by making a list of vitamins and minerals that are produced by these fruits and vegetables.

The last activity was on page 24 whereby learners were expected to fill in the type of disease against the type of food that was lacking in the diet. Continuous assessment was sustained. The conclusion involved the evaluation of the school's feeding scheme.

Most of the presentation was done on the board and English was used as the medium of instruction. The integration of Natural Sciences and Technology was never tackled, instead it was postponed to the next lesson on food processing. CAPS instruction regarding presenting an integrated curriculum was never followed, instead, emphasis was placed on Natural Sciences. The section on Natural Sciences was understood by the learners without the integration of Technology.All of the activities were provided by the educator, and all the learners had to do was respond to the educator's questions and prompting.

6.2.4 The structure of activity inschool D

School D wasa small primary school (Grades1 -7) situated in thesuburban area of Tongaat. The school wassituated in adeep rural settlement and shareda site with the Roman Catholic Church.

The Grade 6 educator was a soft spoken woman who claimed to have no knowledge of the content of Technology.

She did her preparation from the textbook*Natural Science and Technology a solution for all*. The lesson was on *Balanced diet*. The textbook method dominated the presentation of the lesson. Emphasis was placed on the diseases caused by not eating a balanced diet. As a result, there was too much reading directly from the textbook in such a way that the learners showed signs of being tired or bored as the lesson progressed. The activity came from the textbook in the form of answering a few questions provided in the book, this was done towards the end of the lesson. TheTechnologycontent was compromised throughout the lesson presentation, only the Natural Sciences content was treated accurately and fairly.

She introduced her lesson by definingthe terms diet, balanced diet, amongst others.The next part of the lesson focused on malnutrition and diseases associated with malnutrition such as diabetes. The learners were expected to list the content of balanced food. The second activity was on the prevention of diseases associated with particular kinds of diet.

The assessment was part of the activities on page 40 of the textbook, where a comparison was made of two boys living different life styles. The question and answer method of presenting was used based on previous activities. The lesson was accompanied by textbooks, and the activities were prepared using a chart. Although English was used as the medium of instruction, the educator presented her lesson in isiZulu.

The talk and chalk method was used to convey the lesson in the classroom. Discipline was maintained throughout using the rules of the Technology classroom, and by the educator herself.

6.2.5 The structure of activity in school E

School E wasone of the biggest primary schools in the Phoenix area. It wasa well-known school due to thegood results obtained by its learners. This was one of the biggest schools situated in a semi-urban area. The school had all of the necessary resources and equipment, and the enrolment was estimated at 1020 learners.

The Grade 6 educator was a middle-aged man who felt that he would be overloading the learners if he integrated Natural Sciences and Technology.

He prepared his lesson from the textbook *Viva Natural Sciences and Technology*. The topic of his lesson was *Illegal and legal connections of electricity*. He introduced his lesson by explaining tothe learners the dangers of illegal electricity connections. He made the learners draw the sign in their exercise books.

The next activity was based on two pictures of electrical construction, one representing the illegal connection of electricity and the other the legal connection of electricity. The learners were expected to make comments about what they sawand give reasons for their answers. The lesson moved on to the effects of illegal electricity connections.

The second activity focusedon defining the term 'appliances'. Learners were instructed to make a list of items that constituted appliances, such as a kettle.

The third activity looked at safe ways of using electricity, as well as energy saving. The class read the first four paragraphs on page 87 of the textbook, and assessment was carried out on continuous basis.

The learners were allowed to comment and give reasons for their comments. The lesson took concluded with the educator advising the learners not to connect electricity illegally and also to report people who did do that.

There was no proper integration of Natural Sciences and Technology. The lesson was presented in the form of questions that required a response from the learners, which was based on the textbook and a picture displayed by the educator.

The common rules of the school and class played an important part in controlling the behaviour of the learners.

The learners seemed to cope with the lesson because it addressed items that were prevalent their environment, however, integration was reduced to a few drawings with no design or brief.

6.2.6 The structure of activity in school F

School F was a medium sized primary school (Grades R – 7) situated in the rural area of Inanda. This was one of the more disadvantaged schools situated deep in the rural area.

Enrolment was estimated at 400 learners at the time of this study.The school was characterised by old buildings and shortages of classrooms. The communitymembers were are struggling to make a living, as evidenced by the poverty of the area.

The Grade 6 educator was a woman who was a bit shy in expressing herself openly. She could not integrate her lesson because she complained about a lack of content knowledge in Technology.

Her lesson preparation was based on the textbook *Natural Sciences and Technology solutions for all*. The topic of her lesson was *Renewable ways to generate electricity*, and she introduced her lesson by defining the terms ‘renewable’ and ‘non-renewable’.

The first activity was based on a chart that was divided into column A and column B. Together with the learners, examples of renewable and non-renewable resources of energy were listed on the chart.

The next activity focused on displaying the manner in which each of the above mentioned energy resources was used to generate electricity, for example, water turns generators and turbines.

The assessment was presented in the form of a revision of all of the activities. The learners were then instructed to copy the whole presentation into their exercise books**.**

English as the medium of instruction was used throughout the presentation. CAPS rules were never attended to, which resulted in no integration being introduced, and the blame was shifted onto the poor quality of the workshops attended.

Due tothe poverty of the community and the school, the educator used her own money to print some of the activities.

Judging from the above observations, there appeared to be a serious drawback in the teaching of an integrated Natural Sciences and Technology curriculum in these educators’ classrooms. It was clear that all ofthe educators in these six schools treated the Natural Sciences and Technology as separate subjects; there was no integration at all.

The findings of this study indicate that although these Grade 6 educators had a good understanding of an integrated curriculum, they did not apply this understanding to their classroom practice. It is in this regard that it was hoped that the post-observation focus group interviews would possibly provide the various reasons for their failure to implement an integrated Natural Sciences and Technology curriculum.

6.3 DATA ANALYSIS AND PRESENTATION OF RESEARCH QUESTION 2, SUB-QUESTION 2

- ***What informs Grade 6 educators' classroom practice?***

It is significant to note that participants E1, E4, E6, E7, E8 and E13, in their post interviews,had come to the common agreement that they did not succeed in implementing the integration of Natural Sciences and Technology for various reasons, as clearly illustrated in Table 6.1 above. These reasons are further illuminated in the section below.

6.3.1 Lack of guidance on integration from textbooks

Some educators felt that the textbooks that they used did not provide enough information on the integration of Natural Sciences and Technology. As illustrated in Table 6.1 above, this perception was held by one participant out of six (17%).

6.3.2 Certain themes of Natural Sciences and Technology do not yield themselves to curriculum integration

On this point, the majority of the educators made reference to themes like food processing, balanced diet andthe food-web. This perception was held by three participants out of six (50%).

6.3.3 Lack of materials and resources hinders the integration of Natural Sciences and Technology

Some participants regarded the shortage and lack of learner support materials (LTSM) as the problem hindering the successful integration of Natural Sciences and Technology.One out of

the six participantswas in favour of this perception (17%). In the focus group discussion,the following themes were raised and elaborated on further.

6.3.4 Insufficient budget

During the focus group interviews, the issue of insufficient information in the textbooks was discarded. Books were seen to have enough information on the integration of Natural Sciences and Technology. The real problem was the issue of insufficient budgets to buy the required number of textbooks due to a limited fund allocation from the Department of Education. The schools' Libraries were considered to not be a possible solution to this problem due to the fact that many of these schools were situated far from these libraries.

6.3.5 A lack of material and resources.

The issue of materials and resources was further elaborated on during the focus group interview. The following resources were lacking at the schools:

Libraries: They are needed to supplement a shortage of informative books.

Iodine: This is used for testing starch.

Wires, light bulb, battery: Used for an electric circuit.

Laboratories: To carry out experiments. These resources are regarded as essential for ensuring the smooth flow of the integration of Natural Sciences and Technology. Due to the fact that some schools did not have sufficient financial allocation, integration was affected negatively.

6.3.6 Ineffectiveness of the workshops

A lot was said about the ineffectiveness of the Department of Education workshops on the following grounds:

Quality: The quality of the workshops wasaffected negatively due to the following factors.

Duration: One day workshops werevery common instead of one week or one monthworkshops.

Method of training: Only a few educators wereexpected to attend the workshop with a hope that they would go back and train the rest of the staff. This method results in the poor quality of the information being delivered.

Intervals: The number of workshops provided was not enough to transform the educators. After training, there was no follow up and evaluation to ensure the effective implementation of the results of the workshop. This situation resultedin integratingNatural Sciences and Technology on paper, but this did not materialise in the educators' practices. This means that educators are not ready for the integration of subjects.

6.3.7 Lack of content knowledge in Technology

Technology is a new learning area, therefore very little is known about it as compared to Natural Sciences. Educators tend to teach what they are comfortable with, in this case Natural Sciences. This situation ends up influencing educators to have a negative attitude towards Technology, and some educators become biased in dealing with Natural Sciences and Technology.

6.3.8 Lack of incentives

One way of overcoming the problem of a lack of content knowledge is to enrol for new and scarce learning areas. Alternatively, there were no incentives to encourage educators to enrol for these new and scarce learning areas in Higher Education institutions at the time of this study. Another problem is that older educators are too old to go back to school with the aim of improving their content knowledge.

6.3.9 Lack of funds

The Department of Education regards aninsufficient budget as the cause for failing to fund many projects and programmes. This results in no subject advisors being employed to perform their monitoring task of visiting schools.

6.4 CONCLUSION

This chapter presented the findings gathered from analysing the data of the second research question. The results revealed that although these Grade 6 educators had a good understanding of the integration of Natural Sciences and Technology, this understanding was unfortunately not enacted in their classroom practice.

It also showed that the Department of Education faced challenges inlevelling the playing field so that the integration of the Natural Sciences and Technology could be implemented without fail at classroom level. Taking into consideration such challenges, most of the recommendations and possible solutions towards these problems will be dealt with in the next and final chapter.

CHAPTER 7

DISCUSSION AND RECOMMENDATIONS

Having explored the data in Chapters 5 and 6, this chapter provides a conclusion to the thesis by revisiting the work that I have done in the previous chapters. Additionally, my findings will be evaluated and recommendations for future studies on this topic will be given. This chapter presents a discussion of the findings of this study, as presented in the previous two chapters. Activity Theory forms part of this chapter to guide the discussion of the findings. According to Hofstee (2006), the discussion, conclusion and recommendations exist to explain what the researcher has discovered and the value thereof. The purpose of this study was to critically engage the Grade 6 educators, to see whether they had an understanding of the integration of Natural Sciences and Technology and implemented this in their classroom practice.

To address these questions successfully, a descriptive, explorative, qualitative research design was used. The multi-method approach was found to be the most appropriate methodology for data collection as it ensured that a deeper understanding could be ascertained of how Grade 6 educators enact the integration of Natural Sciences and Technology in the classroom.

The collection of the required data to answer the research questions was done through three phases:

- Phase I (questionnaire): finding out the Grade 6 educators' understanding of the term 'integration'.
- Phase II (class observation): finding out how this understanding was enacted in their classroom practice.
- Phase III (focus group): finding out what informed their practice in the classroom.

7.1 DISCUSSION OF KEY FINDINGS

This study explored the Grade 6 educators' understanding of the integration of Natural Sciences and Technology from two perspectives. Firstly, the general understanding of the term

‘integration’ was discussed. Secondly, the application of their understanding in their classroom practices was explored. The implementation of the integration of Natural Sciences and Technologywasbasically informed by the integrated curriculum and the Grade 6 educators’ understanding of what integration is. These six educators were faced with the challenge of successfully integrating Natural Sciences and Technology at various levels. However, the most prominent two were: there wasa lack of sufficient documentation on integration. Secondly, not much had been written on what the Grade 6 educators were supposed to do to integrate Natural Sciences and Technology in their teaching.

This study reveals the following regarding the integration of Natural Sciences and Technology in the Intermediate Phase (Grade 6). The Grade 6 educators’ understanding of the term ‘integration’ may be divided into two levels:

- Firstly, the majority (92%) of the participating Grade 6 educators had a common general understanding of the term ‘integration’. Only one Grade 6 educator confused the term ‘integration’ with ‘inclusive education’. Secondly, some of the Grade 6 educators understood the term ‘integration’ in relation to the curriculum. Within the curriculum understanding, some of the Grade 6 educators hada general understanding of the term ‘integration’, while others hada cross curricula understanding.
- With regard to the integration of Natural Sciences and Technology, six perceptions were highlighted. They ranged from the fact that Natural Sciences and Technology support each other, to content knowledge being regarded as a prerequisite for the integration of Natural Sciences and Technology.
- With regard to whether these Grade 6 educators enacted their understanding of integration in their classroom practice, the results revealed that all six Grade 6 educators failed to enact their understanding of an integrated subject.
- In terms of the question, “What informs these Grade 6 educators’ classroom practice”, the results showed that four out of six perceptions informed their classroom practice. They ranged from a lack of guidance in the textbooks, content knowledge, materials and resources, and incentives, to a lack of funding.

In Activity Theory,it is important for teaching and learning to be studied, to understand the subject, the object and the outcome. The participating Grade 6 educators (subject) failed to implement the integration of Natural Sciences and Technology (outcome) for learners (object) to gain a deeper understanding of the integrated curriculum. This shows that an understanding of the term integration does not necessary mean that it will be successfully implemented in the classroom. This study clearly reveals that theGrade 6 educators understood the term integration, but there wasno evidence that there was any implementation of this understanding in their teaching. It is therefore necessary to look for other options that could support Grade 6 educators in their endeavours to deal with, and implement an integrated curriculum.

Based on the findings of this study, several recommendations have been made to the different stakeholders to show how the integrated curriculum could be improved upon. I believe that if the recommendations could were put into practice, the integration of Natural Sciences and Technologycould be effectively implemented to promote meaningful teaching and learning.

7.2 RECOMMENDATIONS

It is evident that these Grade 6 educators failed to integrate Natural Sciences and Technology in helping learners to gain a deeper understanding of the integrated curriculum. They lackedan understanding of the principles and ideas upon which Natural Sciences can be integrated into Technology to become one learning area. The CAPS document, despite focusing on and discussing knowledge strands to be used to integrate Natural Sciences and Technology, it does not specify how educators are supposed to enact this integration.

I believe that these will inform all stakeholders involved in the education system about what is really going on in schools so that they can take appropriate measures to improve Grade 6 educators' teaching and learning contexts.

Based on the findings of this study, the researcher proposes several recommendations to various groups of stakeholders, these are outlined below.

7.2.1 Policy makers

There is a need to review the aspect of CAPS that focuses on the integration of Natural Sciences and Technology, and to clarify in detail what integration means, how it should be

enacted and why it is to be carried out (instructional strategies). This is necessary due to the fact that most Grade 6 educators do not seem to have a balanced understanding of the content knowledge of Natural Sciences and Technology. An expanded curriculum document could help in explaining how integration could be incorporated into the teaching and learning contexts for different subjects.

7.2.2 Textbook writers

This comprises the people who prepare materials for classroom use. Some of the participating Grade 6 educators expressedthat some textbooks did not deal with the integration of Natural Sciences and Technology clearly and effectively. Some textbook writers could learn a lot from the selection of books used by Grade 6 educators. They therefore stand a better chance of improving the quality of their textbooks to meet the required standard of integration. Such steps could be a great help for senior and newly appointed educators who happen to rely upon textbooks when carrying out their classroom practice.

7.2.3 Educators

The findings of this study showed that educators both senior and newly appointed were under-developed in terms of teaching Natural Sciences and Technology as an integrated subject, therefore they need to be capacitated to effectively and competently play their role in integrating these two subjects. The following programmes could provide solutions to this problem:

- Comprehensive support coupled with follow-up and evaluation workshops are recommended when any innovation is brought into the education system.
- A mobile unit is recommended for intensive in-service training whereby clusters of schools in a vicinity are visited to ensure the total transformation of the educators. Such attention is needed since educators are key implementers of any classroom innovation.
- Educators need to continue as life-long learners in order to keep themselves motivated and ready to carry out integration in their classrooms, not just to have knowledge of the policy document.This could ensure that quality education is facilitated in their classrooms.

- Educators need to engage themselves in networking and the sharing of information within their cluster, ward, circuit and region. This could ensure that learners experience the same curriculum despite beingtaught by different educators.
- Non-Government Organisations (NGOs) should provide funding for promoting Natural Sciences and Technologyeducators regardless of workshops that are organised by the Department of Education.
- Special bursaries should be allocated to educators enrolling for Natural Sciences and Technology courses, and incentives should be provided for those educators who are doing well in their classroom practice.

7.2.4 Schools

Schools that are better off in terms of coping strategies in their classroom practice should adopt those schools that are struggling to cope.

Schools need to engage in programmes that will improve their fundraising ability. Schools also need to capitalise on the opportunities that present themselves and identify possible funders to supplement the Departmental financial allocation. This could ensure that learner support material is adequately provided to learners.

There is a need to allocate more resources towards integrated Natural Sciences and Technology development.

Subject advisors shouldvisit schools on a regular basis with the aim of developing and supporting Grade 6 educators in implementing the integrated curriculum.

Lastly, schools need to organise training or short courses for educators to acquire the skill of selecting the best textbook out of a bulk of textbooks supplied by different publishers. This would reduce the number of textbooks that the school has to buy in that particular learning area.

7.2.5 Researchers

It is important to note that this study was conducted on Grade 6 and where most of the results are negative, it is likely that further research needs to be conducted in Grades 4 and5 to establish where changes need to be made to ascertain positive results.

This research was conducted in the Mafukuzela – Ghandi circuit in the region of Durban, KwaZulu-Natal, South Africa. The findings of this study can neither be generalised to other schools in the same circuit northe region for Grade 6. This therefore requires further research to be carried out to cover other circuits and regions.

Further research may be necessary if the Department of Education and all other stakeholders fail to implement the necessary changes. In this regard, an investigation could be carried out on factors that hinder the Department of Education and other stakeholders from following up on recommendations such as those provided in this dissertation.

Problems in the integration of Natural Sciences and Technology are numerous, although only a few have been briefly highlighted in this study, all of which require further research.

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APPENDIX 1

A LETTER TO THE DEPARTMENT OF EDUCATION: ETHEKWINI REGION

10 Shadybrook place
Brookdale
Phoenix
4068
27 November 2013

The Department of Education.
EThekwini Region

Dear Sir/Madam

RE: REQUEST FOR PERMISION TO CARRY OUT RESEARCH IN ETHEKWINI REGION, PRIMARY SCHOOLS

My name is Peter Khanyile. I am a student at the University of KwaZulu-Natal doing a Master's Degree in Technology Education.

My research study is entitled: ***"Exploring Grade 6 educators' understanding of the integration of the Natural Sciences and Technology in Mafukuzela-Ghandi circuit, Ethekwini region".***The study is aimed at empowering educators in using an integrated approach in their teaching of the integrated Natural Sciences and Technology Education. This will result in improving the standard of teaching and learning.

The study will be guided by the following research questions:

Critical question: What do grade six educators understand in relation to integrated Natural Science and Technology.

Sub-question: How is that understanding enacted in their classroom practice?

Sub-question: What informs their practice?

I hereby request permission to conduct research in primary schools in the Ethekwini Region, Mafukuzela-Ghandi ward between February and August 2013, with the aim of answering all research questions. The ward is selected because of its convenient accessibility to me.
There are three stages involved in this study:

Stage one

To answer the first research question, a survey is going to be conducted to explore grade six educators' understanding of integrated Natural Science and Technology Education.

Stage two

The second stage of the study involves classroom observation to see how the understanding of integrated Natural Science and Technology Education is enacted in the educators' classroom practice. It will therefore provide the answer to research question two.

Stage three

The third stage involves a focus group interview with the teachers to ascertain what informs their classroom practice.

A study of this nature will benefit almost all the stakeholders such as educators, textbook authors, and Policy makers.

In case you need further information regarding this research, please contact either myself on 0792139654 or my supervisor Dr. B.P. Alant on 031-2607606.

Please be informed that you are requested to complete the declaration form attached to show your willingness to participate in the study.

Thanking you in advance for your cooperation.

Yours sincerely,

…….
Mr. Peter Khanyile

DECLARATION BY THE DEPARTMENT OF EDUCATION OFFICIAL

I ---------- the Department official, grant permission to Mr. P.D. Khanyile to conduct his research study in the primary schools in Mafukuzela-Ghandi ward.

SIGNATURE OF THE DEPARTMENT OF EDUCATION OFFICIAL

_____

DATE

_____

APPENDIX 2

KWAZULU-NATAL DEPARTMENT OF EDUCATION POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004 EMAIL ADDRESS: kehologile.connie@kzndoe.gov.za / Nomangisi.Ngubane@kzndoe.gov.za CALL CENTRE: 0860 596 363; Fax: 033 392 1203 WEBSITE: WWW.kzneducation.gov.za

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Enquiries: Nomangisi Ngubane Tel: 033 392 1004 Ref.:2/4/8/357

Mr PD Khanyile
38 Bailey Road
Greenwood Park
RED HILL
4051
Dear Mr Khanyile

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"EXPLORING GRADE SIX EDUCATOR' UNDERSTANDING OF INTEGRATION OF NATURAL SCIENCES AND TECHNOLOGY EDUCATION IN THE INTERMEDIATE PHASE",** 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 15 February 2015 to 15 February 016.
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.

Pinetown District

_____

Nkosinathi S.P. Sishi, PhD
Head of Department: Education

APPENDIX 3

A LETTER TO THE PRINCIPALS

10 Shadybrook place
Brookdale
Phoenix
4068
27 November 2013

The Principal

Dear Sir/Madam

RE: REQUEST FOR PERMISION TO CARRY OUT RESEARCH AT YOUR SCHOOL

My name is Peter Khanyile. I am a student at the University of KwaZulu-Natal doing a Master's Degree in Technology Education.

My research study is entitled: ***"Exploring Grade 6 educators' understanding of the integration of the Natural Sciences and Technology in Mafukuzela-Ghandi circuit, Ethekwini region".*** The study is aimed at empowering educators in using an integrated approach in their teaching of the integrated Natural Sciences and Technology Education. This will result in improving the standard of teaching and learning.

The study will be guided by the following research questions:

Critical question: What do grade six educators understand in relation to integrated Natural Science and Technology.

Sub-question: How is that understanding enacted in their classroom practice?

Sub-question: What informs their practice?

I hereby request permission to conduct my research at your primary school during the year 2014. As part of my research, the educators from your school will be involved in the following three activities: survey,

where a questionnaire will be given, class observation and focus group interview. The three stages of the study entail:

Stage one

To answer the first research question, a survey is going to be conducted to explore grade six educators' understanding of integrated Natural Science and Technology Education.

Stage two

The second stage of the study involves classroom observation to see how the understanding of integrated Natural Science and Technology Education is enacted in the educators' classroom practice. It will therefore provide the answer to research question two.

Stage three

The third stage involves a focus group interview with the teachers to ascertain what informs their classroom practice.

A study of this nature will benefit almost all the stakeholders such as educators, textbook writers, researchers as well as policy makers.

I would like to give an undertaking that the name of the school and other particulars will be kept anonymous. Furthermore, research will only be conducted after permission has been granted by the Department of Education. The data will only be used for the research purposes.

You are kindly requested to fill in and sign the declaration form attached to signify your consent and grant of permission for me to do the study at your school.

I thank you in advance for your on-going support and co-operation. If you require any further information, please feel free to contact me on 0792139654 or my supervisor Dr. Alant on 031 2607606.

Yours Sincerely,

……

Peter Khanyile

DECLARATION BY THE SCHOOL PRINCIPAL

I ……. the Principal of

…….. Primary School, grant permission to Mr. P.D. Khanyile to conduct his research study in my school.

SIGNATURE OF THE SCHOOL PRINCIPAL

_____

DATE

_____

APPENDIX 4

A LETTER TO THE GRADE 6 EDUCATORS

10 Shadybrook place
Brookdale
Phoenix
4068
27 November 2013

Dear Sir/Madam

RE: REQUEST FOR PERMISION TO PARTICIAPTE IN A RESEARCH STUDY

My name is Peter Khanyile. I am a student at the University of KwaZulu-Natal doing a Master's Degree in Technology Education.

My research study is entitled: ***"Exploring Grade 6 educators' understanding of the integration of the Natural Sciences and Technology in Mafukuzela-Ghandi circuit, Ethekwini region".***The study is aimed at empowering educators in using an integrated approach in their teaching of the integrated Natural Sciences and Technology Education. This will result in improving the standard of teaching and learning.

The study will be guided by the following research questions:

Critical question: What do grade six educators understand in relation to integrated Natural Science and Technology.

Sub-question: How is that understanding enacted in their classroom practice?

Sub-question: What informs their practice?

I hereby request your permission to participate in my research study which will be undertaken in your classroom during the year 2014. You have been chosen on the account of your involvement at your school as a Natural Science and Technology educator in the intermediate phase.As part of my research, you will be involved in the following three activities: survey, where a questionnaire will be given, class

observation and focus group interview. The data collected will only be used for research purposes and will not be used for any other purpose without your consent.The three stages of the study entail:

Stage one

To answer the first research question, a survey is going to be conducted to explore your understanding of integrated Natural Science and Technology Education.

Stage two

The second stage of the study involves classroom observation to see how your understanding of integrated Natural Science and Technology Education is enacted in the educators' classroom practice. It will therefore provide the answer to research question two.

Stage three

The third stage involves a focus group interview with other Grade 6 teachers to ascertain what informs your classroom practice.

A study of this nature will benefit almost all the stakeholders such as educators, textbook writers, researchers as well as policy makers.

Please note that participation is voluntary and you are free to withdraw from the study at any stage and for any reason you see fit. Please be informed that no real names will be used in any material that I write up for the research. Every attempt will be made to keep the material confidential. Other material such as voice recordings will be kept in a safe place. Please fill in andsign the declaration form attached to signify your consent and grant of permission for me to do the study in your classroom, which will be collected later.

I thank you in advance for your on-going support and co-operation. If you require any further information, please feel free to contact me on 0792139654 or my supervisor Dr. Alant on 031 2607606.

Yours sincerely,

……

Peter Khanyile

DECLARATION BY THE GRADE 6 EDUCATOR

I ……., the Grade 6 Educator of

…….. Primary School

hereby agree □ / do not agree □

to participate in the above study as outlined in the above request. I hereby consent /do not consent to have classroom observation and focus group interviews video/audio recorded.

SIGNATURE OF THE GRADE 6 EDUCATOR

_____

DATE

_____

APPENDIX 5

A LETTER TO THE GRADE 6 EDUCATORS

10 Shadybrook place
Brookdale
Phoenix
4068
27 November 2013

Dear Sir/Madam

RE: REQUEST FOR PERMISION TO PARTICIAPTE IN A RESEARCH STUDY

My name is Peter Khanyile. I am a student at the University of KwaZulu-Natal doing a Master's Degree in Technology Education.

My research study is entitled: ***"Exploring Grade 6 educators' understanding of the integration of the Natural Sciences and Technology in Mafukuzela-Ghandi circuit, Ethekwini region".***The study is aimed at empowering educators in using an integrated approach in their teaching of the integrated Natural Sciences and Technology Education. This will result in improving the standard of teaching and learning.

The study will be guided by the following research questions:

Critical question: What do grade six educators understand in relation to integrated Natural Science and Technology.

Sub-question: How is that understanding enacted in their classroom practice?

Sub-question: What informs their practice?

A request is hereby made for your child _____ to participate in the above-mentioned study at his/her school. The study requires that the learners participate voluntarily (that is not one be forced to take part), in stage two (classroom observation) of the study (see stage below). Real names are not to be used and confidentiality will be upheld at all times during the duration of the study.

The data collected will only be used for research purposes and will not be used for any other purpose without your consent.The three stages of the study entail:

Stage one

To answer the first research question, a survey is going to be conducted to explore your understanding of integrated Natural Science and Technology Education.

Stage two

The second stage of the study involves classroom observation to see how your understanding of integrated Natural Science and Technology Education is enacted in the educators' classroom practice. It will therefore provide the answer to research question two.

Stage three

The third stage involves a focus group interview with other Grade 6 teachers to ascertain what informs your classroom practice.

A study of this nature will benefit almost all the stakeholders such as educators, textbook writers, researchers as well as policy makers.

Please note that participation is voluntary and your child is free to withdraw from the study at any stage and for any reason you see fit. Please fill in andsign the declaration form attached to signify your consent and grant of permission for me to do the study in your child's classroom,

I thank you in advance for your on-going support and co-operation. If you require any further information, please feel free to contact me on 0792139654; my supervisor Dr. Alant on 031 2607606 or Ms Ximba at the HSSREC Research Office on 031 260 3587, Email: ximbap@ukzn.ac.za.

Yours sincerely,

……

Mr. Peter Khanyile

DECLARATION BY THE GRADE 6 PARENT

I ……., the Parent/Guardian of the following

Grade 6 learner ……..……. of

…….. Primary School

hereby agree □ / do not agree □

for my child to participate in the above study as outlined in the above request. I hereby consent /do not consent to have classroom observation and focus group interviews video/audio recorded.

SIGNATURE OF THE PARENT/GUARDIAN OF GRADE 6 LEARNER

_____

DATE

_____

APPENDIX 6

SAMPLE OF THE INVITATION TO FOCUS GROUP INTERVIEW SESSION

To: Grade six educators

As research participants teaching integrated Natural Sciences and Technology at Intermediate Phase from the following schools:

B primary, La primary, Q primary, W primary, S primary Ba primary.

You are cordially invited to attend a Natural Sciences and Technology focus group interview session scheduled as follows: -

Date: _____

Venue: _____
Time: _____
Facilitator: _____

Attached please find the themes for the day.

The session is meant to help you with content knowledge and will empower you to have confidence in your future presentations

Please bring: 1. Your Technology personal file
2. CAPS documents.
3. Prescribed Technology Textbook
4. Sample of Natural Sciences and Technology lesson plan, work schedule, and learning programme

Thank you.

_____ _____
Mr. Peter Khanyile Date

APPENDIX 7
INSTRUMENTS FOR DATA COLLECTION
7.1 QUESTIONNAIRE

EXPLORING GRADE 6 EDUCATORS' UNDERSTANDING OF THE INTEGRATION OF NATURAL SCIENCES AND TECHNOLOGY IN MAFUKUZELA-GHANDI CIRCUIT, ETHEKWINI REGION

Denzin (1978, p.24) states that all methods of data gathering have limitations, but using three methods, namely a questionnaire, observation and focus group interviews, the researcher will be able to triangulate in order to obtain a large database and thus validate the data.
This study therefore used these three instruments mentioned above to collect data from grade six educators

Phase 1

Questionnaires schedule

The questionnaire responds to research question one: What understanding do grade six educators have, in relation to the integration of Natural Sciences and Technology?

Biographical information

Please either circle the appropriate answer or provide a detailed response as requested in the questions below.

Gender	**Male** **female**
Name of the school	
Qualifications	
Number of years in the teaching profession	**0-4 5-10 11-15 16-20 21-25 26>**
Number of years teaching science	**0-4 5-10 11-15 16-20 21-25 26>**

Streams currently teaching	
Number of workshops attended	

Questionnaire-survey schedule.

1. What, in your mind, does the term “integration” mean to you?

_____

_____

_____

_____

_____

2. Are you aware of the Natural Sciences and Technology integration? Elaborate.

_____

_____

_____

_____

_____

3. What is your understanding of the integration of Natural Sciences and Technology? Explain.

_____

_____

_____

_____

_____

4. What in your opinion is the value/impact of the integrated Natural Sciences and Technology curriculum

_____
_____
_____
_____
_____

5. Are there any other comments / suggestion that you would like to add? If so use the space provided below

_____
_____
_____
_____

APPENDIX 7.2

OBSERVATION ASSESSMENT SCHEDULE

Class observation will respond to question two:"How is an understanding of integrated Natural Science and Technology enacted in the classroom.

Observation schedule

NB. This observation schedule was adopted from Khumalo (2008, pp.126-130) thesis on a context-based problem based approached in grade 8 Natural Science teaching and learning

Date:_____

Time:_____

1. **Physical setting**.

School information.

School:_____

Location.

Rural.	Semi-rural.	Urban.	Semi-urban.

Type.

GET	FET

2. Human setting.

Learner's information.

Grade.	No. of learners.	Females.	Males.	Learners doing physical science.	Females.	Males.
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

How do learners get to school?

They walk.	By buses.	By taxis.	By their parent's transport.	By bicycles.

Educator's information.

Principal.	Deputy principal.	Head of Departments	Educators.

School's language policy.

Language used during teaching and learning in the school.

English.	Isizulu.	Afrikaans.	Other.

Language used in physical science classrooms during teaching and learning.

English.	Isizulu.	Afrikaans.	Other.

Language used during group discussions.

English.	Isizulu.	Afrikaans.	Other.

Learner's home language.

English.	Isizulu.	Afrikaans.	Other.

Physical science educator's home language.

English.	Isizulu.	Afrikaans.	Other.

3. **Programme setting.**

Physical resources.

Facility.	Availability.	Comments.
CLASSROOM FACILITIES.		
Grade 11 classrooms. (permanent)		
Grade 11 classrooms. (temporary).		
Desks per classroom.		
Writing board (s).		
Dedicated display area (for charts).		
Educator's table.		
Educator's chair.		

Cupboards.		
Textbooks.		
Stationary (papers, exercise books etc.)		
Writing aids (pens, pencils, calculators etc.) for learners.		
Science corner.		
ADMINISTRATIVE FACILITIES.		
Principal's office.		
Deputy principal's office.		
Head of department's offices		
Staffroom.		
EDUCATIONAL FACILITIES.		
Library.		
Library books.		
Library shelves.		
Science laboratory.		
Laboratory equipment.		
Computer laboratory.		
Computer (s).		
Video Camera recorder.		
Television.		

Video recorder.		
Radio.		
Overhead projector.		
Photocopy machine.		
Posters.		
Internet.		
RECREATIONAL FACILITIES.		
Sports field.		
Sports equipment.		
INFRASTRUCTURE		
Toilets.		
Security system.		
Electricity.		
Water availability.		
Access by road.		

Pedagogic styles, curricula and their organization.

What kind of curriculum is being followed?

What characterizes the pedagocic style of the educator?

How does the educator engage her learners in the teaching and learning situation?

How does the educator prepare the teaching and learning tasks?

How are the learners being assessed?

4. Interactional setting.

What happens in the physical science classrooms in terms of interaction that are taking place?

Interactions	Comments.
Formal.	
Informal.	
Planned.	

Unplanned.	
Verbal.	
Non-verbal	

APPENDIX 8:

Validation of data collected from the research instruments

8.1 Phase one: Validating: (Questionnaire)

Researcher1: Let me first revise the questionnaire that I gave you, now if you remember very well the questionnaire, the first question was more or less general: What do you understand by integration? The second question was: Are you aware of the integration? And the third one was: What do you understand about the integration of Natural Sciences and Technology? The fourth question was: Do you see value or impact in the integration of Natural Sciences and Technology? And the last question was about the general comment on the integration of Natural Sciences and Technology that is a summary of the questionnaire.

Now one thing, when I looked at responses from different educators I came to the following conclusion or if I may call it themes: **One** I gave it a name **generalor automatic** understanding of integration. Why do I say is general, it's because to me it sound as if during OBE curriculum people were encouraged to do integration. That is the type of integration I find in most of your presentation, you integrate other learning areas like English when you say to the learner give the spelling of the word, or count the number of items that is part of English and Mathematics but it became part of your presentation. In other word what you are doing you are integrating other learning areas but not Technology. This type of integration I gave it the name to be **automatic** (**general) integration** whereby when you present something you come upon certain information than you integrate that information. In your response you put it in this fashion integration is mixing of two things to make it one or it is putting two ideas to achieve one goal. Do you agree that such integration took place during your presentation and also in your responses you put it in this fashion?

Stereo: Yes we do agree with you sir.

Researcher1: The **second one** I call it is a **specific integration.** Why do I say specific? It's because it doesn't happen automatically but there is specification in telling you that you must integrate Natural Sciences and Technology not anyhow but you must follow a certain procedure that is you must link this theme with another specific theme. Let me give an example: Life and living from Natural Sciences is specified that it must integrate with structure in Technology, secondly you must integrate matter and material together with processes in Technology, thirdly you must integrate earth and beyond with system and control and lastly energy and change integrate with also system and control. When you open the grade six books you will find put like that although it is called strands, that is why I have concluded that people in their responses have said there are areas though you did not mention those areas as strands but to me you were aware of them, that's why I am saying this one is a specific one.

Now let me come up with the **thirdone**, which I have given the name **original integration**. What do I mean by this, is there are some of you who in their responses came up very clearly to say Technology is the practical application of Natural Sciences, in other word that person is saying science is theory and technology is practical. For example if the doctor diagnosis that you have problem with your eyes, that is more scientific but when the doctor is designing the spectacle it becomes Technology. In other word you are saying originally these two learning areas are together, that means science first and technology is the second, technology is responding to science, science dig the problem out and technology comes with the solution. That's why I have given the name original integration.

The **fourth** and the last one is the idea that these two learning areas have got **nothing** to do with each other. People have said although we are aware of integration it's because it is recorded in the books but according to their understanding these two learning areas are totally separated. Therefore I cannot say these people have said nothing. I took that and put it at the corner there.

Now I want to pause and give any one a chance to say anything about these categories or themes. Anything to say about these themes; say if they do make any sense come out clearly but if they do not make any sense also feel free to say so. Let me stop there at the moment, is there anyone who can comment.

Stereo: As far as myself is concerned your conclusions do make sense, they are valid.

Researcher2: Now you have mention four categories, I want us to put it this way for example the automatic integration while you are teaching you add any other information you come across, under specified you also draw from your teaching and learning background , think.

Researcher1: Just think about your first theme in Natural Sciences and see how other learning areas fits in or relevant, that you cannot put them aside. Topics like ecosystem, balance diet, food web etc.

Stereo and Max: I think is English especially grammar, spelling and pronunciation.

Researcher1: which other learning areas that are relevant to the first theme, you said English, others they don't worry about integration, they only stick to their learning area.

Researcher 2: Some reflection of what you do in the classroom, as someone has mention grammar.

Researcher1: What about maths? Where can you fit in mathematics in presentation of Natural Sciences and Technology?

Zoro: When you are measuring out something like certain solutions, may be using beakers than you measure the amount of solution.

Stereo: Sorry are we talking about all the themes or we are concentrating on life and living?

Researcher1: At the moment we are general, we are looking at automatic but we are bringing in any information from other learning areas as we have spoken about grammar in English and measurement in Maths, just say anything from other learning areas. You can also mention something that you usually do in the classroom than we can see where it fit in in terms of learning areas.

Max: Okey, in terms of the original integration where we talk about theory and application of theory, I can refer to maths because when you teach Maths you first explain the terms to the learners, they must know what are we going to learn about for example the fractions you must explain to the learners what are the fractions and they must raise their views about the definition of fractions than you do the fractions practically with them , you can put the fruit, for an example an apple and then you cut that apples so that they can see the fraction of an apple practical

Resesrcher1: that example you are placing under the original integration, but it can also fall under automatic integration because other examples can overlap, we cannot restrict that if we want to make our lessons more interesting but it needs a thorough thinking, by so doing you add value to you lesson. Any other thing coming from Maths that may be integrated in Natural Sciences and Technology lesson? What about Art and Culture?

Staccato: In Social Sciences earth and beyond, like planets in Social Sciences integrate with planet in Natural Sciences

Researcher1: That means there is n area in Social Sciences that integrate with another area in Natural Sciences which is more specific. Any other comment before we can go on to the next phase. If I may conclude really integration is part of us but it depends on the level of creativity of the teacher. One educator may present a lesson without touching other learning areas just because she/he is not creative enough but another person may come with many ideas.

Researcher2: Let us reflect more on what we do in the classroom, because we are here to exhaust all in this meeting.

Max: Creative Art can integrate with Technology, because they do practical when they draw most of the time can also integrate with Natural Sciences when you ask them to draw the food web, the skill of drawing in these three learning areas is important.

Researcher2: She has mentioned Creative Art, what about other learning areas? Think of something that is not part of your lesson but you try to bring it to clarify the concept, we talked about an apple, that is introducing Mathematics, another example is when you connect two areas using one switch you bring mathematics if you count one switches in connecting electricity in two areas., that is one is to two. It doesn't mean you must know all learning areas, but you draw

from other learning areas. Let me say, you are teaching film flash, you can now refer that person to lightning. You can see you are bringing Natural Science. This means you bring anything from anywhere to clarify your concept.

Let me ask you the question, what are your learning areas:

All members: Social Sciences, Mathematics, English, Life Skills (creative arts, swp, psw) Natural Sciences, Natural Science and Technology, IsiZulu

Researcher2: What we are talking about under automatic integration is how you can bring in something here and convey your teaching as is it. What about life Science Sciences

Max: Life Skill in Physical Education and in PSW they learn about their body, their personal hygiene.

Researcher2: What do you study in Natural Sciences?

Max: Life and living talking about plants and animals

Researcher2: In Technology? About structures, there are many thing you can use to convey information here. For example you can talk about plumping which fall under Technology, you can teach somebody how to operate the water tap, you can refer someone when you are urinating, that is the natural way of controlling a tap, that means you are bringing something here in order to talk about tap, this is a natural tap that you can relate to an artificial tap in terms of opening and closing it, So there a lot of things you bring out to teach our learners, let's think about them.

Max: For an example in psw we use to teach them that they must be clean, their homes are clean even themselves, they brush their teeth and so on. In Natural Sciences they learn about processes of cleaning water is related to psw because we teach them the importance of clean water and also in psw they learn about personal hygiene.

Researcher2: How do you use these things to convey the message? How do you bring the in? How do you relate the cleaning of water with a particular aspect?

Max: I can ask them what we must put in water in order that we drink clean water. They can tell me that we can put jick before we can drink, they can mention that we can boil water to make sure that the water that we drink is clean especially to those go to the river to fetch water.

Researcher1: Natural science talks about plants and human. other areas such as earth and beyond, matter and material in other word even water is a process, if you take that and compare it with processes in Technology whereby everything must follow a certain step, even in science

when you are solving problem, you don't jump into conclusion but you follow certain steps towards solving problems.

Max: When they are cleaning water they must count how many spoons of jick may be in 2iitres of water that relate to Maths since you cannot put five spoons of jick, there is an element of counting.

Researcher1: Is there anything that you want to add under automatic integration? Do you know an automatic car? It just change gears on its own

Researcher2: You can relate that with reflex action, something that happens on its own. You can now say this is what I remember under automatic

Researcher1: I think we have digested almost everything under automatic, can we move on to the next theme that is specified integration where you are given the strands that you have to integrate. What is it in Technology under structure that you may integrate with science?

Zoro: Skeleton of animal and human being in Technology

Researcher1: How does that integrate with science?

Stax: I am just thinking of the situation where life says people need to live together and had to provide themselves with food, shelter but at the same time these shelters are to be built without taking into consideration some certain aspect, for example if you need a shelter that is strong, than how do you provide stability to your structure for example the roof which fall under structures how do you make it strong using all possible ways to make it strong, like triangulation and also using the correct material for example how you mix cement, what you are doing you trying to make sure that your structure is strong so that people can live under that structure and actually find protection under that same structure but it goes together in that people living there have taken necessary precautions, that just an idea that came into my mind under structure and living.

Stax: What I can say under life and living we are talking about animals I think the structure gives the idea that animals are divided into groups, they have different body structures, there are those animals that have bones vertebrates and 0thers are called invertebrates and you make it clear to learners that animals have different body structures

Researcher1: Who can mention one or two examples on the structures?

Stax: It's surprising how people have changed or have tried to bring in to their living structures of dead animals in trying to provide decoration or ornaments for their homes like you go and collect some shells, these are shell structures they bring those to their homes as decoration, that's

living at the same time they need to get other structures for example an animal that died, the relationship has not broken away as people go and collect to their places.

Researcher1: One example that we get is shell structure that can be used in our life and living, one example shell structure, are we not living under a structure that is the building.

Stax: Structures go a long way we have structures that are made to carry loads, that means people come in and make those man- made structures like the bridge where we want to cross what is no living for example we are on the other side of the river what do we do to provide those structures so that we can use them in trying to continue with our way of living to be able to move from one side to the other side but we also need something that can provide the span or the distance from other side and be able also to carry whatever load that we come with, so that we find ourselves being able to cross the river and fix that relationship between structures and also being able to live our life

Researcher1: I think you have mentioned a lot of example between life and living and Technology but you can move on to other area of matter and material if we have exhausted life and living, we can now look at matter and material

Stax: Even if we go to the shops to buy we also need, we may not think about these as structures but carrying your plastic bag, actually that is another structure, but it's there to contain whatever that you buy, you get a loaf of bread, rama and everything than you need these plastic bags, so there is a connection that you see, than you carry your plastic that gives you the ability to carry whatever you have bought.

Researcher1: That's fits very well when we discuss the uses of structures, we say the structure can carry something, any other thing before we move on to matter and material, for example processing in Technology how do you relate with matter and material. What falls under matter and material?

Max: Solids, liquid, gas

Reseacher1: Give one example of a solid

Stereo: table

Researcher1: Liquid like what?

Max: Like water in food processes because, in food processing we have different types of food some of the food are in the form of a solid, liquid for example a juice is a liquid and at the same time is a solid just like an apple we eat it but we can also drink it as a juice, this involve processing.

Researcher1: What else can we mention?

Stereo: Fruit salad and processing

Researcher1: What about fruit salad? Who can expatiate on it? Give us example which fruit can you put together to make fruit salad.

Zoro: Apple, banana, strawberry, and matter and material sand

Stax: There again on the food salad, material that we are using, it has to be right material, eg when you look at the material, materials can be tools that you are using, you need knife so that you chop fruits, you need your board to put on, those are the materials, solids but also you need something to extract juice or you combine all those things that is processing but at the same time there is matter and material. Some could go to expiries to make sure that food can be preserved and can stay for a long period whether you put salt or what to make it stay for a long period

Researcher1: Anything you can say about earth and beyond together with system and control, this is tough one, what falls under systems and control? Electricity, what other systems, hydraulic system, and pneumatic system and levers and linkages, they must come in here to link with energy and change or earth and beyond, how do we relate these ideas?

Stax: On the roads where constructions take place you see systems and energy and change, you will find that the load is put somewhere and you will find those linkages used so that they can lift up that load into somewhere else, there you will see energy and change where there is a movement, that is a motion we do find energy and change, that load is taken to somewhere. Ait becomes easier because carrying by hands might not that easy but when you introduce those systems where you have those linkages working together everything become possible.

Researcher1: Is there anything before we conclude this section and move to another section.

Group: None

8.2 Phase Two: Validating: Class observation data

Let me go on to the next session, it is something that came out in the classroom as a reflection from different educators.

Educators: **First reflection**

We don't find integration easy because books or materials are not giving us enough information on integration.

Validation:

Stax: Personally I it surprises me that there are educators who feel that books they are using in class are not providing enough information. It makes me ask questions such as: do they prepare enough before they go to the class to present the lesson. If you don't have enough information in the book that you are using, you can consult publishers or go to the library. Personally I think integration can have a meaning but what we just don't have, because schools differ in affordability, some schools cannot buy resources that are needed to have a flow of integration, that is where the problem lies, that the material that you need at some instances you will find that you don't have, you try to make use of what you have which will not actually make you to deliver properly as what supposed to be, so you have limitations , you cannot do as you would have loved, that is where the problem is, the material in our schools, some schools cannot even buy may be when you integrate you need to have a computer in the classroom but you do not have a computer in the classroom, worse you don't have an electricity so that you can actually do what is needed, learners have to Google or go to internet but where do you get all that, you are unable to do that even yourself you cannot have a media centre in your school to have computers and laptop where learners can go at their free time to do a research, so those are the limitations that we have but in terms of information I think there is more than enough books that have information when you need it, that's how I see it personally.

Researcher2: The book are not provided by the school therefore you have to buy it.

Stax: Yes, books are provided, like I said schools differ in a way we are getting money but each and every gets allocation from the department of education, that allocation caters one for the buying of the books, so you have a portion that you cannot at all use it for any other purpose but it caters for books. So schools are able and above it all there are libraries where educators can go when they are preparing for their lessons

Researcher1: What comes out clearly here is that not the the books they don't have enough information, it's only that sometimes we don't get hold of all the books, even information may be there in the book but the book is not with you, you cannot use that information, that's how I understand it. Let's go to another person. What do you say?

Stereo: What I can say I can agree with the gentleman that information is not a problem, if you don't have a book you can go to the library to get more information, the problem is lack of other resource for example if you want to do something for example with me to put an example you want to conduct a food test and you have the problem of iodine solution, so you can't do it properly because you are lacking this resource but information is there in the book it tells you what to do but the resource is not there.

Max: I agree with maam because in NSTech practical activities are formal assessment we do have problems when to practical's because we have a lack of resources

Researcher2: Can you elaborate on what you lack?

Stax: Say by chance you get a person with iodine solution coming now with that iodine solution to test a starch you bring all things but the floor space does not allow you to use all that , you are in the classroom ,you are carrying out a science activity which needs you to be in a lab near water tap, to wear protective clothes, and you don't have all that so now you begin to wonder whether you carry out this activity because you might find yourself harming or other children getting hurt because these things are poison. Other children use bare hands to touch, it might than fire back to you because they may end up swallowing or inhaling, because you don't have even a lab those are the limitations we have.

What you tell me is that you don't have a problem with information but we have a problem in applying that information. That's what you are saying.

Educators: Yes

Reaearcher1: That means you are not applying that information that is in the book, you are running short of the resources

Researcher2: Can you mention those resources

Educators: wire, battery, light bulb, electric circuit, a lab, if you have a lab but no other resources, chemicals such as iodine, even books because the library is not there.

Stax: Other schools do have books but the way those books are kept , because they do not have space, you cannot even go there to look for a certain book, that's why we I said we don't have media centres where you can actually keep those books

Researcher1: That is one point you are trying to validate to me that people are not doing integration because of lack of resource that's what you say

Educators: Yes

Researcher1: Now what you are trying to tell me is that information is there but resources to apply that information is not there that's what you are telling me. At least you have just corrected something from me because I was under the impression that information is not there but you are saying information is there but resources not there.

Just like when you teaching and you are told to use a pond where learners will get a chance to observe animals that live in that particular pond but going to that pond can be a lot of challenge.

Researcher1: Let me bring another observation after visiting the classroom.

Educators: Second reflection

Educators are saying we don't do integration because we don't we don't understand what Technology is all about, to us is a new learning area, therefore we are not in the point of integrating Technology, that was educators reflection after going to the classroom. Educators have indicated to me that they are comfortable with science. What do you take on that? Can I take it as a valid point?

Science and Technology are not separated, when you teach Natural Science you sometimes relate it to Technology, they are combined, for example when you teach about different kinds of food you also relate to technology because you got to show how an apple is processed to make an apple juice and how it is preserved. You need to indicate that now it is Technology and now it is Science

Stax: I think coming from what Khanyile has said that educators have said that they are okay with NS but the problem is Technology, they do not know what is Technology I think also it can also go back to our own department you know when they have started introducing , it was Natural Science alone and Technology alone , all right and then they started bringing these changes they than integrated these learning areas, they brought Natural Sciences together and technology but the thing is they were putting these learning areas together but they did not consider that we had a Natural Science educator and Technology educator , those people were left alone not integrated, there was no integration of teachers, so now teachers treating Natural Science and Technology as a new subject, in that if I was teaching NS ,now that it has Technology I don't teach that or when they teach Natural Sciences and Technology they become bias, I going to teach Natural Science the Technology part I am no good at, I going to leave that out, Fortunately when we are at workshops facilitators of those workshops even subject advisors kept on saying that when you teach Natural Sciences and Technology you find that you are not okay with Technology you can go out and ask a particular educator who is good in Technology to come and just take that part that of technology , that can be allowed when two educators attend to one particular subject for the reason of making sure that the section of that particular subject doesn't left behind, so a particular educator will come and just take processing , I have taught everything but processing is a problem from technology , can you come and give a hand

or help me there just do that part, so it happens in Life skills they brought in drama, dance and everything and I may be teaching in my school teaching life skills but I cannot sing but you know that singing is part of Life skills and has to be taught I can decide to go out and outsource or look for a person who gonna come and handle that particular part the subject but coming back to the statement that we do not know what is Technology I do not understand, because Technology has been there since I don't know when and for educators to say I don't know Technology , It would have been better if they said we have not been workshoped in the field of Technology to say they don't know what is Technology is a different story and another issue is our SMT's during the staffing they just said you teach this , they don't look at the expertise, they say go and teach Maths when you look at your qualifications nothing about Maths, may be they do that because of the staffing problems, saying we do have educators but we lack educators who have specialised in that particular subject

Max: When you ask them they say Primary do not specialise, you teach everything, that is the answer the give.

Researcher2: The problem is not with department of education but how they allocate people to teach, what you mean the department introduce integration but they left out educators

Max: educators have negative attitude towards Technology, not that they don't know it, may be if they can change their attitude it will be better

Researcher2: What aspects that we want to be improved? What the department need to do in order to bridge this gap between these teachers.

Stax: On the side of the department there is only one thing provision of workshops, that one part but the sickening thing about the workshops, the department doesn't provide sufficient workshops for an educator to be transformed, as maam has said we need that change of attitude, If you want me to teach something that I am not competent with, I am no comfortable with then I would begin to have a negative attitude towards that and I will keep on appeal to my HOD's that please change me from this particular subject so that I can do something that I am okay with, now once you develop that negative attitude and it will also hinder the progress in terms of teaching that particular subject , now when the department comes in the workshops that I have observed so far , they do those workshops just to be able to account and say that there was once a workshop here, the workshop that start at twelve o'clock to two yet they are expecting you to be a know everything after the workshop, they take you for two hours, the reasons why they offer workshops that have limited time, they will tell you it's lack of funds, the department itself is lacking funds to workshop the educators to become professionals or become confident and competent and making sure that they able as a department to fulfil their vision and mission, but they don't do that , now than again if than we say workshops is one part of making sure that we solve this problem it can also be educators given incentives to be able to go to certain

universities or other institutions of higher education where they can actually take those particular subjects and enrol for those particular subjects and become better in terms of handling those subjects , that also is another problem, they are not even given a chance to go and study, so we end up saying educator is a lifelong learner , see what you can do .

Researcher1: Do you agree if I can summarise what you have said that there are workshops but those workshops are not effective or we say workshops are not enough or we are saying there are enough workshops but not effective because they don't give us information, because of money and time factor they are not effective at the same time you are saying there is nothing that is encouraging you to go and enrol for these new learning areas like Technology mixing with Science. Now let's take the first one, are we saying workshops are not effective

Stax: When educators come back after a workshop they are still unable to apply whatever they have learned there , still unable to go and teach with confidence that particular subject , because the workshop did not give the what they needed because it was one day , not even one day two hour workshop

Researcher1: What do you say about the provision of those workshops? Does the department provide enough in terms of number of workshops except the information that is not effective Are you satisfied about the workshops that are given by the department only information is a problem?

Stax: May be educators may think about when they introducing CAPS isn't they call the educators to workshop we should think along those line how many days did the call educators for that particular subject to come to those workshops, you will find the that they just call them for one day, they are calling you to come and do NS and Tech in one day and is a new subject but you are being called for one day workshop

Reseasrcher1: My statement was educators don't integrate Science and Technology because they feel they don't have enough information of Technology, okay now what you are saying educators were not getting enough information to have confidence in integrating Science and Technology because information they get from workshops is not enough, is not enough both sides, or you saying Technology itself is a problem before you combine it with Science we have problem with Technology itself , that is what I am trying to get from you that technology give us a problem but on the side of Natural Sciences we don't have a problem but is a combination of something that I don't know with something that I know, that's what I am trying to get from you. May be workshops are there but they are not giving you enough information from the side of Technology and they are taking for granted that you know science you know Technology therefore let us combine this information yet on the other hand you don't know anything about Technology , that's what I want to get from you

Stax: We have also said the department integrated the subjects but did not actually look at the educators who were teaching those subjects

Researcher1: Okay, they were not consulted

Stax: Even though there was consultation but before CAPS or before integration there was Natural Sciences and Technology, so there was one educator for Natural Sciences and one educator for Technology when they brought Technology and Science together they forgot about Science and Technology teachers, they left the like that, they took those two subjects and gave them to one person whom for example was just teaching science and there the problem started because this one was teaching Natural science and Technology was brought and this person became bias and say I gonna teach science because I know Science rather than Technology

Researcher2: In other words educators have specialise on one learning area but they are forced to integrate

Researcher2: If I understand you very well there is supposed to have a workshop not on the learning area but an integration workshop to enlighten educators on the need for collaboration, just like the apple, okay you teach them about the apple and you teach them about the processing when you teach them about them awareness about integration you teach them ten over ten the learners will loss all, when this one finishes, is one to three , four, five, six that workshop they have integrated the teacher , in this case the teachers are left out.

Researcher1: These are few point I just pick up from the reflection from the part of educators one is lack of resources and the one that, they are not trained to teach both learning areas

Researcher2: Not necessarily that they are not trained, they are not integrated, they have integrated every aspect of the subject, they have information but is not integrated.

Stereo: That problem apply to me as you explain it I been teaching Natural Sciences for a long time and another educator has been teaching Technology when these two learning areas are integrated, they said now you are going to teach Technology where else I don't know anything about Technology, I was not told that to change apple into a juice is processing so I was not aware, that is why confuse as to how to integrate Science with something I don't know

Researcher2: If I may ask you now ever since you were asked to teach a particular grade about this Natural Sciences and Technology have you been doing it? Have you been teaching it?

Educators: Yes

Researcher2: So, what happen to the Technology aspect if you don't know it?

Stereo: I am just living aside, but if I see I can do it, I do it but I stick more to Natural Sciences

Researcher2: You are saying you don't do the Technology aspect, it is left aside. Does anybody take it?

Educators: No

Researcher2: That is very important, that Technology is left aside and learners are suffering.

Researcher1: That is the most important point I picked up from most educators, other say we are too old to go back to study Technology

Researcher2: What the department of education should do?

Stereo: I think teachers need to be workshoped about this new learning area, so that you can understand, because as we are talking here, we see that it is not something that is completely out but I don't know how to apply Technology. I know that foo can be changed to another form for example dry food to make tit last longer, but I don't know that, that part is Technology, I need to be trained to know it as Technology

Researcher2: That means you need to be workshoped, do you suggest that two teachers must be assigned to take a particular grade for Natural Sciences and Technology

Stereo: The one who is going to teach Natural Sciences and the one to teach Technology,that will be better

Researcher2: Do you have concrete solution

Researcher1: But even if there are two teachers, the lesson must be one

Researcher2: These are two learning areas but in terms of the document they are one , the educators ,we want to defend educators were teaching two different learning areas but they are now brought together but the educators are not considered

Stereo: The other educator that are they know this, they has been using different exercise books for Natural Sciences and Technology, they are separating them.

Researcher2: That means even if they may be inside one house they may not be integrated, using different exercise books tells you that they lack orientation and the awareness of integration.

Researcher1: They are not convinced about integration, it's far away from them but they are forced, that's is a big word but they are not ready to do it. To me what I got from educators is about not information now but is about the access to information, than the second one you are saying is about the element of consultation, people were not made aware of the integration but were forced , they find themselves having to practise it, those are two reflections from the side of

the educators. My conclusions were not different from this I can say openly in many lessons that I observed I did not find integration, I was under the impression that may be is the understanding factor

Researcher2: On the workshop to be specific, the aspect of the educators, how to organise workshop, the workshop should talk to how these two educators should work together for integration, not that they don't know it but they have to be made to understand this is the different aspect, they need to be told that this is the aspect

Researcher1: That is how I conclude my observation. Anything to comment on? What to take to the department?

Max: The department need to provide us with resources to do practical's for Technology because we don't have them, they must make sure that we do have them in our schools.

Stereo: Principals must make use of the allocated funds and training for Technology

Researcher1: Let me put together these ideas, bringing the material and train people to make use of that material. In one research somebody said instrument were there but people were not aware of those instruments, because they were not trained to use them, so what you are saying we need instrument, if that was an instrument that was needed and the person must be trained how to make use of that particular instrument in order to be effective.

Reseacher2: They say the department must organise workshop, what intervals must be considered for these workshops? Let's you have twelve month in a year.

Stereo: I think the workshop should be called before the implementation of the learning area, may be one week workshop than after that there must be a follow up workshop so that we can be checked how is it going with the implementation

Researcher1: That is a pre-service, in-service (monitory)

Stax: But the department has put in place the mechanism to control or make sure that those things work, there are also subject advisors above the workshops but these subject advisors are unable to come to schools to do what there for, they will only call you for workshops and thereafter no monitors, no visiting or going to site just to check and give immediate assistance the way it is needed, they don't do that, one of the reasons is that they are also unable to , they don't have means of doing that because there is lack of funds. So subject advisors are there but they do not go to schools.

Researcher2: If it does all these things fall under the jurisdiction of IQMS

Stax: Partly it, we also do have IQMS that was currying on I am thinking base in our school which is also another tool of making sure that teaching and learning takes place accordingly or properly looking at or checking the curriculum coverage in schools but it will than because of lack of that oomph to go and teach and implement even the IQMS it's just failing, because it's not achieving the goal they supposed to achieve during that IQMS, that is the reason When you cry and say advisory I got the problem, please how can you make sure that you come and assist us here, they don't come, there are nowhere to be found

Reseacher1: I think is enough for today we cannot be hundred percent in our discussion but you can see we need each other, if this problem is common to our schools, you may think you are suffering on your own while other people are finding things easy on their side but you only find that everywhere there is a problem but we need to have solutions to those problems. I am just taking this opportunity to thank you for your patience, thanking you for your time, I didn't expect that we are going to spend so much time but through the discussion everything has taken it's course. I think we are going to close here and proceed next item. Let's have some drinks and something to eat I will see how get back for those who came with me, thank you very much, you may take very lightly what we are saying but we shall present this information to higher authorities and point out the problem

Stax: What has taken place here wants to be the true nature of the subject meetings that should be taking place in our schools, you will find that it's not taking place because it is very effective even in sharing some light if this subject meeting were taking place properly the way they should in schools we wouldn't be facing so much problems when it comes to integration but since that we are lacking subject meetings in our schools , so this is an eye opener this one as well to read what about integration but at the moment in schools we are treating subjects as subjects that's why integration does not leave with us or in us as educators I have my Natural Sciences and I have my Technology that I go and teach, when did I last think about the word integration when I am carrying my Science books

Researcher1: That's why you will find Natural Sciences and Technology teacher never set down and talk about this integration the other one is there and the other one is on that other side in one school not even in the next school, really we need this type of discussion. Thank you very much.

APPENDIX 9

Validation and interpretation of themes as per research question

Phase 1: Validation and interpretation of themes from RQ 1

Research question 1: What is Grade six educator's understanding of the integration of Natural Sciences and Technology?

Grade six educator's understanding of the integration of Natural Sciences and Technology can be presented in various levels depending on the manner in which integration is viewed by different Grade six educators. These levels may form themes of this study which needs validation and interpretation through focus group interview.

In the first level the integration of Natural Sciences and Technology is generally understood. Technology is treated like all other learning areas such as English, Mathematic etc which can integrate with Natural sciences randomly depending in Grade six educator's level of creativity and experience. In most cases drawing of various structures is interpreted as Technology with no emphasis on the design briefing and any other aspects of Technology. This manner of understanding is interpreted as the general or automatic integration.

The second level is represented by Grade six educators, who understand the integration of Natural Sciences and Technology in terms of strands or themes. Although they did not come up clearly as to which themes from both learning areas are to integrate, but they do have specific areas (strands/themes) that need to integrate from both learning areas. It remains a question whether grade six educators are aware of these specific strands that are to integrate or not. The integration that takes place in this manner is referred to as specific or thematic integration.

In the third level, Grade six educators also believe that Natural Sciences and Technology core existed. Their understanding seem to suggest that Natural Sciences existed first and thereafter it was made applicable to certain situations. In this case Technology is understood as the application of Science. This actually means the one cannot exist without the other one, we thus give it the name original integration.

Lastly, we cannot throw it away the understanding of Grade six educators, who see no connection between Natural Sciences and Technology. They recommended the separation of these two learning areas.

Phase 2: Validation and interpretation of themes as per RQ 2 and 3

Stage one

Validation and interpretation of the reflection of educators

Research question 2: How are the Grade six educator's understanding ofthe integration of Natural Sciences and Technology enacted or practised in the classroom? What informs their practises in the classroom?

From the class observation and post- interview, it became clear that the implementation of the integrated Natural Sciences and Technology curriculum faces more challenges. These challenges wouldhave dealt with in the validation and interpretation of the reflection of Grade 6 educators. The following are some of the reflection of the Grade 6 educators.

1. Workshops are not effective.

Grade 6 educators felt that workshops are not properly **organised** in terms of intervals. Workshops that is supposed to run for mort ha one day, you will find that it run for few hours due to the shortage of finance from the Department of Education. According to Grade 6 educators there should be a pre-workshop and follow up workshop.

Grade 6 educators also believe that workshops are not effective in producing enough information. This factor may be linked to the above mentioned factor. They feel that what they get from these few workshops does not built **confidence** in approaching Natural Sciences and Technology curriculum. They end up developing negative attitude towards the subject. This condition has brought many results in as far as the teaching of Natural Sciences and Technology syllabus is concerned. Some Grade 6 educators are not making any attempt of integrating Natural Sciences and Technology. Any integration that may take place is by chance and therefore is automatic. This is evident when some Grade 6 educators confess that they sometimes cannot realise that they have integrated Natural Sciences and Technology in their lessons, this is due to the lack of knowledge of Technology. Some Grade six educators resort to trial and error method.

Grade six educators believe that workshops are **not targeting** Natural Sciences and Technology educators but they are addressing other aspects of the subject. As a result some Grade six educators are not ready or aware of the integration. To these Grade six educators the integration of Natural Sciences and Technology was left in the doorsteps of their classrooms and was forced down their throats. They even suggested the introduction of two educators to deal with integrated Natural Sciences and Technology curriculum.

2. No dedicated place for Natural Sciences and Technology.

Grade six educators mentioned the fact that integrated Natural Sciences and Technology curriculum demand a place that is fully equipped for the experimentation to take place. Instead experiments are carried in the classroom which lack tap water, proper protective clothes and there is danger of inhaling poisonous substances. This condition affects the schools with good allocation of fund, schools that can depend on the local institutions such as libraries and educators who can consult their colloquies for such substances like iodine.

3. No floor space.

Grade six educators admit that there are school that get enough allocation of money from the Department of Education. Those schools manage managed to buy almost all the resources that are needed by the school. The only problem that they are facing is the absence of protective place such as media centre and library to keep these resources safe and accessible. By so doing such conditions may keep any necessary information hidden from the Grade six educators. We can conclude by saying there is enough information from the books on integrated Natural sciences and Technology curriculum but the fact is some schools cannot have those books due to limited fund. Those who have funds to buy books they may lack space and appropriate structures to keep those books as result the school may not benefit any information from those books.

4. No proper motivation.

Grade six educators argued that there is no support and incentive from the Department of Education to motivate them to enrol with any institution to improve their understanding of Natural Sciences and Technology curriculum. Another fact is some Grade six educators are too old to study these new learning areas.

Stage Two

Validation and interpretation of the reflection of the researcher

Based on the class visits and observations of more than five Grade six lesson presentation, I have concluded that there has been no proper integration of Natural Sciences and Technology. Some of Grade six educators are not even aware of the themes or strands that need to be integrated from both Natural Sciences and Technology, hence we speak of general or automatic integration. During discussion some Grade six educators confessed that they have dropped the integration of Natural Sciences and Technology for various reasons.

During post- interview session some also Grade six educators admitted that integration took place by chance, most of the time with other learning areas such as English and Mathematics because they have little information on Technology. As a result they could not recognise the integration of Natural Sciences and Technology in their presentation.

APPENDIX 10

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To whom it may concern

The dissertation entitled "Exploring Grade six educators' understanding of the integration of the Natural Sciences and Technology in the Mafukuzela – Ghandi circuit, Ethekwini region" has been edited and proofread as of 25 May 2016.

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Kind regards

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