SOUTH AFRICAN TOWNSHIP TEACHERS' VIEWS ON THE INTEGRATION OF INDIGENOUS KNOWLEDGE IN NATURAL SCIENCES TEACHING

by

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DECLARATION

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I declare that the work contained in this dissertation is my own and all the sources I have used or quoted have been indicated and acknowledged by means of references. I also declare that I have not previously submitted this dissertation or any part of it to any university in order to obtain a degree.

Signature: ____________________________

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LIST OF ACRONYMS

AIK	African Indigenous Knowledge
CAPS	Curriculum and Assessment Policy Statement
DOE	Department of Education
HOD	Head of Department
IK	Indigenous Knowledge
MKO	More Knowledge Other
NCS	National Curriculum Statement
NOIK	Nature of Indigenous Knowledge
NOS	Nature of Science
NS	Natural Sciences
SP	Senior Phase
VNOIK	Views on the Nature of Indigenous Knowledge
WK	Western Knowledge

ABSTRACT

The purpose of this study was to explore the views of natural sciences (NS) senior-phase teachers on the nature of indigenous knowledge and their practices when integrating it into their teaching. An attempt to identify a relationship between NS teachers' views and their teaching practices is a long-standing focus and point of interest for science education research because it is believed that what the teachers know influences their teaching practices. The study assumed that teachers' views about the nature of indigenous knowledge (NOIK) determine how they integrate indigenous knowledge (IK) in their NS classrooms. The overarching research question was: how do natural sciences senior-phase teachers' views about the nature of indigenous knowledge influence their teaching practices? The study employed social constructivism as a theoretical framework.

Using an explanatory sequential mixed method research design, a sample of 80 teachers was randomly selected from 78 township primary schools. From the 80 teachers, six were selected for interviews using a purposive sampling method. Data collection included administration of the Views of the Nature of Indigenous Knowledge (VNOIK) questionnaire to 80 NS teachers and interviewing six selected teachers using a semi-structured interview schedule.

In answering the first research sub-question, what are the natural sciences senior-phase teachers' views on the nature of indigenous knowledge?, the findings revealed that very few teachers (20%) had informed views; the majority had partially informed views (46%); and 34% of teachers held uninformed views about the nature of indigenous knowledge. The study established that variables such as gender, teaching experience and religion had a role in influencing teachers' views about the nature of indigenous knowledge.

In response to the second research sub-question, what is the relationship (if any) between these teachers' views and their classroom practices when integrating indigenous knowledge into their teaching practices?, the research findings showed that a relationship exists between the NS township teachers' views and their classroom practices. An example is when a teacher with an uninformed view indicated that she could not teach something that she herself did not understand. The views that teachers held influenced whether they integrated indigenous knowledge into their

NS teaching. Teachers with uninformed views indicated that they do not even attempt to integrate IK into their teaching. The ones with partially informed views pointed out that they sometimes abandoned the integration process even though they had somehow planned it for their lessons, due to inadequate knowledge and skills.

It was established in the study that the teachers did not have a clear understanding of indigenous knowledge and this had a negative impact on their efforts to integrate IK into the teaching of NS in the classroom. The teachers highlighted various difficulties that impede them from successfully integrating IK in their NS classrooms. These include lack of support for integration, the unavailability of instructional and learning materials, lack of clear instructional methods, and lack of training on what IK entails and how it can be integrated into the classroom. These research findings provide research-based implications for in-service and pre-service teacher development programmes to develop teachers in innovative teaching strategies, research and policy.

Key words: Indigenous knowledge, township schools, natural sciences, social constructivism

CHAPTER 1: AN OVERVIEW OF THE STUDY

1.1 Introduction

This study explored the views of 80 natural sciences (NS) senior-phase (SP) teachers from 78 township primary schools about the nature of indigenous knowledge (NOIK) and the influence of these views on their teaching practices. Emerging research has highlighted the importance of exploring teachers' views and the influence of these views on their planned and enacted instructional practice in the classroom (Richardson, 2003). Views are those individually and personally constructed understandings and meanings that are harboured by an individual about the nature of the knowledge of a discipline that guide that individual's intentions for action (Hancock & Gallard, 2004). On the other hand, there is an urgent need to address the "philosophical underpinnings", views and Natural Sciences' teachers perspectives on both the nature of science and nature of indigenous knowledge before any instructional techniques on the most proficient way to execute indigenous knowledge (IK) integration into the science classroom can be recommended (Vhurumuku & Mokeleche, 2009; Cronje, De Beer & Ankiewicz, 2014), since Curriculum and Assessment Policy Statement (CAPS) advocates that NOS and IK be integrated into NS classrooms (Department of Basic Education, 2011). However, it is acknowledged that CAPS document provides very little information or instructional strategies on how this advocated integration should be performed in the real instructing and learning classroom setting.

It is assumed that a teacher's conception directly translates into their teaching practice (Lederman, 1992; Abd-El-Khalick, Bell & Lederman, 1998; Koksal & Cakiroglu, 2010) and this study, therefore, took the view that teachers' views about the NOIK are the main requirements for meaningful classroom teaching and learning, and they become translated into their classroom practice. Examining teachers' views forms part of the way toward getting a more clear picture of how teachers comprehend their work, which, in turn, is significant for the comprehension of their teaching practices (Mansour, 2008).

Chapter 1 brings a concise introduction of the problem and its setting, presenting the background of the study by outlining the state of natural sciences instructing and learning in South African classrooms. It also explores the significance of incoporating indigenous knowledge (IK) into the instructing and learning of science, as well as teachers' experiences and challenges when incorporating IK into the science classroom, as concluded by previous research studies. Secondly, a gap in the research is identified, which gives rise to the problem statement, purpose of the study, research question and sub-questions. Thirdly, the chapter gives a summary of the research design, sampling, data collection and analysis methods and procedures employed. Finally, the significance of the study, delimitations, limitations, summary of Chapter 1 and the organisation of the study are outlined.

1.2 Background to the Study

It is imperative that the instructing and learning of every science subject acknowledge the existence of different knowledge systems. This is encapsulated in the National Curriculum Statement (NCS) Grades R–12: Curriculum and Assessment Policy (CAPS) (DBE, 2011), which values "indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution" (p. 5).

The current National Curriculum Statement (NCS) and Curriculum and Assessment Policy Statement (CAPS) for NS senior phase (SP) states that the learners ought to comprehend the uses of NS and indigenous knowledge (IK) in society and the environment, and ought to comprehend that school science can be applicable to regular daily existence (DBE, 2011). IK is defined as the local unique knowledge of a given culture or society that is passed on orally from generation to generation (Agrawal, 1995). Owusu-Ansah and Mji (2013) regarded culture as the "lens" one uses to understand and interpret one's reality. Accordingly, Cronje, De Beer and Ankiewicz (2014) argued for the need for South African teachers to incorporate IK into their lessons. By incorporating learners' socio-cultural backgrounds, that include their regular encounters, beliefs, socio-cultural practices and their rich indigenous knowledge system (IKS) in the teaching of NS, teachers tap into the qualities that the learners bring to the science classroom (Mavuru & Ramnarain, 2014; Msimanga & Shizha, 2014). This could add toward the comprehension of difficult science concepts and comprehension of a topic that is being taught (Pretorius, De Beer & Lautenbach, 2014), hence the urgent call for teachers to integrate IK into science classroom teaching. Vhurumuku and Mokeleche (2009) described IK as the knowledge itself and that "IKS is the cultural matrix in which IK is enmeshed and stored and should include understanding of nature of science" (p. 98).

Science teachers in South Africa have struggled to cope with the introduction and implementation of the many new policies and curricula within a short time after the first democratic elections (Cronje, 2011). Gouws and Dicker (2007) found that science teachers felt inadequately trained and furthermore, did not have the essential knowledge and aptitudes to satisfy the new educational programme demands. As such, the South African education system was regarded as being in disarray in that respect (Antoniou, De Beer & Ramnarain, 2014). Most teachers do acknowledge that IK needs to be incorporated into the science curriculum (Msimanga & Shiza, 2014; Sjoberg & Schreiner, 2010; Aikenhead & Ogawa, 2007), but still lack the know-how (Cronje, De Beer & Ankiewicz, 2015; Cronje, 2011; Hlanganani & Motlapane, 2014). Among the reasons for the absence of integrating of IK into the science classroom is the negative attitudes and naive views that science teachers hold towards IK; the lack of resources, content and teaching strategies; the fact that most NS teachers were themselves taught in the Western science education system and they also fear that they might be perceived as teaching pseudo-science (Mothwa, 2011; De Beer, 2012).

Haney, Lumpe, Czerniak and Egan's (2002) theory of planned behaviour confirms that teachers' views and beliefs are crucial indicators of the teachers' behaviours that one can expect to encounter in the classroom. This means that one way to improve implementation is to ensure that teachers have an informed state of mind and a clear understanding and assimilation of the new curriculum that is being introduced (Du Plessis, 2013). However, although many research studies have shown that classroom practice is influenced by teachers' views and beliefs, there is still a need to explore teachers' views in order to clarify how this takes place (Mansour, 2008). Specifically, this study investigated the views that SP science teachers in South African township schools hold about the NOIK, and how these views become translated into their classroom practice. It also endeavoured to establish whether IK is integrated into science classrooms, as prescribed by CAPS, and, if so, how this is done in the Soweto township schools, in the Gauteng province of SA. Furthermore, the researcher envisaged exploring challenges, if any, that NS teachers experienced during IK integration in the classroom.

1.3 Statement of the Problem

It is imperative that the instructing and learning of every science subject acknowledges the existence of different knowledge systems. This is encapsulated in the National Curriculum Statement (NCS) Grades R-12: Curriculum and Assessment Policy Statement (CAPS) (DBE, 2011), which values "indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution" (p. 5). The curriculum further expresses that the learners ought to comprehend the uses of NS and IK in society and the environment, and ought to comprehend that school science can be pertinent to regular day to day existence (DBE, 2011). Accordingly, Cronje et (2014) argued for the necessity for South African teachers to incorporate IK into their lessons and also to teach the nature of science (NOS), which, according to Abd-El-Khalick (2001), is "the main perennial goal of science" (p. 215).

Kelly (1986) postulates that the attitudes, perceptions and views of teachers, including those of the learners, play a very significant role towards the success of any new curriculum being introduced. Saad and BouJaoude (2012) stated that the teachers' views on the nature of IK could form a boundary as the new CAPS educational programme is being actualised, and there is along these lines a pressing need to determine teachers' views.

The integration of IK in NS classrooms still remains, to this end, a challenge, due to teachers' views that are not in line with the requirements from the IK community on the acceptable views on NOIK. Lederman (2006) stated that science teachers need to have an adequate knowledge of what they are attempting to communicate and teach to their learners. The results from previous research show repeatedly that primary and secondary school teachers hold naive views of several important aspects of the nature of indigenous knowledge, which are not consistent with the contemporary conceptions of the nature of science. Teachers, therefore, need to be guided to develop the desired understanding of the nature of IK and this is based on the assumption that teachers' conceptions directly translate into their teaching practices (Lederman,1992; Abd-El-Khalick, Bell & Lederman, 1998; Koksal & Cakiroglu, 2010).

1.4 Purpose of the Study

This study sought the views that South African township teachers hold about the NOIK and also explored the influence of these views on their teaching practices when integrating IK into their teaching. The participants in this study were teaching in primary schools situated in Pimville, Soweto, in a township setting.

Vhurumuku and Mokeleche (2009) recommended in their critical review of research in science education study that future research should focus more on the integration of IK, thereby putting more emphasis on developing teachers' views on NOIK, among others, at primary and secondary school levels, since this area is under-researched in South Africa.

1.5 Research Questions

This study sought to answer the question, how do natural sciences senior-phase teachers' views about the nature of indigenous knowledge influence their teaching practices? In order to answer this question, two sub-questions were asked. What are the natural sciences senior-phase in-service teachers' views on the nature of indigenous knowledge? What is the relationship (if any) between these teachers' views and their classroom practice when integrating indigenous knowledge into their teaching practice?

1.6 Aim and Objectives

The study aimed to explore the views of natural sciences senior-phase teachers on the nature of indigenous knowledge and their practices when integrating indigenous knowledge into their teaching. In order to realise this aim of the study, the following objectives were set: to determine natural sciences senior-phase teachers' views on the nature of indigenous knowledge, and to investigate the relationship between the teachers' views and their classroom practices when integrating indigenous knowledge into their teaching.

1.7 Methodology

In this explanatory sequential mixed method research design, more emphasis was placed on the division or section of curriculum implementation, exploring science teachers' views on the NOIK, and how these views impacted on their incorporation of IK in their classroom teaching of NS as a subject. Creswell (2014) stipulated that a research design is a plan on how to conduct a research project. The researcher, in this specific mixed method study, first conducted a quantitative research, collecting and analysing the quantitative data. She then built on and used results to select participants for further data collection, and planning of a qualitative research. In this manner, multiple viewpoints, perspectives, positions and standpoints were elicited, at the same time about a single phenomenon, thereby gaining a thick, rich and in-depth understanding of the research problem (Creswell, 2014). Similarly answers to research questions were addressed and provided. The quantitative data (using VNOIK questionnaires) and qualitative data (using semi-structured interviews) were collected sequentially and then merged to better understand the teachers' views on the NOIK and their practices when integrating IK into their NS teaching.

Creswell (2014) stipulated that a mixed method is premised on the idea that data from either quantitative or qualitative method on its own may be insufficient, so the collection and combination of both quantitative and qualitative data gives a better understanding of the research problem under study, since there is more evidence and more convincing arguments from different perspectives. This data collection method is suitable for this study as it affords the whole investigation in-depth clarity on teachers' views on the integration of IK in natural sciences teaching. It also identifies the challenges experienced by teachers as they integrate IK into their lessons, which leads to the unsuccessful integration process. Finally it provides direction on how teachers could be assisted in overcoming these challenges, thus making the integration process a success. This method leads to a clearer and detailed account of what actually takes place in the classroom during the delivery of science lessons, both in written text and oral means.

Convenience and purposeful sampling was appropriate for selecting the six teachers to be interviewed, as they were township teachers, who had responded to the VNOIK questionnaire and were selected based on some defining characteristic that made them the holders of the information that was required for the investigation, as decided by the researcher (Creswell, 2014). The initial sample comprised 80 participants, all NS Grade 7 teachers, from 78 schools from the Johannesburg Central and Johannesburg North districts, Soweto, situated within a 10km radius of the school where the researcher was teaching. It was convenient to access these schools and the sampled teachers.

Data collection entailed gathering quantitative data first and after that clarifying the quantitative results with follow-up in-depth qualitative data. In the first quantitative phase of the study, the validated survey instrument, *Views-on-the-nature-of-indigenous-knowledge (VNOIK) questionnaire* (Cronje, et al 2015; see Appendix G) was administered to collect data from 80 Grade 7 natural sciences teachers' at Soweto township primary schools to explore and establish a good baseline on their views on the nature of indigenous knowledge and to explore how these views inform or impact their teaching practice. The second qualitative phase was conducted as a follow-up phase, using semi-structured interviews, because more clarification and in-depth understanding of VNOIK responses were sought. In this follow-up phase, the influence of their views on the teaching practice was also tentatively explored with the six teachers, at their schools. One main reason behind consolidating quantitative and qualitative data in a logical explanatory sequential design was to comprehend the data at a more detailed dimension as the qualitative follow-up data helped to clarify quantitative survey data that was acquired from the initial phase and build upon the underlying quantitative results.

For analysis purposes, data or responses to the VNOIK instrument were analysed and quantified using anticipated responses and the rubric that was specially designed for the analysis by Cronje et al. (2015), which rated an informed view with a score of 2, a partially informed view with a score of 1 and an uninformed view with a score of 0. These responses were further analysed using descriptive statistics to give a clear picture of the participants' views on NOIK (Cronje et al., 2015). The semi-structured interviews with individual teachers were audio-recorded, transcribed word-for-word and the Saldana (2009) manual coding method was then used to analyse the qualitative data.

1.8 Significance of the Study

It is envisaged that the study will contribute to the field of science education in different ways. NS teachers in the SP still struggle to integrate IK into their lessons and research is still ongoing (Ogunniyi & Onwu, 2006). The significance of this study lies in its focus on in-service NS teachers in the SP classrooms and provides insights into their views of the NOIK, which influences the implementation and integration of IK into their science classrooms. The study will add to the information that is currently available regarding the views that teachers in South African township schools hold about NOIK and towards the integration of IK into science education. Most of the studies carried out on teachers' views about the integration of IK are qualitative studies, so the mixed method approach employed in this study will assist in revealing both written and oral in-depth, thick and rich understandings of many teachers' views on IK integration. It will also add to our knowledge about the impact of teachers' views in their classroom practice. This information might be relevant to curriculum developers as they develop learning materials that incorporate relevant IK content. This may even lead to the development of IK instructional strategies in the science classroom. As a science teacher, I am also looking forward to being empowered by the findings of this study, as it will provide me with background knowledge to integrate IK and ways of dealing with challenges that may arise from time to time in class during integration, and this could be shared with colleagues.

The greater part of the IK content is not accessible in document format and is not promptly available to teachers. It is, therefore, envisaged that teachers' concerns about what IK content to teach will be addressed as this study will contribute by documenting teachers' current views of the NOIK and some cultural knowledge obtained from the teachers. The findings of this study will also build an appropriate knowledge base, upon which the development, design and implementation of science teachers' pre-service training programmes and in-service continued professional development programmes can improve.

1.9 Delimitations

The study focused on 79 Grade 7 NS teachers, each from a different township school in two districts of the Gauteng Province of South Africa, Johannesburg Central and Johannesburg North districts. Since other factors like teacher training, fear of teaching pseudo-science and teachers' pedagogical content knowledge (PCK) do influence the integration of IK in science teaching and learning; the focus of this study was only on the role of teachers' views on classroom practice. Specifically, the focus was on establishing the nature of science teachers' views on IK and establishing a relationship (if any) between these views and the integration of IK in natural sciences teaching.

1.10 Limitations

This study is a mixed method design. One frequently cited limitation of mixed method studies is that they are time-consuming (Creswell, 2014). Seventy-nine teachers completed the questionnaires and six one-on-one semi-structured interviews were conducted. In each primary school, there was one Grade 7 NS teacher, except for two schools, where two teachers in each, were sharing the two Grade 7 classes. The limitation was the excessive amount of time the researcher took to physically visit 78 primary schools as the questionnaires were hand-delivered to the participants in selected schools. This limitation was addressed by making telephonic arrangements and appointments with the relevant teachers, and this made it easier to distribute the questionnaires and collect them, as the researcher was already expected on arrival.

Another limitation is that not enough interviews were conducted in order to make generalisations about all Grade 7 NS teachers in township schools. The recommendations were based on findings in the study, and should only be interpreted within certain parameters. This means that it may not be appropriate to apply the findings from this study to other township teaching environments, as the nature of teachers may not be the same, especially their cultural and economic backgrounds, which can influence the IK integration during the teaching and learning of science. However, the qualitative component of the study was informed by a quantitative survey among 79 Grade 7 teachers. The six interviewees did minimise the problem of generalisability by providing in-depth, rich and thick descriptions of teachers' views which shed some light on six different ways that science teachers in township schools experience and view the integration of IK in their classroom practices.

1.11 Summary of Chapter 1

In this chapter, the background to the study, statement of the problem, purpose of the study, main research question and sub-questions, research design and methodology, and significance of the study were discussed, as well as the knowledge gap that is addressed by the study. This chapter ends with the clarification of key terms, compliance with ethical standards and the outline of the five chapters.

Research on teachers' views on the integration of IK into the science classroom and the relationship that exists between their views and their teaching practice is a long-standing focus and point of interest for science education research, because of the continued lack of IK integration. In this study, a suggestion is presented that IK be considered the most appropriate knowledge in the fourth industrial revolution.

In the next chapter, which is a literature review, the researcher presents social constructivism as the lens used in this study and then discusses the key local and international literature relevant to this study, and reviews it in the light of South African township teachers' views on the nature of indigenous knowledge and its integration into science education, in relation to science teaching and learning.

1.12 Organisation of the Study

The study comprises of five chapters. Chapter 1 provides the background to the problem, purpose of the study, research questions, as well as objectives of the research.

The second chapter reviews the relevant literature starting with social constructivism, which is the theoretical framework used as a lens to discuss and interpret the research findings. Findings and discussions from previous research studies are also discussed.

Chapter 3 describes the explanatory sequential mixed method research design, methodology and instruments that were employed in the study. The rationale for the explanatory mixed method employed in this study is also provided. The description of data collection methods followed in the study and analysis of the collected data are provided. The sample and sampling procedures included in the study are accounted for.

Chapter 4 provides results and findings from the study and they are presented in two parts: In Part A, the results from the analysis of quantitative data, collected by VNOIK questionnaires, are reported and discussed. In Part B, the results from the analysis of qualitative data, collected by means of semi-structured interviews are reported and discussed.

Chapter 5 offers an overview of this study by giving a discussion of the main findings, and clearly stating the implications of the findings for education researchers, policy makers, and teachers. Conclusions drawn are also presented. Recommendations for classroom practice, future continued professional teacher development programmes and education policy makers are made, thus helping NS teachers to integrate IK in their classrooms confidently.

The following Figure 1 briefly shows the summary of the whole research study, showing what each chapter entails.

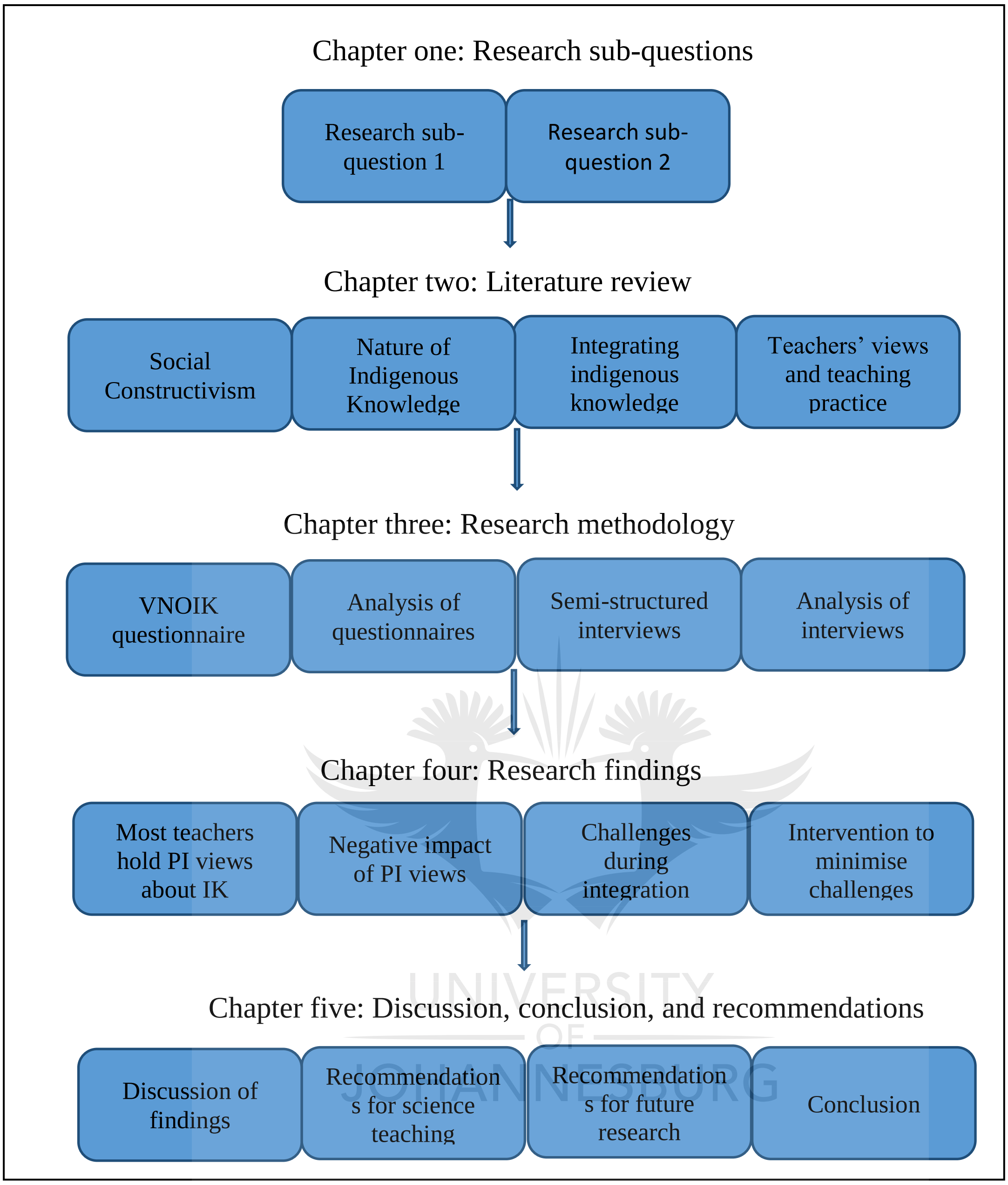

Figure 1: Summary of the whole research investigation

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter presents social constructivism as a theoretical framework and a lens through which this study is viewed. Secondly, the definition of indigenous knowledge, its characteristics and its tenets are discussed. Third, a comparison is made between indigenous knowledge and a Western worldview, thus highlighting differences in order to conscientise science teachers to consider the learners' backgrounds when planning lessons so as to minimise misconceptions. This is followed by the discussion of the integration of indigenous knowledge into the science classroom and the challenges teachers experience during this integration. Finally, the importance of teachers' views on the nature of indigenous knowledge and the impact of their views on classroom practice are explored and discussed.

2.2 Social Constructivism

Social constructivism originated from, and is strongly influenced by, the work of the post-revolutionary Soviet psychologist Lev Vygotsky's theories of social development and the concept of Zone of Proximal Development (ZPD) (Vygotsky, 1978). Vygotsky argued that the basis of all cognitive functions lies in social interactions and that the path taken by the process of learning flows from social to the individual learner (Vygotsky, 1978). It therefore means that knowledge is first constructed in a social context before it becomes internalised, personalised and used for reference purposes by an individual (Jaramillo, 1996). Social constructivists place more accentuation on the significance of culture and social context in comprehending what takes place in society and subsequently the construction of knowledge based on this specific comprehension.

According to Gee (2008), researchers who put accentuation on social constructivism regard learning as a cultural and social procedure that happens with regards to human connections and activity and not simply in the heads of individual learners. The socio-cultural context has an effect on how people learn (through being involved in social cultural activities, and what is learned (social practices), and is itself part of what is learned. A social construction learning indicates that what is learned by people is largely about participating in various communities as this is where meaning resides and people always make sense from a particular cultural perspective (Cole, 1996).

Based on the social constructivist views, it means that knowledge construction is dependent upon one's enculturation into their immediate or social environment, thus highlighting the importance of social interaction during the learning process. Accordingly, Jaramillo (1996) argued that, when a learner enters into the classroom, he or she is not just an empty container, waiting to be filled with information by teachers, but already has knowledge acquired from social interactions.

On the other hand, science education is underpinned by the view that the knowledge is not a directly transmittable entity from one person to the next, but must be actively constructed by the learners' mental activity (Driver, Asoko, Leach, Scott & Mortimer, 1994). They further argued that the construction of knowledge is an active meaning-making process based on pre-existing knowledge that was acquired during the learner's interaction with the social environment. This study uses social constructivism as a theoretical lens, as it is informed by the view that scientific knowledge is constructed within social settings and the process of learning science entails both the individual and social processes of knowledge construction. From a social constructivist perspective, the learning process entails being acquainted with a symbolic world that is made up of a set of organised and clearly stated belief systems about what exists, how to reach goals and what needs to be given high value (Bruner, 1985). He further argues that the understanding of this symbolic world entails the need for help from others.

For scientific knowledge purposes, this means that the meaning-making of scientific knowledge is constructed in the presence of other individuals, who are socially engaged in conversations, talk, discussions and shared tasks or responsibilities. This means that the learning of science entails first the personal level of knowledge construction, which is then followed by the social level, where a learner is introduced to and is gradually being socialised into the concepts, symbols, practices and scientific discourse community in the science classroom, thus entering into a different way of thinking about and understanding of the natural world (Lemke, 1990). Accordingly, for the integration of IK in the science classroom, knowledge construction must be extended beyond personal empirical enquiry, as learners must be experientially guided through teacher interventions, to concepts and models of science and be able to acknowledge their relevance and be able to apply them to everyday life (Rogoff & Lave, 1984). Learning takes place as less experienced and less skilled individuals are ushered into a world of symbols by the more skilled members or the more knowledgeable other (MKO). In order to do this, it means tasks must be redefined and restructured to the levels of the less experienced individuals, thus simplifying them so that they can understand, perform and internalise processes and tools for later use (Bruner, 1985). Learning is assumed to involve the shifting from the existing mental capability to a higher potential mental capability. This shift is what Vygotsky refers to as the Zone of Proximal Development (ZPD).

2.2.1 Zone of Proximal Development

Vygotsky believed that there is a space between what the learners can easily do on their own, without being helped and that which they can only do with the mediation, support and help from the more capable peers. The concept of ZPD emanates from this distance that exists between the actual developmental levels and potential developmental levels. The actual developmental level is achieved when the learner becomes able to solve learning-task problems independently and the potential developmental level is achieved when the learner becomes able to solve problems under the guidance, cooperation and help from the MKO (Vygotsky, 1986). In this concept, Vygotsky (1986) maintained that there are concepts that learners can easily master on their own, without being assisted. However, there are other concepts that the learner cannot just master, unless they are assisted by adults or other learners who are more knowledgeable than them. The more capable others in the learner's social environment in today's world include parents, teachers, community members, other learners and friends and also technology. ZPD, in turn, entails forming a bridge between what is known and that which is unknown. Pre-existing knowledge is crucial in ZPD, and encompasses all the knowledge, skills and capabilities that have not yet been acquired, but which can be acquired with support from the capable others.

The mind of an individual plays a very important role during the thinking, assimilation and accommodation processes of knowledge. It is one tool that is capable of functioning either at a lower or higher mental level, based on the level of support that has been received. The higher mental processes include the ability to re-arrange information and use it to solve problems, keep the information for later reference and recall it when needed (Vygotsky, 1978).

When there are skilful others providing support to the learner, his intellectual ability is able to improve (Rogoff, 1990). For this to take place, a MKO must be available to offer support and guidance to the learner. This support is, however, not permanent, but will gradually cease to exist as the learner also gradually masters and acquires the skills being taught. This means that, when a teacher offers help and support to the child during the learning process, this help is gradually withdrawn, and this assists the learner to achieve great performance results. At this stage, the mediator serves as a link, providing experiences that will help learners to constructively learn and pose questions that will further the learners' thought process. (Mason, 2003). He further asserts that mediation bridges the gap between cultural divides and improves the learners' self esteem. By fostering understanding, trust and empathy, mediation provides a platform for teachers to teach and for learners to learn (Mason, 2003).

In simple terms, a scaffold is the temporary structure that one finds in places where new and strong buildings are being constructed, and they are set up to offer support to the new structure that is being built. As soon as the new structure can stand on its own, the scaffold is removed. The availability of scaffolding in the form of providing support and assistance assists to improve a lower mental level to a higher mental level (Vygotsky, 1978). For learners to be able to acquire scientific ways of thinking, the intervention and negotiation with an authority or the MKO, that is the teacher, is significant (Wing-Mui, 2002). He further argued that the teacher must play two major roles, that of introducing new ideas or cultural tools where necessary and providing support and guidance for learners during meaning-making process, and secondly to listen to and be in a position to diagnose the ways in which the instructional activities are being interpreted so as to inform further action. The teacher will continue to offer help and support until the learner masters the new content that is being learnt.

2.3 Conceptualisation of Indigenous Knowledge

In this section, the concept of indigenous knowledge is explained. This leads to the exploration of a relationship between teachers' conceptions of IK and the science classroom teaching and learning practices. Important studies on science teaching and learning in multicultural, disadvantaged or township environments are also explored.

Vhurumuku and Mokeleche (2009) described IK as the knowledge itself and that "IKS is the cultural matrix in which IK is enmeshed and stored and should include understanding of nature of science" (p. 98). It is the end-product of many years of shared experiences, customs and values, and spiritual and cultural beliefs including traditions, which have been transmitted by local people to future generations by means of word of mouth, paintings, and writings or sometimes by other artefacts (Stevenson, 1996). IK is the knowledge and skills together that are harboured by people living in a certain area that has enabled them to thrive throughout the years, in their natural environment (De Beer & Whitlock, 2009). It envelopes learning about agriculture, fishing, forest resource management, climatology, architecture, teaching, engineering, medicine, veterinary science and pharmacology (Odora-Hoppers, 2002). It also serves as the basis for local decision making in a number of activities, such as clothing, agriculture, healthcare, food preparation, learning and natural resource management. IK is embedded in the social, cultural, ethical and spiritual environment of its particular society. The success of the development of this IK lies entirely on its oral intergenerational transfer (Raseroka, 2002).

The way the learning process is perceived to take place is takes specific culture into consideration. Matike (2008) stated that different communities have different cultures, and each culture has its own way of interpreting and experiencing its own natural environment. These informal, culturally- and locally-based ways of learning are regarded as the people's traditional ecological ways of producing knowledge, as they include socio-economic complicated information, understanding, perceptions and interpretations that guide them as they interact with their environment. The African people, like all local and indigenous communities of the world, had developed their own sets of experiences and interpretations and explanations pertaining to their environments (Mosimege, 2004). This took place long before the European colonialists and missionaries introduced the Western education system to Africa. This, briefly, means that the coming of Western knowledge systems to Africa did not in any way symbolise the beginning of ways of knowing and knowledge production. This had been in existence already, and their future therefore does not depend exclusively on it. This is called African indigenous knowledge and is used by African people in agriculture and animal husbandry, hunting, fishing, natural resource management, conflict transformation, health, interpretation of natural phenomena and in developing strategies to cope with environmental instability (Semali & Kincheloe, 1999).

IK is a multifaceted and multidimensional concept. As a result, the definition of what constitutes IK can be viewed differently, as it is dependent on the theoretical lens through which it is viewed. According to the CAPS document, IK can be viewed as "a body of knowledge embedded in African philosophical thinking and social practices that have evolved over thousands of years" (Department of Education, DOE, 2002:9). At school level, IK can be viewed as the knowledge possessed by different stakeholders, like the teachers, learners and parents, about their socio-cultural environment, including educational policies and cultural norms (Ford, 1992). When viewed at classroom level, IK entails the knowledge possessed by teachers and learners about the manner in which they perceive their own culture and those cultures different from theirs, and how the teachers view classrooms as social contexts (Cochran-Smith, 1997). On the other hand, IK is viewed as that long-standing, localised and unique knowledge found in a particular culture or society, which has been acquired through the building up of experiences, informal experiments, and the intimate comprehension of people inhabiting that specific ecosystem (Warren & Rajasekaran, 1993; Onwu & Mosimege, 2004).

By drawing from the definitions above, the current study conceptualises IK as the knowledge of learners' diverse socio-cultural contexts that they have developed through interactions with one another and with their local environment. On this note, science teachers are urged to prioritise understanding the diverse socio-cultural contexts from which their learners come in order to make the instructing and learning of science effective.

For purposes of this study, the term *indigenous knowledge* will be used to specifically refer to African indigenous knowledge, since this study takes place in Africa. The researcher wishes this choice not to be viewed as meaning that other racial groups in Africa do not have IK, but this was done to show the boundaries of this study.

2.3.1 The Nature of Indigenous Knowledge

A number of indigenous knowledge characteristics have been identified by various authors, but for purposes of this study, the ones mentioned below, as identified by Barca and Arenas (2010), will be discussed. IK is intimately associated with the local area and to day-to-day living. It has its basis and its roots on what takes place in a certain specific place, at a specific time. The people who gather it together and generate it must be living in that place during that given time of knowledge production (Ogunniyi, 2004; Baumwoll, 2008). IK displays what takes place in people's lives during their daily practical interaction with their environments. Its production and reinforcement are based on day-to-day trial-and-error and are a consequence of this practical engagement (Grenier, 1998).

IK is context-dependent. It has social, technological, political, moral and cosmological implications for the local people’s beliefs and behaviours, because it is embedded in the social, cultural and moral setting of a specific community of people. The ways of knowing are based on locally, ecologically and seasonally contextualised truths (De Guchteneire, Krukkert & Von Liebenstein, 1999; Maurial, 1999).

It is unique to a given location, culture or society (Onwu & Mosimege, 2004). There are certain socio-cultural environmental criteria that the elders of the specific community set that the IK production must meet before it can be considered valid, and this validity is only based in that specific area where it was produced, and tends to lose its relevance, application and meaning if it becomes displaced. What is regarded as important knowledge by the local people does not necessarily mean that it will be important for everybody living in another place. Most scholars agree that applying IK to another place runs the risk of devaluing and dislocating it.

The transmission of IK does not take place in a formal classroom situation, as it is the case with Western knowledge. It tends to be informal, taking place during those face-to-face daily interactions, which include, among others, observation, modelling and apprenticeship (Stevenson, 1996; Grenier, 1998; Kibirige & Van Rooyen, 2007). IK is also orally-transmitted from generation to generation via individuals whom the community specially selects and prepares for this special and significant role (Agrawal, 1995; Senanayake, 2006). This means that this kind of knowledge is found mainly in people and is not systematically documented in written form in books, academic journals and articles in schools or universities. Hobart (1993) postulates that it is preserved in the memories of certain individuals, who may exist by virtue of their ritual or political authority.

IK accepts a profound spiritual association among people and nature. It reflects a special relationship that local people have with the space that they live in. There is a general belief that is shared by indigenous people that all things are sacred and are part of a whole. This confirms their view that material and spiritual realities converge upon nature. Indigenous people give nature a special place in their lives and they view it as an integral whole that needs to be well taken care of and nurtured, and that it takes care of them in return. This means that nature is viewed as a supernatural being and a living phenomenon.

2.3.2 The tenets of the Nature of Indigenous Knowledge

Different authors in the science community have given a number of definitions in an attempt to define the nature of indigenous knowledge (Aikenhead & Ogawa, 2007). However, from all their definitions, as mentioned above, there are general characteristics that usually stand out and they tend to agree on most of them. Cronje et al. (2015) stipulated that these general characteristics correspond with their suggested tenets or principles of the IK framework, as stated below.

Nature is viewed as a real entity, with empirical evidence that is partly or generally tested and observed. It is validated by needs-based experimentation, in order to be confirmed or dismissed. The universe is seen as orderly, partly predictable (Agrawal, 1995; Le Grange, 2007) and "embraces both testable and non-testable metaphysical phenomena" (Ogunniyi, 2011, p. 106).

IK has withstood the test of time, and has been in existence for thousands of years, but, because it involves people's experiences, it is not fixed, but is constantly showing signs of change; it is fluid and transformative. When new knowledge emerges and becomes available, the existing knowledge must be reshaped, redefined, modified or edited (Mphahlele, 2002). The repository ways in which the community elders engage, in order to obtain knowledge, are regarded as the truth and must not to be challenged (Senanayake, 2006).

The IK facts are testable and can be experimentally observed. An inference is a conclusion, a claim or a statement that plays a very important role in explaining and clarifying the causes of what has been observed (Ramnarain, 2010; Porter, McMaken, Hwang & Yang, 2011), and an observation is a descriptive statement made using the five senses, or other modern technologies, like microscopes, and based on the evidence of nature, to describe natural phenomena, and which other people can also access, observe, measure and confirm **(**Lederman, Abd-El-Khalick, Bell & Schwartz, 2002). The events that take place in nature have both natural and unnatural causes, and metaphysical dimensions are very important (Le Grange, 2007, Senanayake, 2006).

The generation of knowledge in IK is not limited to making observations and conducting needs-based experiments, but also involves the ability of human beings to invent creative and original explanations, imaginations, metaphors and myths (De Beer & Van Wyk, 2011).

The understanding of nature and the origin of the universe, together with culture and the spiritual are very important in IK. Because IK has a human activity status, it has a subjective component which is unavoidable. This means that facts do not necessarily influence the keepers of knowledge, but it is mainly their previous ways of knowing, their personal backgrounds, their feelings, their biases and their beliefs (Aikenhead & Ogawa, 2007; Ogunniyi, 2004).

IK is generated as people continue to engage in daily collaborative interactions with nature, at a particular place. This means that IK is a human activity that relates to people's habits, traditions and beliefs, and it exists within and is shared and practised by certain people within a social and cultural environment. It is locally rooted and is ecologically-based, and it involves transmission and acquisition requires word-of-mouth. After being generated, generalisations are made and shared among local and sometimes international communities (Agrawal, 1995).

The trial-and-error practices during the daily practical interactions play a major role in IK development. The methods that are employed to improve retention and reinforcement involve repetition, imitation and ceremonies and rituals, so as to ensure that the knowledge and experience can be used to make good decisions and judgments. When new information emerges, it is not just dismissed but it is put into a test in the "laboratory of survival" (De Beer & van Wyk, 2011; Senanayake, 2006; Aikenhead & Ogawa, 2007).

IK is not constructed for the "what-and-why" things taking place, but also engages in what ought to happen in nature. This means that more emphasis is put on usefulness and practical skills, as it involves peoples' daily lives, instead of facts, theories and laws (Agrawal, 1995; Aikenhead & Ogawa, 2007).

Multiple knowledge systems make up IK, and they include science, religion, psychology and many other fields, and hence Ogunniyi (2007a: 965) speaks of a "conglomeration of knowledge systems". In the event of complex challenges, the whole or holistic method is applied, meaning, IK approaches them not in smaller parts, but in a holistic manner, without being limited by boundaries with the metaphysical world (Senanayake, 2006; Agrawal, 1995***).***

2.3.3 Comparing indigenous knowledge with western knowledge worldviews

The manner or way in which we make sense of and construct personal understandings of the world we live in is called worldview (Keane, 2008). Aikenhead (1996) postulates that there are other alternative ways or worldviews of knowing that would assist indigenous learners in townships, urban and reserved environments, instead of always centralising the Euro-Western scientific worldview. In this study, two worldviews are presented, the indigenous knowledge (IK) and Western knowledge (WK) worldviews. These worldviews have been found to be crucial in teachers' decisions about classroom practice (Water-Adams, 2006).

De Beer and Van Wyk (2011) highlighted the importance of comprehending the distinguishing characteristics of IK and Western science, as well as the similarities between the two ways of obtaining knowledge. This knowledge assists in developing ways of how the knowledge from the two frameworks can be brought together to make a superior comprehension of the natural world. Indigenous knowledge and Western science represent two different ways of viewing the world around us. The goal of Western science is to understand the natural world through the study of individual parts. On the other hand, IK seeks to understand the world in a more holistic way through the observation of connections between all parts. Due to these differences, there is a great potential for IK to complement the Western science system (De Beers & Van Wyk, 2011).

With the emerging new science curricula that place more emphasis on the integration of IK, it is important to take a moment and look into the role of both worldviews, that of the teacher and that of the learner, in science teaching and learning. One of the prerequisites for knowledge integration is an understanding of the similarities and differences between the two knowledge forms, IK and WK worldviews (Davis, 2006; Barnhardt & Kawagley, 2005). Although IK is different from WK, it still remains scientific. The teachers, as implementers of the curriculum, have total control of what takes place in the classroom. Accordingly, if the IK to be integrated does not fall in line with or contradicts the original deep-seated worldview held by the respective teacher, the chances are the teacher will feel hesitant, resist or even refuse to integrate IK in the science classroom. The worldviews form part of an individual's set of culturally-based views, perceptions, understandings and assumptions about the nature of the world we live in (Nyawaranda, 1998). This means that those worldviews that are culturally dependent tend to influence the basic state of mind. Likewise, when the learner's worldview is different from the WK worldview, the science being taught in the classroom becomes abstract and unfamiliar to him or her. Learners' worldviews are said to impact their learning (Cobern, 2000) and understanding (Hewson, Javu & Holtman, 2009) of science greatly. Snively and Corsiglia (2001) argued that all the problems of integrating IK into the science classroom are greatly based in IK and WK worldviews. Based on this, Odora-Hoppers (2002) postulated that to integrate IK in a legitimate manner calls for a thorough and careful exploration of the learners' underlying worldview. For purposes of this study, the IK and WK worldviews will be examined separately, in their standalone status, so as to obtain an intense, comprehensive and in-depth comprehension of the nature of each worldview. Another reason is to build up a platform for comparison of the two worldviews, while establishing how they speak to each other, including their convergent and divergent sections. Le Grange (2004) revealed that IK and WK can work together, as they complement one another and are not in conflict with each other. This was confirmed by Onwu and Mosimege (2004) who postulated that IK and WK could be taught together in the science classroom (Davis, 2006).

One of the differences between IK and Western knowledge (WK) lies in the context. WK is decontextualised, meaning that it is not specific to a content or culture (Kibirige & van Rooyen, 2007). WK is universal and transcends national and cultural boundaries. IK on the other hand is contextualised, meaning that it is specific to a particular people. IK is generated locally and demonstrates the social and cultural values of the community. Another difference that is highlighted by Masemula (2014) is that WK is materialistic, meaning that it investigates objects. Scientists conduct experiments or investigations as they solve problems. On the contrary, IK is spiritual, meaning that it is rooted in a strong belief system. Practitioners of IK observe nature to generate knowledge and give explanations about their observations. These explanations do not always have natural causes that are predictable.

IK is rooted in a strong spiritual belief system. The practitioners of IK observe nature in order to generate knowledge and give explanations about their observations. These explanations do not always have natural causes that are predictable. WK is materialistically-based. It investigates objects. Scientists conduct experiments or investigations when trying to solve problems.

Masemula (2014) argued that WK follows a reductionist approach, where the focus is on the main problem, while IK takes a holistic approach in which practitioners look at other probable sources when solving problems. The generation of WK and IK also marks a major difference between the two forms of knowledge. Western knowledge is not usually generated in a community but by individuals at different places, while IK is generated in the local community by the people and is practised in the community. IK uses in-built, intuitive and natural instinct to solve problems, while the WK uses a rational approach, taking balance, coherence and a logical approach to solving problems. IK is cooperative in nature, while WK is competitive in nature.

IK places emphasis on the communal, as it is generated in the local community, by the people and is practised in the community. It cherishes a way of existing, and being part of a community, which entails complex relationships. At the individual level, Nziramasanga (2012) postulated, it inculcates the values of honesty, care, good manners and being considerate of others. WK places emphasis on the individual, as it is not usually generated in a community, but by the individual at different places. IK views time as circular, while WK views time as linear.

An IK worldview upholds connections and the interrelatedness of the natural (human, land, water and animals) and the metaphysics (intuition and spiritual). This means that it is sacred and secular, and includes the spiritual. This knowledge has limited documentation and is stored orally, in local "human archives" (Otulaja, Cameron & Msimanga, 2011), in cultural practices and artefacts, and possesses powerful predictability in local areas. WK views knowledge as secular only, often excluding the spiritual component. It is accessible from books and computers, and has powerful predictability in natural principles (Sethole, 2007).

The objectives of IK include, among others, cultural and ecological sustainability, for practical use and application in everyday life and integration of critical thinking and cultural values in decision-making. The objectives of WK include economic stability, abstract knowledge to obtain good marks in examinations and integration of logical and critical thinking in making decisions (Harding, 1998).

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The methods of instructing and learning of IK include learning through experience, teaching through example, modelling, ritual and storytelling, and IK is tested in practical life situations. In WK, learning takes place by formal education in classrooms and laboratories, teaching through abstract concepts and didactic methods and is tested scientifically in examinations.

The highlighted differences between WK and IK are crucial for this study as they assist in developing strategies for integrating the two types of knowledge in the teaching of science. Having established the differences, it is crucial to establish the views of different researchers on the integration of IK in the science classroom

2.4 Integrating Indigenous Knowledge in the Science Classroom

The learning of science in the classroom entails entering into and acquiring a new culture (Driver, Asoko, Leach, Scott & Mortimer, 1994). They further stipulate that the home and community environment from which learners come is a culture on its own. It means that the learners are moving to and fro between two cultures. This therefore shows that the need for the integration of IK in the science classroom goes beyond curriculum requirement. If the classroom science culture harmonises and does not clash with the learners' indigenous knowledge culture, the learning of science will be effective, as it will be supporting their worldview. Owusu-Ansah and Mji (2013) regarded culture as the "lens" one uses to understand and interpret one's reality. Accordingly, Cronje et al (2014) argued for the need for South African teachers to incorporate IK into their lessons. A number of scholars have advocated for the integration of IK into science teaching and learning. By incorporating learners' socio-cultural backgrounds, that include their day-to-day experiences, beliefs, socio-cultural practices and their rich indigenous knowledge system (IKS), in the teaching of NS, teachers tap into the strengths that the learners bring to the science classroom (Mavuru & Ramnarain, 2014; Msimanga & Shizha, 2014). This could add toward the comprehension of problematic science concepts and an understanding of the subject matter (Pretorius, De Beer & Lautenbach, 2014), hence the urgent call for teachers to integrate IK into science classroom teaching.

Masemula (2014) stated that the currently held notion of what knowledge is and what education ought to be taught in the current Western-dominated science curriculum was constructed without involving millions of African indigenous people, who remained voiceless and did not participate in making decisions during the formulations of constitutive roles or forces that bind them. Thus, in an attempt to integrate IK, it is of utmost importance to comprehend the original ideas about education and knowledge, taking into consideration what the indigenous people of Africa regard as knowledge, how they produce knowledge and what they use knowledge for.

In the African context, integration of African indigenous knowledge (AIK) entails an attempt to use African knowledge, practices and African ingenuity to inform African education and to enhance problem solving in Africa. This integration of IK into science was a chance afforded to African people to share with the rest of the world what they had always known but were unable to because of colonisation (Odora-Hoppers, 1998). It is a way of addressing what Odora-Hoppers (2004) calls 'knowledge apartheid'. The integration of IK improves the effectiveness and relevance of education as indigenous learners can relate what they are learning to what they already know regarding their experiences, language and customs (Hamilton-Ekeke & Dorgu, 2015). In this way, learners grow to love, appreciate and respect different cultures.

At classroom level, the integration happens when teachers infuse WK concepts with the learners' IK conceptions and use that to teach science (Trumper, 2001). He further argues that reforms in science education call for teachers who are well-versed with science content, process and enquiry teaching. The challenge with this is that most teachers' views about IK are inadequate, as they were only exposed to western science during their schooling and training years (Tosun, 2000).

Despite the teacher challenges expressed in literature, many countries throughout the world, like Japan, Australia, Canada and America, have adopted multicultural science education. Likewise, several African countries, including South Africa, have undertaken curricular reforms in science education to address multicultural classrooms and to render due recognition of other ways of knowing about nature.

There is explicit postulation in the CAPS NS curriculum to integrate IK into mainstream science, but there is hardly any indication or guidance as to how this integration could be achieved, and neither are there available reference teaching materials to use. In Sheya's (2014) research study conducted in selected schools in the Northern part of Namibia, the integration of IK to support environmental education in rural schools was investigated. The review of curriculum documents revealed that Western values were continually being reinforced at the expense of IK. IK was found to be ignored, underutilised and not given the recognition it deserves as a source of knowledge for sustainable development. Likewise, Katonga (2017) sought to investigate to what extent the primary teacher education-integrated science courses address IK in both content and actual teaching practices at a college of education in north-western Zambia. The findings in this study revealed that there was a gap between the firm theoretical pronouncements of education indigenisation policies to IK integration and the actual practical formal education, thus leading to the Gray nexus between theory and practice. The same results were found in a study by Sakayombo (2014) that revealed that IKS was to a greater level not integrated into the teaching of agricultural sciences in secondary schools in Zambia.

The textbooks that are prescribed for teachers and learners to use also lack effective IK integration. The findings in the study by Moloto (2012) that analysed three purposefully selected NS textbooks showed that representations of IKS in all three were minimal, naive and implicit, and therefore did not respond well to this mandate.

The integration of IK is also affected by the fact that science teachers do not have the desired and adequate conceptions of IK. Seehawer (2018) sought to explore whether and how IK could be integrated into the Grahamstown's teachers' daily classroom practices. The study revealed that teachers do not have the desired understanding of IK, but the integration at both primary and secondary grades was possible as the communities from which the learners came were used as reference resources. Hence, the study argues for a bottom-up approach to IK integration and to the decolonisation of education.

From the studies discussed above, it can be deduced that science teachers do not integrate IK in their classrooms. In some studies, some teachers claimed that they were integrating IK in their lessons, but the findings proved otherwise. In Nnadozie's (2009) qualitative study, in which the integration of IKS in the teaching of the conservation of biodiversity and natural resources by Grade 10 Life Sciences teachers in the Pinetown district of KwaZulu-Natal was investigated, an analysis of part one of data showed that 90% of the participant teachers who had indicated that they do integrate IK in their science teaching had no evidence of a proper understanding of this integration in their teaching, and could therefore not be seen as cultural brokers. An analysis of part two data showed that they had a limited understanding of the principles and ideas upon which IK could be integrated into the Life Sciences curriculum.

Reddy, De Beer and Petersen (2017) aimed to investigate the integration of Indian IK into the South African Life Sciences curriculum. The findings in their study showed that teachers were fully aware of the value of IK, especially IKS, and they fully supported its integration, but the many challenges that they face when it comes to integration make the process of integration a difficult task to pursue. These teachers also had inadequate conceptions of NOS and were therefore not in a position to assist their learners to understand that IKS can be accepted just as scientific concepts are accepted.

Visagie (2016) conducted an interpretative case study, in collaboration with a rural community in the Erongo region as he aimed to understand how two Grade 6 NS teachers use the local IK to teach the topic of water conservation in their classrooms. It was revealed that the IK among the Topnaars is governed by the principles of 'ubuntu', and that proper planning is crucial in order to successfully integrate IK in science lessons, to clear up misconceptions that may arise as a result of IK. The same results were found in a study by Sakayombo (2014) that revealed that IKS was to a greater level not integrated into the teaching of agricultural sciences in the secondary schools in Zambia.

One of the popular debates in South Africa about a culturally relevant science curriculum is the affordances of IK-integration in the instructing and learning of science. This aspect of IK-integration has been debated the world over (Barnhardt & Kawagley, 2005). Snively and Corsiglia (2001) maintained that the integration of IK has made significant contributions to science education. The next section explores these benefits or affordances of integrating IK into the science classroom.

2.4.1 Affordances of indigenous knowledge integration

Aikenhead and Ogawa (2007 defined education as the engagement of learners and educators in an effort to mutually construct meaningful knowledge. Findings from studies conducted in the area of education have established that indigenous people possess deep knowledge of the environment in which they reside (Msimanga & Shizha, 2014). The occurrence of effective and meaningful learning requires taking into account these indigenous knowledge systems through integration into the formal school system. The calls for the integration of IK into the science curriculum have become a very popular trend in South Africa and beyond. Science teachers are expected to employ cultural relevance corrective measures in an attempt to align science education with indigenous cultures (Snively & Corsiglia, 2001). Many labels such as "cross-cultural" (Aikenhead, 2000), "culturally-sensitive" (Jegede & Aikenhead, 1999), "multi-cultural" (Cobern & Loving, 2001) and "culturally-responsive" (Castagno & Bradboy, 2008) have been attached to the teachers' practice of indigenising the science curriculum. For purposes of this study, the integration of IK into the science curriculum is conceptualised as *cultural-enhancement of the science curriculum*.

To date, the science education taught in classrooms in African schools, particularly in South Africa, is mainly Western-oriented (Makhurane, 2000). Before looking at the possible strategies for IK integration, it is important to look at the benefits or affordances of IK integration in science instructing and learning, as there can be no effective IK-integration in African schools without the acknowledgement of IK and its affordances in socio-cultural, political and economic development (Msimanga & Shizha, 2014).

Reddy, De Beer and Petersen (2017) posited that the integration of indigenous knowledge in the formal school curriculum also assists in creating harmony between the two bodies of knowledge. Educators will find the opportunity to utilise what is available from the immediate environment in teaching learners. On the other hand, learners will have the opportunity to comfortably relate what they would have learnt in school with their real-life experiences, which in turn enhances effective and meaningful learning (Nnadozie, 2009). There will no longer be a restriction of formal learning to what is learnt in the classroom alone but will also encompass every bit of the daily experiences of the learner.

Integrating IK in science teaching and learning enhances the content that is being taught and learnt in the classroom. Accordingly, the findings from Nnadozie's (2009) study revealed that the integration of indigenous knowledge into the formal school system will assist in enhancing the richness of academic content. When African and Western knowledge systems are afforded equal opportunity in the academic arena, academic knowledge becomes a body of knowledge that is more integrated, embracing different forms of thought and knowledge.

The benefits of integrating IK in the science classroom cannot be underestimated. This was confirmed by Kuhlane's (2011) study that aimed to investigate the benefits of eliciting and integrating learners' prior knowledge and experiences during the teaching of acids and bases. This study was conducted in a small public school in Grahamstown, among 38 Grade 7 learners. The findings revealed that using learners' prior knowledge that learners enter into the classroom with assists in facilitating and making the process of learning meaningful, and also enabled them to learn the so-called difficult scientific concepts and terms with ease and in a more relaxed atmosphere.

The integration of IK into the science classroom signifies transformation in the new education system, especially for South African teachers, who are faced with multicultural learners every day in their classrooms. IK enables learners to be actively involved in the construction of their knowledge, and be able to share what they already know, thus promoting identity awareness among learners. IK plays a significant part in forming a relationship or a link between what the learner is learning in the classroom and what the learner already knows before entering the classroom, as IK harmonises itself with the learners' experiences that are characterised by their worldviews (Shizha, 2006). This means IK is important for changing the abstract notion of science into more relevant and meaningful science content. When learners realise the importance or relevance of what is learnt in class, the level of interest increases, thus positively impacting learner performance.

Van Wyk (2002) postulates that integrating IK fosters cultural, social and identity perspectives into an education system that acknowledges learners' prior knowledge and experiences. Learners will therefore obtain a firm foundation in their education by receiving the opportunity to recognise their identity and begin to place value on their own knowledge and have the ability to connect it with other knowledge systems. The education of learners will no longer be directed solely towards Western patterns of thought, but will now be balanced between African and Western knowledge systems (Nnadozie, 2009).

Reddy et al. (2017), in the findings of their study, stipulated that teachers were fully aware of the value of IK, especially IKS, and they fully supported its integration, but the many challenges that they face when it comes to integration makes the process of integration a difficult task to pursue. Despite all intense advocacies for and affordances of IK-integration alluded to by previous research, this integration has to this end not been translated into tangible and observable classroom practices in the teaching and learning of science in many parts of Africa (Ogunniyi, 2011). Hewson and Ogunniyi (2011) postulated that this lack of integration can be viewed as the result of the presence of underlying threats and challenges experienced by teachers during IK-integration. The following section explores the nature of these challenges that teachers experience as they integrate IK into their science classrooms, which has led to the lack of effective IK integration in the teaching and learning of science.

2.4.2 Possible teaching strategies used in indigenous knowledge integration

This section explores the various instructional tecnhiques in which IK can be integrated into classroom science education. Khupe (2014) suggested that educational policies should recognise the value of IK in the science programme. There is a need for the curriculum to include the indigenous knowledge systems and practices of the learners. Nnadozie (2009) highlighted the need for textbooks and other resources to be designed in such a way that they take into account the practices and activities of the indigenous people. The designing of instructional materials should take into account local settings. There should also be the compilation of stories relating to the ways in which indigenous people engage in scientific practices for use in classrooms. This calls for educators to draw up from their indigenous knowledge when teaching in the classroom.

Township schools and their learners are historically viewed as disadvantaged, since most of the learners come from disadvantaged backgrounds, and the schools lack a number of crucial resources essential for the effective teaching and learning of science. Previous research has revealed that teaching strategies are very important for effective teaching of science and teachers at all levels; science teachers in township schools included are feeling the need to indigenise the curriculum and decolonise the teaching and learning of science by integrating IK in their classrooms (Abell, 2007). This means that it is imperative that these teachers develop teaching strategies that take cognisance of the different cultural perspectives that are found to exist in today's science classrooms. To do this, teachers must acknowledge the ability of learners from multicultural social contexts to contribute to scientific understanding and experiencing of the world. This section explores the ways and possible teaching strategies in which IK can be effectively integrated in a classroom environment that is poorly resourced and with learners from diverse social contexts. Sjoberg and Schreiner (2010) pointed out the need for education to take the form of dialogue between teachers, learners, and researchers, which will assist in empowering local students.

Reddy et al. (2017) indicated that there is a need for ensuring that science textbooks incorporate the several contributions that IK has made to long-established indigenous communities to Western culture. Textbooks and other resources need to be designed in such ways that they take into account the practices and activities of the indigenous people (Nnadozie, 2009). In the South African context, the manner in which IK has been integrated into textbooks has been mainly the traditional bits and pieces that fit only to some sections of the textbook chapters, while other chapters are ignored (Keane, 2008).

The involvement of elders in science education was highlighted by Khupe (2014) as an effective strategy that can be used for the successful integration of IK into classroom learning. Khupe (2014) described elders as individuals who are respected and have amassed a great deal of knowledge, wisdom, and experience. They are looked upon by the community for sound judgement and guidance. According to Nnadozie (2009), the wisdom that the elders possess is central to cultural learning. The involvement of elders in education assists in generation gaps created by the legacies of residential schools. Elders should be recognised as deeply entrenched in educational foundations and they should therefore actively participate in the instructional activities and be given professional treatment.

The designing of instructional materials should take into account the local settings. There should also be the compilation of stories relating to the ways in which indigenous people engage in scientific practices for use in classrooms. This calls for educators to draw up from their indigenous knowledge when teaching in the classroom. On this note, Nnadozie (2009) pointed out the need for teachers to possess adequate information about the concept and practice of IK, as well as its place in education today. This calls for teachers to conduct research on IK, particularly on IK that is found in the local areas where they teach and where their learners come from. This research will assist them in becoming familiar with the knowledge of the learners and come up with better ways of integrating this knowledge into their lessons. There is also a need for teachers to have a thorough understanding of the contents of the curriculum document on IK and its integration in formal learning.

The findings in the study by Sheya (2014) revealed that three very different approaches were used in order to interpret and implement the curriculum. These approaches were an assimilation approach, that brings IK into science teaching and learning by seeking best of ways in which IK fits into science: a segregationist approach, that holds IK side-by-side with WK in the classroom; and an integrationist approach, that makes links and connections between IK and WK in the classroom. This study further suggested that IK-integration requires slight movement away from the current strong subject-based, content-focused and examination-driven curriculum into a cross-cultural science technology and society (STS) curriculum framework, that provides a diverse context allowing for equitable comparison of all knowledge systems.

Jegede's theory of collateral learning has been suggested in Le Grange's (2007) study as an IK-integration strategy to enhance the learning and teaching of science. In his study, he further suggested that learners should be exposed to opportunities to exhibit and interact with the IK they bring to the classroom.

The discussion of the literature on possible strategies for IK integration is crucial for the current study as it will assist in coming up with ways of ensuring that the two perspectives can be combined for the benefit of learners. By so doing, teachers will find readily available material that they can use in the classroom to integrate IK into the instructing and learning of science.

2.4.3 Teachers' views on indigenous knowledge integration

Previous research (Timba, 2000; Mothwa, 2011; Akerele, 2016) showed that primary and secondary school teachers hold naïve views of some of several important aspects of the nature of IK. Therefore, there is a need to explore teachers' views on the nature of IK and also to ensure they have the desired understandings of the nature of IK, and this is based on the assumption that teachers' conceptions directly translate into their teaching practices (Lederman, 1992; Abd-El-Khalick et al., 1998; Koksal & Cakiroglu, 2010). This means that one way to improve the implementation is to ensure that teachers have an informed state of mind, a clear understanding and assimilation of the new curriculum that is being introduced (Du Plessis, 2013). Further to this, if the teachers' views about the integration of IK into the science classroom are explored and understood, it will be easier to find ways of addressing challenges associated with its integration. Previous research has highlighted the importance of exploring teachers' views and the influence of these views on their planned and enacted instructional practice in the classroom (Richardson, 2003). Documenting teachers' views about the integration of IK may even lead to the development of IK instructional strategies in the science classroom.

According to Hancock and Gallard (2004), views are a personally constructed understanding held by an individual about the nature of knowledge of a particular discipline that guide that particular individual's intentions for action.

There is an urgent need to pay more attention to the philosophical underpinnings, views and convictions of NS teachers on the nature of IK before recommending appropriate instructional strategies to employ when incorporating IK into the science classroom (Vhurumuku & Mokeleche, 2009; Cronje et al., 2014). Vhurumuku and Mokeleche (2009) also recommended in their critical review of research in science education study that future research should focus more on teachers' views on the nature of IK and its integration in science teaching, among others, at primary and secondary school science classrooms, since this area is under-researched in South Africa. There is, therefore, a need to explore teachers' views on the nature of IK and also to ensure they have the desired understanding of the nature of IK. This is based on the assumption that teachers' conceptions directly translate into their teaching practices (Lederman, 1992; Abd-El-Khalick et al., 1998; Koksal & Cakiroglu, 2010).

The purpose of the study by Mhakure and Mushaikwa (2014) was to research science teachers' IK identities in relation to the professional development programme, produce the instructing and learning material so as to facilitate integration and to introduce the pre-service and in-service teachers to the construct of multicultural science teaching and learning environments. From the results, it emerged that five of the six teacher participants, after attending the professional development programme, experienced a shift from a Western science-based worldview that regarded IK as "backward" to a more equipollent worldview that viewed both WS and IK as equally important and equally valuable. Nnadozie's (2009) study also confirmed that the Grade 10 Life Sciences educators in the Pinetown district, in KwaZulu-Natal province harboured a restricted understanding of the principles and ideas upon which IK could be incorporated into the Life Sciences curriculum.

Reddy et al (2017) also conducted a study among Life Sciences teachers attending a short course on IK to determine their views and experiences on classroom incorporation of IK, focusing mainly on Indian indigenous knowledge (IIK). The VNOIK questionnaire and another questionnaire focusing on IIK and individual interviews were employed as data collection instruments. The findings in this study revealed that teachers harboured poor views of IK, and that the NOS and NOIK among teachers are not clearly understood. The qualitative study conducted by Jackson, De Beer and White (2016) also confirmed that teachers lack the necessary knowledge about IK, and they are neither familiar nor aware of the value of IK in the learning of science. Teachers were also found to exhibit negative attitudes and views towards IK in studies conducted by Shizha (2008). The aim of this study was to gain rural primary school teachers' views and insights into problems encountered in incorporating IK into the science curriculum. The ten in-service primary school teachers were purposively sampled, and semi-structured interviews were conducted.

Sakayombo (2014) said the need to integrate IK in agricultural sciences education in Zambia in order to reflect the local cultural settings could not be over-emphasised. The respondents to this qualitative study were purposively selected and interviewed so as to gain deep comprehension as to how IKS are viewed and integrated into their agricultural practice and teaching. Interviews, content analysis of the Zambia junior and senior secondary school agricultural sciences syllabi and non-participant classroom observations were employed as instruments. This study revealed that most respondents had a general understanding of IKS.

Previous research studies show that primary and secondary school teachers hold naïve views of some of several important aspects of the nature of IK. In a case study by Dziva, Mpofu and Kusure (2011), teachers' conceptions or views of IK in secondary school science education in the Mberengwa district of Zimbabwe were explored. The sample comprised five purposively selected science teachers from two schools. In-depth interviews and document analysis of homework and test exercise books, as well as teachers' schemes of work, were employed as instruments for gathering data. The findings of this study revealed that science teachers have a limited conception of IK. It also emerged that they harboured negative attitudes towards the integration of IK and they did not perceive IK as useful science content.

Nnadozie's (2009) study also confirmed that the Grade 10 Life Sciences educators in the Pinetown district in KwaZulu-Natal province harboured limited understanding of the principles and ideas upon which IK could be integrated into the Life Sciences curriculum.

2.4.4 Teacher challenges experienced during indigenous knowledge integration

Natural Sciences (NS) teachers in South Africa have struggled to cope with the introduction and implementation of a number of new policies and curricula within a short time after the first democratic elections (Cronje, 2011). Gouws and Dicker (2007) found that science teachers felt inadequately trained, and lacked the necessary knowledge and skills to meet the new curricula demands. As such, the South African education system was regarded as being in disarray in that respect (Antoniou, De Beer & Ramnarain, 2014).

In South Africa, the NS curriculum divides the teaching and learning of science into four main strands: Life and living, Planet earth and beyond. It is important to note that this fragmented approach to integrating IK in these strands as observed by Khupe and Keane (2014) provides a surface understanding and deprives the learners of an in-depth understanding of IK, considering the privileged status of WK (Snively & Corsiglia, 2001). This approach is viewed as contributing towards the lack of IK-integration into science teaching and learning.

Research shows that most science teachers do acknowledge that IK needs to be incorporated into the science curriculum (Msimanga & Shiza, 2014; Sjoberg & Schreiner, 2010; Aikenhead & Ogawa, 2007). However, this is still not evident in their lessons, as they still lack the know-how of how to integrate IK (Cronje et al., 2015; Cronje, 2011; Hlanganani & Motlhabane, 2014) and the motivation to do it.

Mothwa (2011) conducted an explanatory, mixed method research study where she focused on the Life Sciences teachers' lived experiences in incorporating IK in their science teaching in the classroom. The teachers responded to the questionnaire, which was commissioned by GDE, in the first part of this study. Based on their responses, an individual interview protocol was then set up, conducted, recorded, transcribed and then analysed. In addition to this, the researcher also did classroom observations and looked at the teachers', as well as the learners', portfolios, together with the Grade 12 examination scripts. The findings in this study revealed that teachers are facing a number of challenges related to the integration of IK in their lessons. Her findings are in line with a number of challenges that have been exposed by the literature (Mothwa, 2011; Sakayombo, 2014; Sheya, 2014; Visagie, 2016; Akerele, 2016), thus explaining why teachers are still struggling and still seem to resist or ignore the call to incorporate IK into their lessons in classrooms.

Based on the above findings, the integration of IK in NS SP classrooms still remains, to this end, a challenge, and there have been a number of multiple teacher challenges for integrating IK revealed by the literature despite the fact that teachers have received a number of professional developments on this aspect from their subject facilitators. Most of these teachers still do not attempt to integrate IK into their teaching and research is still ongoing on what could be the cause (Onwu & Ogunniyi, 2006).

This study conceptualises the various challenges derived from the literature (Mothwa, 2011; Reddy, De Beer & Petersen, 2017; Sakayombo, 2014; Visagie, 2016; Akerele, 2016; Sheya, 2014), that teachers are facing in the integration of IK in their lessons by grouping them into three levels: personal level, classroom level and integration level. The teacher challenges grouped at a personal level entail those challenges that emanate from the teachers' personal circumstances. This level includes challenges like teachers' views, teachers' schooling and training programmes, and teachers' lack of confidence. One major challenge stems from the inadequate views about the nature of indigenous knowledge that teachers harbour. In Ogunniyi's (2004) study, the findings revealed that most teachers struggle to understand the nature of science and that of their own IK. The teachers themselves have not been exposed to this type of training that includes IK. When teachers were attending school and also undergoing their teacher training, IK was never mentioned, and it was not part of their learning.

Those teacher challenges like the teachers' pedagogical content knowledge (PCK), teachers' use of instructional strategies, teachers' capacity to elicit learners' IK, a lack of resources and poor textbooks are grouped as teacher challenges at classroom level. These are challenges that teachers experience inside the classroom that hinder the integration of IK.

The integration level challenges encompass the many curricular reforms, the teachers' fear of being accused of teaching pseudo-science, the department's top-down approach, a lack of support from school management teams and district officials, and the poor professional development programmes. Integration challenges are those challenges that involve the process of IK-integration. The many curricular reforms that South African, including other African countries', science education has undergone has contributed to teachers' lack of understanding of what is expected of them and the resultant hurdles associated with the successful implementation of IK-integration in science classrooms. Most of the perennial problems as a result of these challenges have been orchestrated by the fact that curricular change is a difficult and problematic process (Davis, 2006). The findings from Sethole's (2001) study revealed that teachers were unsure of what their focus should be during the IK-integration in the classroom. To make matters worse, the policy directives stipulating the IK-integration in science classrooms lack a comprehensible guiding framework on how to bring about this integration, thus making curriculum interpretation difficult and almost impossible to achieve. This has led to many teachers losing confidence and the motivation to integrate IK into their science classrooms.

2.5 Relationship between teachers' views and classroom practice

Teachers' views are an important domain, particularly in this current study, as they are believed to have a strong bearing on what actually takes place during the integration of IK in the science classroom. The attempt to identify a relationship that exists between NS teachers' views and their teaching practice is a long-standing focus and point of interest for science education research, because it is believed that the knowledge that the teacher has will have an influence on what he or she does in the classroom (Saad & BouJaoude, 2012; Lederman, 1992; Abd-El-Khalick et al, 1998; Koksal & Cakiroglu, 2010). Ogunniyi (2004) further postulated that, if the teacher's understanding of indigenous knowledge does not resonate with his or her belief system or worldview, he or she will not be confident enough to integrate IK effectively in the classroom. Likewise, Lederman (2006) pointed out that a science teacher needs to have an adequate knowledge of what he/she is attempting to communicate and teach to his/her students. This means that one way to improve implementation is to ensure that teachers have an informed state of mind, a clear understanding and the assimilation of the new curriculum that is being introduced (Du Plessis, 2013). As already alluded to in 2.4.4, previous research shows that most teachers hold inadequate views about the nature of indigenous knowledge.

These undesirable or inadequate views impact negatively and lead to the lack of integration of IK during the teaching and learning of science in the classroom, The findings in Sakayombo's (2014) confirmed this as they revealed that IKS is to a greater extent not being integrated in the teaching of agricultural sciences in the secondary schools in Zambia, since most participants had a general or limited understanding of IKS.

Likewise, the negative impact of poor views of IK in classroom practice was also noted in a study conducted by Reddy et al (2017). Although the teachers fully supported the integration, and realised the value of IIK in improving learner performance in Life Sciences, their poor views on the NOIK restricted their successful integration of IK in the science classroom. In a study by Water-Adams (2006), it was concluded that four English teachers' tacit and espoused beliefs and views of the nature of science were found to be the most determining factor in what actually takes place in the classroom, that is, in what the teacher will eventually teach in the classroom.

In a study by Vhurumuku (2015), two pre-service teachers' beliefs about the nature of scientific enquiry were explored, and how these beliefs interact with their classroom practices during teaching practices. It was found that teachers' beliefs about the nature of scientific enquiry do impact his or her classroom behaviour and are associated with their teaching practice.

According to Mosimege (2004), the 30 teacher sample responses to the questionnaires revealed that teachers' inadequate knowledge regarding IK becomes translated into the classroom and this makes IK integration very difficult and almost impossible. From these studies, it can be deduced that the success of IK integration lies on the availability of teachers who have an adequate understanding of IK and who know how to transmit it, and this is the major limiting factor against IK integration in the science classroom. Shizha (2008) confirms this in his study by stating that the inadequate views harboured by the ten teachers in his study sample made teachers reluctant to integrate IK into their science lessons.

The fact that science teachers are interested and would like to integrate IK into their lessons is unquestionable. However, the number of challenges that they experience during the attempt to integrate IK makes it very difficult for them to do this. However, in a study by Jackson et al (2016), teachers, after attending the intervention, had their views enhanced, and an increased positive attitude and motivation to teach IK in the science classroom was noted. The same shift of mindset, after attending a series of seminar-workshop sessions, from the initial misgiving about the notion of integrating science and IK to one of acknowledging the potential benefits of an integrated science and IK curriculum, was reported in the findings of the study by Langenhoven and Stone (2013) involving 19 purposively sampled teachers.

Previous research shows that teachers' schooling and the way in which they were trained has impacted a great deal on their views about science teaching and learning (Hodson, 1998). Today these views are a consequence of being brought up and being forced into a western cultural education system, with a history of colonisation that has devalued and undermined other forms of knowledge. The IK-focused teacher development programmes are a necessity in order to try and address the reform of teachers' views and understanding of the NOIK (Hodson, 1998; Ogunniyi, 2004). It must, however, be noted that views that have been harboured for a long time may not be easily altered by education and training programmes, as people have a tendency to hold on to incorrect and incomplete knowledge (Ogunniyi, 2004). This therefore calls for carefully planned IK-focused programmes so as to enhance and improve teachers' views and understanding. The effective teaching of science requires teachers to examine their views, conceptions of indigenous knowledge and cultural positions. As a result, they will be able to recognise the significance of teaching a diverse class of learners from multicultural social contexts.

The diverse IK understandings that learners bring to class does not necessarily fall in line with that of the teacher. In fact, many learners become alienated. The successful and effective integration of IK into science teaching and learning is a cross-cultural process which entails moving between worldviews (Aikenhead, 2001).

2.6 Summary of Chapter 2

This chapter began with a brief description of the theoretical framework, social constructivism, used in this study. Background information on IK, its characteristics and tenets were given, as well as its comparison with the WK. Several empirical studies on IK integration in the science classroom, challenges experienced during integration, teachers' views on its integration in the classroom, as well as the influence of teachers' views on classroom practice were reviewed.

In the next chapter, Chapter 3, the design strategies supporting this study, methods, procedures followed and instruments used for the collection and analysis of data are discussed. Furthermore, the reliability and validity of data will be analysed and discussed, as well as ethical issues

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

Chapter 3 provides a detailed discussion and explanation of the research design and procedure used in this study. First, the research questions and objectives of the study are outlined. Second, a discussion of the research design and how it informs the methodology used to collect and analyse data is made. This is followed by a description of how the participants were selected and the data collection procedures. The process of data analysis from different sources is discussed. Fourth, the researcher describes how issues of reliability, validity and ethics were addressed. Lastly, the chapter presents the framework through which research findings are presented in Chapter 4.

3.2 Research questions

This study sought to answer the main research question: How do natural sciences senior-phase teachers' views about the nature of indigenous knowledge influence their teaching practices? To answer this question, two research sub-questions were asked. What are the natural sciences senior-phase teachers' views on the nature of indigenous knowledge? What is the relationship (if any) between these teachers' views and their classroom practices when integrating indigenous knowledge into their teaching practice? The objectives of this study were to establish natural sciences senior-phase teachers' views on the nature of indigenous knowledge and to investigate the relationship between the teachers' views and their classroom practices when integrating indigenous knowledge into their teaching.

3.3 Research design

A research design is a plan that describes and gives direction as to how the research project is going to be conducted (Creswell, 2014) and how the various major components of the research (the samples, measures, instruments of data collection and analysis, among others) will work jointly to address the research questions (Oakley, 2004). Mouton (2001) viewed the research design as the actualisation and practical implementation of order and logic in a set of procedures that optimises the validity of data for a given research study.

The research study is an explanatory sequential mixed method design. The researcher, according to Creswell (2003), first conducts a quantitative research, analyses the data and then builds on and use results to select participants for further data collection, and then plans a qualitative research. This kind of methodology is suitable for this study because it helps in eliciting multiple viewpoints, perspectives, positions and standpoints about a single phenomenon, thereby gaining an in-depth understanding of the research problem (Creswell, 2003). The quantitative data (using a questionnaire) and qualitative data (using semi-structured interviews) were collected sequentially, and were then merged to better understand the teachers' views on IK integration and their practices when integrating IK in NS teaching. The in-depth qualitative data were used to explain the quantitative results.

The mixed method approach employed in this research study involved collecting both forms of data, the quantitative and the qualitative data, in response to research questions, integrating them and using distinct designs that may involve philosophical assumptions and theoretical frameworks. This approach was deemed appropriate for this study because of the main assumption at the core of this form of enquiry, where there is mixing or blending of data, that it provides a stronger understanding of the problem or question than either by itself. It also assisted in gaining more in-depth insights into the views of natural sciences senior-phase teachers on the nature of indigenous knowledge and their practices when integrating IK into their teaching.

In this study, a survey research design was used during the collection and analysis of quantitative data for the study. A survey design provided a quantitative or numeric description of trends, attitudes, opinions or views of a population by studying the sample of that particular population. From the sample results, the researcher was able to generalise or draw inferences on the population. An interpretivist case study approach was also incorporated during qualitative semi-structured interviews. This was deemed appropriate for this study, firstly, because it gave teachers an opportunity to clarify their responses given to the VNOIK questionnaire. Secondly, it assisted in addressing the second objective, to investigate the relationship between the teachers' views and their classroom practices when integrating indigenous knowledge into their teaching. Thirdly, it enabled the researcher to gain an understanding of human experience, and its purpose was to objectively interpret the created meanings of phenomena that are usually hidden behind expressions of experience (Wu & Chen, 2005).

3.4 Conducting the study

This section presents a discussion of the process that was followed in conducting the research, which focuses mainly on the selection of participants for the study and data collection procedure.

3.4.1 Selection of participants

The 78 selected schools were located in the Soweto Township, in the Pimville and Klipspruit location, south-west of Johannesburg, and were within a 10km radius from where the researcher was working. The learners enrolled in each school were mainly from the township. On further analysis of the six schools where the interview sample worked, it was discovered that the learner enrolment is above 900 in each school. On further analysis, the NS classrooms where these six teachers teach are categorised as overcrowded, with numbers exceeding 36 learners per classroom. English is used as a language of learning and teaching, and none of these learners and teachers uses English as a home language. None of the six schools had a well-resourced science laboratory, which posed a serious challenge to teachers during practical work periods.

For purposes of this study, the participants were selected according to the information they possessed and as per the needs of this study, thus giving more credibility to the findings of this study. Eighty natural sciences teachers teaching in 78 township schools were selected to form a sample for this study. All 80 of them participated in the first part of this research study, while six of them were chosen from the original sample to further participate in the second part of this study. The participants chosen were all teaching Grade 7 natural sciences and they all freely agreed to participate in the study.

In any research study, it is imperative that the selected participants to form a sample are those with special information, knowledge and competence that will provide an intense understanding of the research problem under study (Merriam, 1998). Purposeful sampling was employed in the selection of the 80 teacher participants. They were all teaching Grade 7 NS and were all from different township schools in Soweto, in Gauteng province. The second sample was derived from this original sample, and comprised six teacher participants. Their selection relied on the premise that they were information-rich cases that were in a position to provide a thick, rich, in-depth understanding of the problem under study (Creswell, 2003). There was a wide range of teachers' experiences, ranging between 4 and 24 years, with ages ranging between 27 and 52 years. They were all African Black teachers, but from different gender and cultural groups. Furthermore, convenience sampling was also employed, as they were selected because it was easier for the researcher to travel and access their schools.

The six-teacher sample's background information is summarised in the following Table 3.1. It is important to note that all participants were assured of their confidentiality, and pseudonyms were allocated to each one of them. They were asked what their favourite colour was, and each participant was given a pseudonym based on the chosen favourite colour.

Table 3.1 Profiles for teachers selected for interviews

Teachers' pseudonyms	**Nontuthuko**	**Phakamani**	**Avhashoni**	**Dimakatso**	**Nobuntu**	**Dikeledi**
Gender	Female	Male	Male	Female	Female	Female
Age (years)	27	38	39	42	52	31
Ethnic Group	Zulu	Zulu	Venda	Sotho	Zulu	Tswana
Religion	Christian	African Traditional	Christian	Jehovah' Witness	Christian	Christian
Qualifications	Bachelor of Education degree	Bachelor of Education degree; Bachelor of Education (Honours)	Bachelor of Education degree; Bachelor of Education degree (Honours)	Primary Teachers Diploma; Further Diploma in Education	Primary Teachers Certificate; Secondary Teachers Diploma; Bachelor of Pedagogics degree)	Bachelor of Education degree
Teaching experience (years)	4	9	7	15	24	8

3.4.2 Data collection procedure

In this section, a detailed description of all the stages and steps that the researcher followed in order to collect data is presented. The data-collecting process involved two phases: phase 1 where an open-ended questionnaire, The Views of the Nature of Indigenous Knowledge (VNOIK) instrument (Cronje et al, 2015), was administered to 80 teachers in order to determine their views regarding the Nature of Indigenous Knowledge (NOIK), and phase 2, which involved interviewing six teachers in order to clarify their responses to the VNOIK questionnaire, generate in-depth profiles of their views and to establish a relationship between their views and their teaching practices.

Phase 1: Collection of quantitative data

The first quantitative phase entailed the collection of quantitative data using a validated instrument, which was administered to 79 Grade 7 NS teachers teaching in township schools. The VNOIK (Cronje et al., 2015) contains 10 open-ended questions and it was purposefully chosen because it was developed specifically to assess the teachers' knowledge, understanding and views about the nature of indigenous knowledge. It was also developed in South Africa, and hence this study is a South African study. On the other hand, questionnaires are very common instruments and seem to be easy to use for data collection. One of the advantages of questionnaires is their ability to capture data from a wider audience in a short time. However, one of its disadvantages is that it is not possible for it to be customised to individuals, as it is the case with other methods of data collection.

This phase was conducted in three stages: Stage One, where there was the administration of VNOIK questionnaire; Stage Two, where there was capturing and cleaning of data; and Stage Three, where the qualitative data were analysed.

The data collection process entailed hand-delivery of the VNOIK questionnaires to 78 township schools. This process took three weeks, in October 2018, to complete. The researcher had to approach the principals of 78 primary schools telephonically and set up appointments to come and discuss permission to conduct research at their schools. The first visit by the researcher to the school involved a personal introduction of the researcher and presenting of the letter of invitation to the principal. The heads of departments (HODs) were also invited to be present during these first visits, and in most cases they were the ones responsible for teaching Grade 7 NS. This also contributed towards the facilitation of administering the VNOIK, as second visits were, therefore, not necessary.

The VNOIK was, in most cases, administered on that very same day of the first visit, together with the second letter of invitation to NS teachers (Appendix B), requesting the individual teacher to participate in the research, was then administered. In very few schools, where the HOD did not teach Grade 7 NS, the HODs were asked to act as coordinators to set up appointments between NS teachers and the researcher. The second visits to the school with respective Grade 7 NS teachers were arranged, and VNOIK was then distributed to all respective teachers in the sample schools. The explanation of the aim, purpose and intent of the research by the researcher was done, and the teachers were assured that their responses would be treated with confidentiality and anonymity. Fortunately, all the teachers who were invited to participate responded positively to the researcher's invitation, and they took the questionnaires home with them. To minimise the possibility of poor response, which could reduce the validity and reliability of the research results, the researcher ensured that she approached all individual teachers in the sample, so as to illicit support and interest, and most importantly to remove the middle-man. The teachers' personal contact details were also taken, so as to contact the sample teachers individually to make an appropriate appointment for the personal collection of the completed VNOIK questionnaire.

At the end of phase 1, the VNOIK questionnaires were analysed and the preliminary findings of the quantitative data were then used to inform the second phase.

Phase 2: Collection of qualitative data

The second qualitative phase entailed the collection of qualitative data using semi-structured interviews, which were conducted with six Grade 7 NS teachers teaching in township schools. The results from the analysis of quantitative data were used as a point of departure for the second phase of qualitative data collection. After the analysis of the VNOIK questionnaire, convenience and purposive sampling of two teachers whose responses showed informed views, two showing partially informed views and two showing uninformed views, was done.

The six teachers were each interviewed using a semi-structured interview schedule. These semi-structured interviews were deemed appropriate for this study as they afforded participants an opportunity to clarify their responses indicated in the VNOIK questionnaires. Interviews are commonly known for their ability to provide face-to-face opportunity among human subjects (Creswell, 2014) The open-ended questions, on the other hand, provided detailed ideas of the variety of people's opinions and feelings on the research problem, thus enhancing their ability to think and explain their thoughts and views more clearly and in more detail. Creswell (2014) further pointed out that the interviews also help to unlock the hidden feelings and emotions that could not be discovered through the use of questionnaires.

In order to ensure consistency with all six of the participants, the researcher had a set of 12 semi-structured core questions for guidance so that the same areas were covered with each participant (Appendix H). The open-ended questions were chosen after careful consideration of the objectives of the interview. The interviews were conducted on a one-on-one basis with each of the six participants, in a quiet place to avoid any form of distractions, with each session lasting approximately 45 minutes. By conducting these interviews, the researcher wanted to seek clarification from the teachers' responses to the VNOIK questionnaire, regarding the views that Grade 7 township teachers hold about the nature of IK (this was addressing the first sub-research question) and the relationship (if any), between the teachers' views and their classroom practices when integrating indigenous knowledge in their teaching (this was addressing the second sub-research question).

Each of the interviews was then audio-recorded with permission from the teacher and immediately transcribed. All the interviews took place at the interviewee's respective schools, after school hours, when almost all the learners had left. Each interview session was scheduled in such a way that it did not interfere with the school's daily programme and also to ensure that each interview session was conducted free from distractions and disturbances.

3.5 Data analysis procedure

In this section, a detailed description of all the stages and steps that were followed by the researcher in analysing data is presented. The data analysis took place in each of the two phases of the research study, the quantitative phase and the qualitative phase. After the collection of quantitative data, using the VNOIK questionnaires (Appendix D) to the 80 NS teacher sample, during the first qualitative phase, data were analysed.

During the cleaning of data, one of the returned VNOIK questionnaires was incomplete and was therefore withdrawn, thus reducing the sample size to 79. The 79 completed valid questionnaires were analysed immediately after being collected from respondents. The purpose of this data analysis was to use the findings to inform the selection of the six teachers for interview purposes. The analysis of the responses to each of the 10 VNOIK questions was carried out by using the anticipated responses to the VNOIK questionnaire (Cronje et al, 2015; Appendix F), which provides a list of acceptable responses to each of the ten questions, derived from IK literature. These were used together with the rubric that was also developed for the coding of participants' responses (Cronje et al, 2015; Appendix G). The rubric allowed the allocation of weighting to each of the ten responses of participants and was grouped into any of the three categories of views: informed view (I) which was allocated a weighting of (2); partially informed view (PI) which was allocated a weighting of (1); and the uninformed view (UI), which was allocated a weighting of (0). This rubric was then used to establish if the view to each question was I, PI or UI, and respective weightings were then allocated. In order to determine the overall view for each participant, the weightings or scores achieved in each question were all added together, and then divided by the total number of VNOIK questions, that is, by ten.

Qualitative data from the interviews were analysed by using Saldana's coding theory model (2009). This analysis was done to afford the teachers an opportunity to clarify their responses to the VNOIK questionnaires and to address the second sub-research question about the impact of their views on their teaching practice. Saldana (2009) explained that a code is a short phrase, term or word that represents a specific summative, salient, essence-capturing name for a portion of language-based or visual data. He further explained that an analytical lens is used during the coding process. For purposes of this study, in vivo coding, descriptive coding and value coding were employed. In vivo coding entails taking the code from the exact or direct words spoken by the participant. Descriptive or topic coding entails summarising a passage of what the participant had said in one word or short phrase. Value coding is a reflection of the participant's values, attitudes and beliefs. Simultaneous coding, which Saldana (2009) described as the use of two or more types of coding, was then employed in this research study. Thereafter, those codes sharing the same characteristics were grouped together to form sub-themes. Similar sub-themes were further grouped together to form concepts or themes, which eventually shaped into theory (Saldana, 2009). Figure 3.1 illustrates the code theory model (Saldana, 2009).

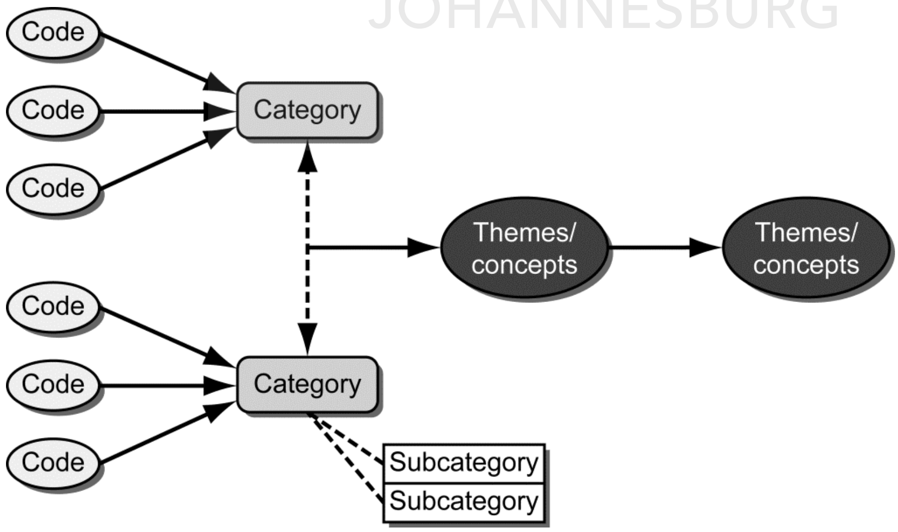

Figure 3.1: Saldana's codes theory model for qualitative enquiry (Saldana, 2009)

From Figure 3.1, the steps followed during the coding process to analyse interview data could be summarised as follows: Step 1: The transcripts were read several times in order to consolidate meaning and explanation from them; Step 2: Each of the transcripts or relevant response was organised and then numbered; Step 3: Brief notes were written down in the margins in order to assign meanings, while keeping the research questions in mind; Step 4: The umbrella categories and a broader spectrum were identified; Step 5: Similar meanings within relevant categories were sought, and those identified as having such were grouped further together and Step 6: Specific words relating to frequent occurrence were identified and those three themes identified were: 1) Township teachers' inadequate views about the nature of indigenous knowledge influence negatively their classroom practices; 2) Teachers experiences determine how they integrate indigenous knowledge in their classrooms; 3) There is a need for indigenous knowledge-focused intervention programmes to equip teachers with the knowledge and skills in integrating indigenous knowledge in the natural sciences.

To summarise the process of collecting and analysing data that was employed in this study, as conceptualised by the researcher, Figure 3.2 was developed. This Figure 3.2 that follows shows the diagrammatic representation of the data collection and analysis process employed in this study:

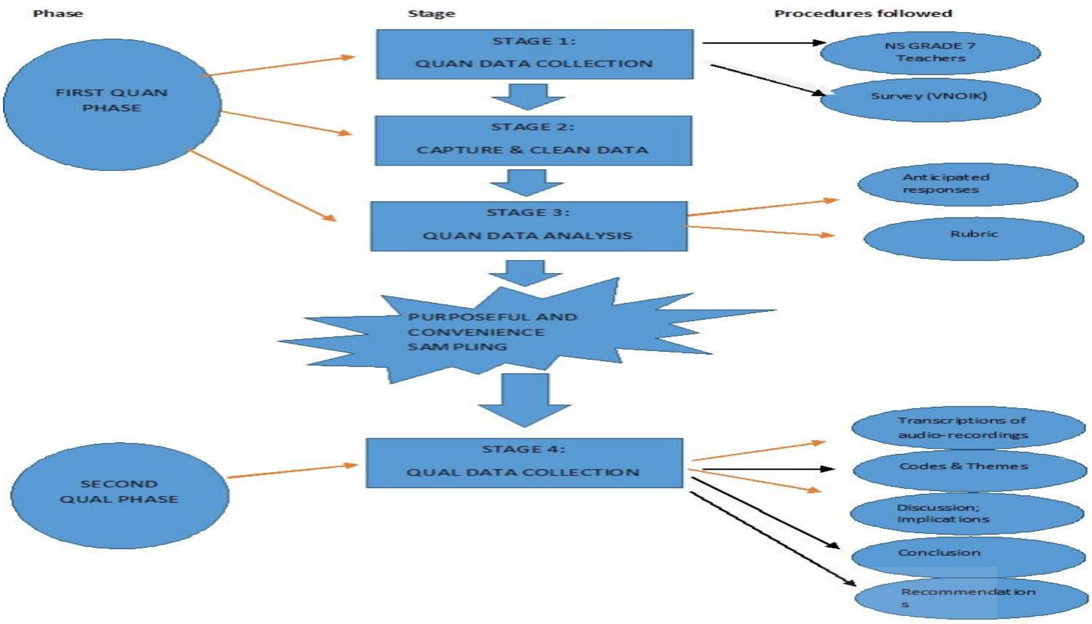

Figure 3.1 Diagrammatic representation of the mixed method data collection and analysis strategy used in this study

Figure 3.2: Diagrammatic representation of the mixed method data collection and analysis strategy used in this study

3.6 Reliability and validity

Reliability usually refers to the level to which another researcher would reach to obtain the same conclusions (Merriam, 1998). For reliability purposes, Merriam (1998) further highlighted the importance of consistency between the results and the collected data, rather than the replication of findings. Validity, on the other hand, refers to the level at which the research method or research instrument measures what it is supposed to measure (Opie, 2004). Validity is also enhanced by the accuracy and appropriateness of the research methods (Maxwell, 1992). The use of a high-quality audio-recorder to capture the exact and direct responses of the interviewees and the immediate word-for-word transcription of recordings enhanced validity. It was crucial for the researcher to establish rigour in this study, in order to ensure that the findings were valid (Guba & Lincoln, 1989). The researcher therefore engaged in prolonged engagement with participants, which refers to the amount of time spent establishing rapport, and to build trust with the participants so as to understand the context more fully, and member checks, which refers to the sharing of documented data and interpretations with the participants so as to ensure that a realistic picture is presented. Accordingly, establishing rigour maximised the validity of results. The six teachers who participated in the qualitative phase of the research were also informed that they would be audio-recorded and were requested to complete a confidentiality agreement (Appendix C). The data that were gathered in this study during both the qualitative and quantitative phases, that is, the VNOIK questionnaires and the interviews and their audio-recordings were appropriately stored as a measure to guarantee the protection of the confidentiality agreement entered into with the teachers.

Trust was also an important issue, during the qualitative data-collection phase. Participants need to respect the researcher and believe in his or her integrity so as to ensure they are both candid and forthcoming (Lincoln & Guba, 1985). The researcher in this study is a senior natural sciences teacher in a teaching school, which is the only one of its kind in South Africa. Moreover, she is a natural sciences cluster leader and is therefore credible, respected by and known to many principals and teachers throughout the Gauteng province. The topic of the research, namely, *South African township teachers' views on the integration of indigenous knowledge in natural sciences teaching*, was one aspect that most teachers were interested in, since they felt that their knowledge of indigenous knowledge is still inadequate, as they still experience challenges in as far as integrating IK in their classrooms is concerned. The teachers were aware that the researcher came from a teaching background, as they belonged to the same cluster and met during Natural Sciences Professional Learning Group (PLG) meetings. This assisted the researcher in gaining teachers' trust and they felt supported and therefore felt confident to communicate many aspects about their teaching. They were also confident that their concerns and frustrations were also addressed. The teachers were requested to fill in the questionnaire in their spare time, and were requested to submit the questionnaire the following day to their respective HOD's at schools. The researcher is aware that the teachers could have quickly filled in the questionnaires for the sake of finishing them; however, it was impressive to discover that most of them requested for more time as they felt that they needed to fill it in appropriately. The teachers trusted the researcher and felt that the study was relevant, and this enabled them to provide candid and forthcoming responses.

3.7 Ethical issues

Ethical considerations are crucial in establishing a relationship of trust. In order to comply with ethical research measures and enter a research setting, ethical clearance from the Faculty of Education Ethics Committee at the University of Johannesburg was sought and granted (Appendix A). It is imperative that the researcher, when conducting the study, conducts herself in an ethical manner, thus ensuring that the participants are not harmed in any way, and that human dignity is preserved. The ethical issues were considered at all times before, during and after both the quantitative and qualitative phases. This was done by adhering to Creswell (2003) ethical guidelines, the informed consent, freedom to withdraw and confidentiality, anonymity and privacy, as outlined below.

The participants in this research study were teachers who agreed to complete the questionnaire and be audiotaped during semi-structured interviews. The participants' consent forms Appendix C) stated clearly the right of participants to participate voluntarily in this study. Before the commencement of the research, the purpose of this study, the procedures to be followed, including the benefits and risks were explained to all participants. All the teachers who were participants in the qualitative phase (those who completed the VNOIK questionnaires) were informed about the exact aim and objectives intended to be achieved and the nature of this research study. They were also informed, prior to the completion of the VNOIK questionnaires and prior to participation in any interview, that their decision to participate in this study was voluntary, and they were free to decline to participate or to withdraw at any time and stage of the research, if they so wished.

Confidentiality, as promised to participants was ensured by treating all the information shared and revealed by participants confidentially and with great respect and responsibility. After the audio-recorded interviews had been transcribed, they were disposed of by deleting them from the audio recorder. The transcribed documents and questionnaires were put away safely in a secure place until their destruction (Cohen, Manion & Morrison, 2000**;** Fraenkel & Wallen, 2009). The anonymity of the participants was protected by ensuring that real names were not used or mentioned at any stage during the study. Participants in a research study are highly vulnerable to having their right to privacy violated. The researcher, therefore, took it upon herself to ensure that privacy of all participants was protected, by ensuring an increased level of sensitivity to information provided and also ensuring access to the participants' information was restricted, being shared only with the supervisor of this study.

3.8 Summary of Chapter 3

In this chapter, the researcher has clearly described the route and processes that were followed in order to answer the two research sub-questions. Description of factors that led to choosing a sequential explanatory mixed method approach was done so as to justify its appropriateness for this study. The two phases of the research process, and their respective stages were discussed. Furthermore, the selection of participants, the various data collection instruments used, namely, the VNOIK questionnaires and semi-structured interviews, together with the rationale behind them, were also laid out to address the main research question: how do natural sciences senior-phase teachers' views about the nature of indigenous knowledge influence their teaching practices?

A description of how issues pertaining to validity and reliability of the findings were met was also provided, including the discussion of the framework for the data analysis and presentation of research findings. Finally, the steps taken to adhere to the ethical guidelines for social sciences research were also explored, including the explanation of measures to ensure the validity and reliability of the data. The next chapter discusses in detail the presentation of research findings

3.9 Framework through which research findings are presented in Chapter 4

The presentation of data in this chapter was guided by the research questions and research sub-questions. The views that NS teachers teaching in South African township schools hold regarding the integration of IK in the science classroom are presented to answer research sub-question 1. The role of IK in the science classroom, together with challenges experienced during IK integration and reflections on the impact of their views on classroom practice are presented to address research sub-question 2. Figure 3.3 is a diagrammatic representation of the framework of data presentation. The way in which the findings lead from one to the next is indicated by horizontal arrows.

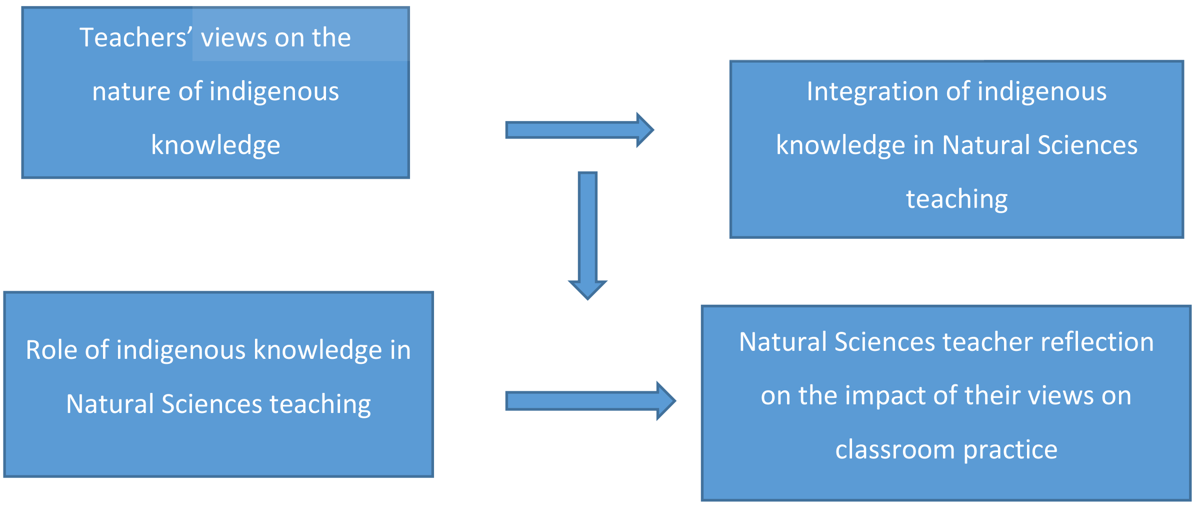

Figure 3.3: Diagrammatic representation of the framework of data presentation

CHAPTER 4: RESEARCH FINDINGS

4.1. INTRODUCTION

Chapter 3 provided details of the research design, as well as the collection of data using the VNOIK questionnaire (Cronje et al, 2015), which was administered to 79 Grade 7 natural sciences teachers from 78 township schools. It also detailed the administration of interviews to six teachers, who were selected on the basis of their results from analysed responses to the VNOIK questionnaire, as well as the analysis of all data.

Chapter 4 is a presentation of research findings. First, the findings of the relationship between teachers' biographical information and their response to each of the ten items in the VNOIK questionnaire are presented and then interpreted separately. This is to answer the first research sub-question: what are the natural sciences senior-phase teachers' views on the nature of indigenous knowledge? Second, findings from the interviews are presented to answer the second research sub-question: what is the relationship (if any) between these teachers' views and their classroom practices when integrating indigenous knowledge into their teaching practice? Third, the chapter presents the overall findings from the questionnaire and interviews and an interpretation is made to answer the main research question: how do natural sciences senior-phase teachers' views about the nature of indigenous knowledge influence their teaching practices? Findings of this study are therefore presented in two parts. In Part A, findings from the analysis of the quantitative data collected using the VNOIK questionnaire are reported. Part B presents findings from the analysis of the qualitative data collected through individual interviews.

4.2. PART A: TEACHERS' VIEWS ON THE NATURE OF INDIGENOUS KNOWLEDGE

In this part, findings from the VNOIK instrument regarding teachers' views on each of the nine tenets of the nature of the indigenous knowledge (IK) framework are presented in order to answer research sub-question 1: what are natural sciences Grade 7 teachers' views on the nature of indigenous knowledge? Teachers' views develop as a result of various encounters, and are developed from personal experiences, such as family traditions and religious affiliations, age and gender socialisation, teacher preparation, professional development programmes attended and the number of years of teaching experience (Cross, 2009). The study population consisted of 79 Grade 7 natural sciences teachers from 78 township primary schools in the Johannesburg

Central and Johannesburg North districts from the Gauteng province of South Africa, who responded to the VNOIK questionnaires. The VNOIK questionnaire was divided into two sections: 'Section A: Biographical information' and 'Section B: VNOIK items'. The biographic information regarding these participants in this study was solicited with items relating to gender, teaching experience and religious beliefs. Findings show that they differed significantly in terms of gender, teaching experience and religious beliefs. There were 34 males and 45 females. They had varying numbers of years of teaching experience, ranging from less than a year to 29 years. From this study population, three religious groups were identified: Christian, African traditional religion and Jehovah's Witnesses. It was from observations of these differences that the researcher became interested in exploring whether these differences had any impact on the nature of views presented by natural sciences teachers in township schools regarding IK. Though not central to the study, the biographical differences helped to contextualise the findings and to formulate appropriate recommendations. The findings from the VNOIK questionnaire were therefore presented in two parts, namely, findings from biographical differences of participants and findings from VNOIK items.

4.2.1 Relationship between teachers' gender and their views

First, the relationship between the biographical data of the respondents (teachers' gender, experience and religious beliefs) and their views to each of the VNOIK items is presented. Gender is regarded as one of the basic means of social differentiation among members of a society, which is brought about by the different but unique experiences, knowledge and skills that they acquire during the execution of their duties and allocated responsibilities (Feldstein, Poats, Cloud & Norem, 1989). The researcher then believed that this social differentiation could lead to differences in the IK and skills held by men and women. On that note the study endeavoured to compare and explore if there was any gender-based relationship between teachers' views on the nature of IK. As already alluded to in Chapter 3, the participants comprised 45 females (57%) and 34 males (43%) (n=79). This finding came closer to the profile identified by Skosana (2018), that women make up 72,5% and men make up the remaining 27,5% of teachers in South African public schools. Table 4.1 shows the different views of male and female teacher participants to each item in the VNOIK questionnaire.

Table 4.1 Distribution of gender-based teachers' views

	Informed views (%)		Partially informed views (%)		Uninformed views (%)	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
VNOIK item						
1. The nature of indigenous knowledge	6	39	65	47	29	14
2. The empirical and metaphysical nature of indigenous knowledge	25	23	41	42	34	35
3. The inferential yet intuitive nature of indigenous knowledge	11	19	50	45	39	36
4. The resilient yet tentative nature of indigenous knowledge	17	16	62	36	21	48
5. The 'wisdom-in-action' nature of indigenous knowledge	32	9	56	44	12	47
6. The functional application nature of indigenous knowledge	15	37	44	48	41	15
7. The holistic approach to problem solving	16	52	46	30	38	18
8. The creative and mythical nature of indigenous knowledge	26	23	24	56	50	21
9. Social, collaborative and cultural embeddedness of indigenous knowledge	6	49	31	34	63	17
10. The subjective nature of indigenous knowledge	21	18	41	37	38	45
Total Views	**18**	**28**	**46**	**42**	**37**	**30**

From Table 4.1 it emerged that there were notable differences in responses to some of the VNOIK items between the views of females and those of male participants. In terms of informed views, females demonstrated a higher average percentage (28%) of informed views as compared to their male counterparts (18%). This is evident in male and female responses to items 1, 6, 7 and 9. With item 1, teachers were requested to explain what they understood by the term *IK* and how it differs from classroom science. Findings revealed that females have more informed views (39%) than males (6%) about what IK is. This means that there are more females than males who have the desired understanding of what IK is. This is very worrying as it is crucial for teachers to have a nuanced and desired understanding of IK in order for them to teach or to integrate IK into the classroom teaching and learning. It is not possible to teach something that one does not understand. The study also believes that the difference in the understanding of what IK is could be caused by gender specialisation, which eventually affects hierarchies of accessing, using and managing IK among the two genders in society. With the second part of the same item 1, more females were further able to give at least four ways in which IK differs from Western knowledge, namely that IK is transmitted orally, it is locally based, is spiritual (includes belief in the ancestors), and involves working together as a community.

The same pattern was also observed in item 6, which is based on the functional application nature of IK. It means that, when responding to this item, more females (37%) than males (15%) agreed and provided reasons to support that IK is a source of wealth and is usable in solving contemporary problems, especially where Western science has failed. On the contrary, for item 6, males, who are known to be responsible for the household's economic status and providing resources for the family, had more (41%) uninformed views than females (15%). The reason for this was that they disagreed that IK can be used to solve global problems, while others indicated that they were not sure of the value of IK in this regard. Such responses were categorised as uninformed, as per the rubric. However, there were some males that did agree in their responses that IK plays a very significant role in sustainable development and alleviating global problems, but did not provide reasons for their answers. Such responses were therefore categorised as partially informed (44%). This raised serious concern about these teachers' ability to integrate IK into their classroom practices, if they do not value the affordances of IK in the teaching and learning of science.

Accordingly, responses to item 7 (based on the holistic approach to solving problems) showed the majority (52%) of female participants having informed views in contrast to male participants (16%). This was to be expected and it confirmed the assertion by Torres-Avilez, de Medeiros and Albuquerque (2016) that there is a gender-based knowledge difference in relation to medicinal plant knowledge, as women know more about medicinal plants than males. This is because women's roles in most households entail being in charge of family health-related issues, diagnosing illnesses and their causes and eventually finding the best medicinal treatment for these illnesses. The roles of females, which entail being in charge of socialising and bringing up children and spending more time with them as they grow, mean that women assume the roles of being primary guardians and transmitters of traditional culture in most local communities. On that note, findings from item 9 revealed that female participants also hold more informed views (49%) than male participants (6%) on the social, collaboration and cultural embeddedness nature of IK.

An interesting observation was made in those responses that were categorised as partially informed. It must be noted that the partially informed views received the highest overall percentage as compared to other views. On further analysis of these views, it was revealed that it is the males that hold the higher average percentage (46%) of partially informed views than the females (42%). These higher partially informed views by males (65%) than females (47%) were observed mainly in item 1 (based on what IK is and how it differs from Western knowledge). The same trend of higher partially informed views by males was observed in item 4 (based on the resilient yet tentative nature of IK), where males demonstrated 62% in comparison to females (36%).

Surprisingly, in item 8 (based on the creative and mythical nature of IK) females changed the pattern and demonstrated a higher percentage (56%) of partially informed views than their male counterparts (24%). Although these females failed to explain and give examples of the mythical and creative nature of IK, they generally agreed that myths and rituals do play an important role in IK. This can be attributed to the fact that story-telling is known to be the part played mostly by women; hence, the demonstration of higher informed views than partially informed views by female teachers in this regard. The possible reason for this could be that most females are generally of the view that it is best to teach a life lesson by incorporating it within a folktale, as it stays longer in the mind of a child. However, the fact that there is not much time for women to spend with the children, as everybody is employed and is focusing on the different careers to make a living. The inquisitive children of our times also do not have time for sitting around and listening to stories, with their lives being overtaken by the recent influx of technology. Men, on the other hand, are naturally not fond of speaking, and it is not surprising for them to refer to the myths, storytelling and other modes of transmitting IK as irrelevant. The male participant responses to item 8 included the following: "myths are techniques of scaring young children; they instil fear among children"; "they are time-wasters"; "they are too fictitious and include things that do not happen in real life, like animals talking".

Uninformed views that were noted meant that participants' responses to the VNOIK items were either not among the list of anticipated responses, or the respondents had just indicated that they were not sure of the answer. It was also noted in this study that the uninformed views were part of the undesired and inadequate views that hindered the integration of IK in science classrooms. As already indicated, the males generally held more (37%) of the uninformed views than females (30%). In item 7, more uninformed views were demonstrated by males

(38%) than females (18%). This means that more males were not informed about the holistic approach in IK to problem solving and the importance of consulting ancestors for help. For item 8, that was based on the creative and mythical nature of IK, more males (50%) than females (21%) were uninformed and did not understand that myths, rituals and stories with life lessons play a very important role in making IK more understandable to children. The same pattern was observed in responses to item 9, where more uninformed responses were from males (63%) than females (17%). This means that there are more males than females who do not understand that IK is within social and cultural traditions and that it can be adapted to solve contemporary problems. However, more females (48%) were uninformed than males (21%) for item 4, which is based on the resilient yet tentative nature of IK. On that note, more females (47%) than males (12%) were uninformed for item 5, which is based on the 'wisdom-in-action' nature of IK. It means that more females than males are uninformed about IK being fluid and adaptable to address new problems as a result of changing times and that more females were uninformed about the generation of IK through every day trial-and-error practices. One possibility of this trend of males being knowledgeable in this regard is that males are regarded as heads of their families who must be able to face dangers head-on and protect their families. The trial-and-error method of gathering knowledge could have serious consequences, and therefore requires that the stronger gender, the males, assumes such a responsibility.

Second, the study acknowledged that the teachers' teaching experience is another factor that could impact knowledge differentiation (Grenier, 1998). On that note, the researcher went on further to explore the possibility for the existence of any relationship between teachers' views and their teaching experience, as indicated in tables 4.2, 4.3 and 4.4 that follow.

4.2.2 Relationship between teachers' experiences and their views

The teachers' experiences in the sample ranged from less than a year to more than 15 years. It is interesting to note from the sample, 4% of the teachers had just graduated, and were teaching for the first time, and therefore had a teaching experience of less than a year; 16% had a teaching experience of 1 to 5 years; 23% had an experience of 6 to 15 years and 57% had an experience of more than 15 years in the teaching profession (n=79). In this study, the researcher is of the understanding that teacher experience is likely to have an effect on teachers' views on the nature of indigenous knowledge, considering the many professional development programmes that the teachers with more experience would have attended during their years of teaching practice. It is also believed that views also develop based on an individual's experience throughout the years, thus resulting in teachers becoming more matured and more independent, and accumulate more knowledge, understanding and skills that enable them to deliver meaningful quality lessons (Du Plessis, 2013). He further confirms that there is still a complicated relationship that seems to exist between teachers' views and practices. The following Table 4.2 shows the distribution of informed views from each of the four groups of identified teaching-experience categories.

Table 4.2 Distribution of teachers with informed views under each experience category

	Distribution of teachers with informed views under different teaching experiences (%)			
	Less than 1 year	**Between 1 and five years**	**Between 6 and 15 years**	**More than 15 years**
VNOIK item				
1. The nature of indigenous knowledge	33	8	10	16
2. The empirical and metaphysical nature of indigenous knowledge	67	30	25	12
3. The inferential yet intuitive nature of indigenous knowledge	34	38	44	9
4. The resilient yet tentative nature of indigenous knowledge	67	10	15	11
5. The 'wisdom-in-action' nature of indigenous knowledge	100	15	19	15
6. The functional application nature of indigenous knowledge	100	19	28	10
7. The holistic approach to problem solving	33	24	27	19
8. The creative and mythical nature of indigenous knowledge	100	18	33	15
9. Social, collaborative and cultural embeddedness of indigenous knowledge	100	31	39	14
10. The subjective nature of indigenous knowledge	67	19	12	22
Total Average	**70**	**21**	**25**	**14**

Findings, as indicated in Table 4.2, revealed that the majority (70%) of informed views came from teachers with less than one year of teaching experience. These are the teachers who are fresh from the university and had just joined the teaching profession as qualified teachers. These teachers demonstrated higher informed views than teachers with more years of teaching experience. Interestingly, they demonstrated 100% of informed views for items 5 (based on the 'wisdom-in-action' nature of IK), 6 (based on the functional application nature of IK), 8 (based on the creative and mythical nature of IK) and 9 (based on the social, collaborative and cultural embeddedness nature of IK). It was also noted that most of the items that these novice teachers are demonstrating informed views on are those that most teachers hold partially informed to uninformed views about.

The teachers with a teaching experience of one to five years demonstrated a much lower percentage of informed views (21%) as compared to those with less than one year of experience. These teachers had not spent a long time in the teaching field, and it was therefore disturbing to note that their informed views had dropped that much. None of the items received at least more than 40% of their informed views, with item 1 (based on what IK is and how it differs from Western knowledge receiving the lowest of informed views, 8%). A total of 25% of informed views was noted for teachers with a teaching experience of between 6 and 15 years, which was slightly more than those with an experience of 1 to 5 years. The possible reason for this could be the recent point of interest and latest stipulation among the South African education officials and universities mainly involved with teacher training to heed the call for and facilitate the integration of IK into the science classrooms. These teachers are now developing themselves and are registered at higher education institutions to upgrade their qualifications.

Surprisingly, the teachers with more than 15 years of experience came last, with the lowest (14%) of informed views on the desired understanding of what IK is and how it differs from Western knowledge. It is important to note that most of these teachers have experienced working with both the old and the new curricula and could have been among the groups of teachers who have been repeatedly expressing their frustrations about the lack of directions and clear instructions from CAPS and crying out for support on the integration of IK in classroom teaching, but all their cries have fallen on deaf ears. They have attended a number of workshops, hoping their concerns and needs would be addressed. To their disappointment, most of the professional development programmes are mainly concerned with curriculum coverage, and the issue of indigenous knowledge and its integration into the classroom. From their responses to all the items, none of their informed views was above 22%. An observed pattern here was that the longer the period of teaching experience, the lower the percentage of informed views on the nature of IK. It means that more teaching experience did not contribute to the teachers' understanding of what IK is and how it differs from classroom science.

It was also crucial to look into the partially informed views demonstrated by teachers with varying numbers of years of teaching experience. Table 4.3 shows the distribution of partially informed views from each of the four groups of identified teaching experience categories.

Table 4.3 Distribution of teachers with partially informed views under each experience category

	Distribution of teachers with partially informed views under different teaching experiences (%)			
	Less than 1 year	**Between 1 and 5 years**	**Between 6 and 15 years**	**More than 15 years**
VNOIK item				
1. The nature of indigenous knowledge	67	85	78	36
2. The empirical and metaphysical nature of indigenous knowledge	33	62	61	41
3. The inferential yet intuitive nature of indigenous knowledge	33	54	43	47
4. The resilient yet tentative nature of indigenous knowledge	0	77	67	49
5. The 'wisdom-in-action' nature of indigenous knowledge	0	62	47	52
6. The functional application nature of indigenous knowledge	0	66	53	54
7. The holistic approach to problem solving	67	55	62	39
8. The creative and mythical nature of indigenous knowledge	0	59	50	66
9. Social, collaborative and cultural embeddedness of indigenous knowledge	0	54	28	68
10. The subjective nature of indigenous knowledge	0	54	72	55
Average	**20**	**63**	**56**	**51**

From Table 4.3 it can be observed that teachers with a teaching experience of between one and five years have the highest (63%) partially informed views on the nature of IK. Most of their partially informed views were demonstrated in their responses to items 1 (based on what IK is and how it differs from western knowledge; 85%) and 4 (based on the resilient yet tentative nature of IK; 77%). Their partially informed views are much higher than their informed and uninformed views. One of the possibilities for this could be that, as new teachers in the field, they are still trying to find their feet and making sense of the CAPS document and its demands. The concept of indigenous knowledge is not new to them, but the many challenges that they encounter in township schools leads to confusion, thus making the practical integration of IK difficult. Their excitement, expecting to find a platform to implement what they were taught at universities, only to find that there is nobody who has an understanding of IK integration, and it is not even discussed in schools. They are gradually becoming disconnected to the knowledge they received at their universities during their pre-service training years. They want to put the knowledge into practice but teachers in the field are mainly focusing on finishing the prescribed set of work for the different terms.

Interestingly, no partially informed views were demonstrated by the teachers with less than one year of experience for items 4 (based on the resilient yet tentative nature of IK), 5 (based on the ‘wisdom-in-action’ nature of IK), 6 (based on the functional application nature of IK), 8 (based on the creative and mythical nature of IK), 9 (based on the social, collaborative and cultural embeddedness nature of IK) and 10 (based on the subjective nature of IK). Their overall percentage of partially informed views was the lowest (20%). Those teachers with an experience of between 6 and 15 years and those with more than 15 years of experience also demonstrated a high percentage of partially informed views, 56% and 51% respectively. However, it was noted that the teachers with an experience of between six and 15 years were mostly partially informed on item 1 (78%) and 10 (72%), which is higher than their uninformed views, as already alluded to, that they are probably upgrading their qualifications by registering at universities. The next table, Table 4.4, shows the distribution of uninformed teachers’ views under each teaching experience category.

Table 4.4 Distribution of teachers with uninformed views under each experience category

	Distribution of teachers with uninformed views under different teaching experiences (%)			
	Less than 1 year	Between 1 and 5 years	Between 6 and 15 years	More than 15 years
VNOIK item				
1. The nature of indigenous knowledge	0	7	12	48
2. The empirical and metaphysical nature of indigenous knowledge	0	8	14	47
3. The inferential yet intuitive nature of indigenous knowledge	33	8	13	44
4. The resilient yet tentative nature of indigenous knowledge	33	13	18	40
5. The 'wisdom-in-action' nature of indigenous knowledge	0	23	34	33
6. The functional application nature of indigenous knowledge	0	15	19	36
7. The holistic approach to problem solving	0	21	11	42
8. The creative and mythical nature of indigenous knowledge	0	23	17	19
9. Social, collaborative and cultural embeddedness of indigenous knowledge	0	15	33	18
10. The subjective nature of indigenous knowledge	33	27	16	23
Average	**10**	**16**	**19**	**35**

From the 45 teachers with more than 15 years of teaching experience, making the largest number of participants in this study, it emerged that 39 of them hold the highest (35%) of uninformed views about the nature of IK. For items 1 (based on what IK is and how it differs from western knowledge), 2 (based on the empirical and metaphysical nature of IK), 3 (based on the inferential yet intuitive nature of IK), 4 (based on the resilient yet tentative nature of IK), and 7 (based on the holistic approach to problem solving in IK), they scored more than 40% of each of uninformed views. The group with less than one year demonstrated the lowest of uninformed views (10%), which were not surprising, as already alluded to. Their uninformed views were only found in very low percentages in items 3 (based on the inferential yet intuitive nature of IK), 4 (based on the resilient yet tentative nature of IK) and 10 (based on the subjective nature of IK).

4.2.3 Relationship between teachers' religious beliefs and their views

Haney, Lumpe, Czerniak and Egan (2002) posited that that which a teacher believes to be true will determine how he or she approaches teaching and ultimately those activities intended to improve educational processes in the classroom. The conflict that is brought about by religion is categorised as one of the main contributors to problems associated with classroom practice (Naude, 2013), as religions have their own views of indigenous knowledge. They are thought to influence teachers' views, understanding and judgements, thus affecting teachers' behaviour and level of innovation in the classroom. The possibility of a relationship between teachers' religious beliefs and their views was investigated, and the findings are presented in Table 4.5.

Table 4.5 Distribution of teachers with informed views under each religion

	Teachers with informed view under each religion (%)		
	Christianity	**African Traditional**	**Jehovah's Witness**
VNOIK item			
1. The nature of indigenous knowledge	44	39	21
2. The empirical and metaphysical nature of indigenous knowledge	15	16	0
3. The inferential yet intuitive nature of indigenous knowledge	89	87	17
4. The resilient yet tentative nature of indigenous knowledge	21	13	17
5. The 'wisdom-in-action' nature of indigenous knowledge	33	33	0
6. The functional application nature of indigenous knowledge	11	7	16
7. The holistic approach to problem solving	96	100	8
8. The creative and mythical nature of indigenous knowledge	22	14	17
9. Social, collaborative and cultural embeddedness of indigenous knowledge	32	35	0
10. The subjective nature of indigenous knowledge	7	0	16
Average	**37**	**34**	**11**

From Table 4.5, it was interesting to note that Christian teachers demonstrated the highest average percentage (37%) of informed views. These views were prominent in items 3 (based on the inferential yet intuitive nature of IK; 38%) and 7 (based on the holistic approach to problem solving; 96%). The African traditional religion came second with 34% of informed views, while Jehovah's Witness came with 11% of informed views. Teachers affiliated to the

African traditional religion were more informed on items 3 (based on the inferential yet intuitive nature of IK) and 7 (based on the holistic approach to problem solving). Surprisingly, none of them was informed about item 10 (based on the subjective nature of IK). The next table 4.6 shows the distribution of partially informed views under each religion.

Table 4.6 Distribution of teachers with partially informed views under each religion

	Teachers with partially informed view under each religion (%)		
	Christianity	**African Traditional**	**Jehovah's Witness**
VNOIK item			
1. The nature of indigenous knowledge	56	61	67
2. The empirical and metaphysical nature of indigenous knowledge	78	71	67
3. The inferential yet intuitive nature of indigenous knowledge	11	13	32
4. The resilient yet tentative nature of indigenous knowledge	63	69	50
5. The 'wisdom-in-action' nature of indigenous knowledge	56	56	83
6. The functional application nature of indigenous knowledge	87	89	54
7. The holistic approach to problem solving	3	0	17
8. The creative and mythical nature of indigenous knowledge	67	67	50
9. Social, collaborative and cultural embeddedness of indigenous knowledge	44	44	100
10. The subjective nature of indigenous knowledge	78	78	67
Average	**54**	**55**	**59**

Table 4.6 shows that partially informed views were demonstrated more or less equally across all religions. This means that belonging to any of the three different religions did not produce any significant impat on the views on the nature of IK. However, the majority (59%) of the partially informed views were demonstrated by teachers belonging to Jehovah's Witnesses.

Biographical details about the sample revealed that teachers who participated in the survey belonged only to three religious denominations: Christianity, African traditional religion and Jehovah's witnesses. The following table, Table 4.7, shows the distribution of uninformed views under each religion.

Table 4.7 Distribution of teachers with uninformed views under each religion

	Teachers with uninformed view under each religion (%)		
	Christianity	**African Traditional**	**Jehovah's Witness**
VNOIK item			
1. The nature of indigenous knowledge	44	0	12
2. The empirical and metaphysical nature of indigenous knowledge	15	11	33
3. The inferential yet intuitive nature of indigenous knowledge	89	0	51
4. The resilient yet tentative nature of indigenous knowledge	21	18	33
5. The 'wisdom-in-action' nature of indigenous knowledge	33	11	17
6. The functional application nature of indigenous knowledge	11	4	30
7. The holistic approach to problem solving	96	0	75
8. The creative and mythical nature of indigenous knowledge	22	19	33
9. Social, collaborative and cultural embeddedness of indigenous knowledge	32	21	0
10. The subjective nature of indigenous knowledge	7	22	17
Average	**37**	**11**	**30**

According to Table 4.7, Christians held more (37%) uninformed views than all the other religions. This was to be expected as most Christians are totally against IK integration, claiming that it teaches learners about witchcraft and evil spirits. The majority of their uninformed views were demonstrated by responses to items 3 (based on the inferential yet intuitive nature of IK) and 7 (based on the holistic approach to problem solving). Teachers belonging to African traditional religion held the lowest of uninformed views and this was to be expected. In most of their responses, no uninformed views were demonstrated, such as in item 1, 3 and 7. Teachers have been exposed to their different religions in one form or another, and they have created their own worldviews, based on the specific religion's doctrine. In some cases, the integration of indigenous knowledge is in conflict with their doctrines when the teacher tries to integrate indigenous knowledge into his or her classroom practice.

4.2.4 Summary of teachers' views about the nature of indigenous knowledge

In order to present the summary of teachers' views about the nature of IK, each VNOIK item was evaluated against the specific tenet of the nature of indigenous knowledge framework it represents, so that teachers could give a rich and comprehensive view. Figure 4.1 shows how each of the ten VNOIK items is linked to its specific tenet of the NOIK framework, as well as the summary of teachers' views about the NOIK.

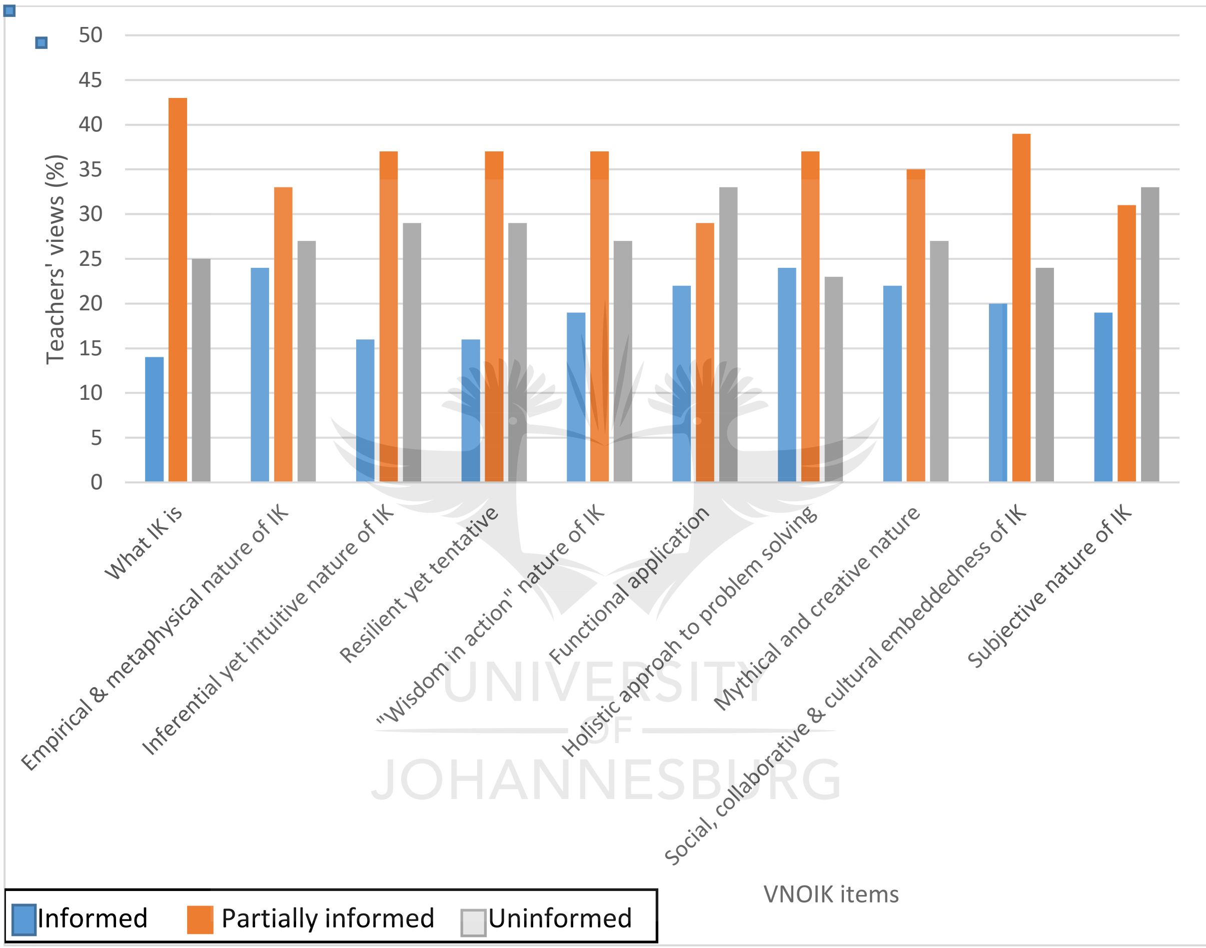

Figure 4.1 Summary of teachers' views about the nature of indigenous knowledge

Figure 4.1 presents findings collected from the 79 participants who completed the VNOIK questionnaire. Findings reveal that the partially informed views are the most prominent in all of the VNOIK items. Item 1, based on what IK is and how it differs from Western knowledge was the one with the highest of partially informed views. This item is the most important one, as it reveals the teachers' understanding of what IK is and whether the teacher can identify the similarities and differences between IK and the Western knowledge on which classroom science is based. If the teachers are demonstrating such high partially informed views (43%), and also uninformed views (25%) on item 1, it means that 68% of Grade 7 science teachers in township schools do not have the desired understanding of what IK entails, and are therefore not in a position to integrate IK in their classrooms. This is a cause for concern. The percentage of uninformed views was much higher than those of informed views, by 11%. Although in most of the teachers' responses, they were able to mention at least two of the anticipated answers regarding what IK is, it is very worrying that most of these teachers think that there is a conflict between IK and classroom science. For successful integration, it is important that both IK and classroom science be viewed as complementary to each other. This raises a serious concern about how the integration of IK into the natural sciences classroom can take place, if teachers themselves are harbouring undesirable views about what IK is. Accordingly, teachers must ensure that they clearly understand the content before teaching it to the learners.

In the second item, dealing with the empirical and metaphysical nature of IK, where teachers were requested to explain whether the practitioners of indigenous knowledge do experiments and tests to verify or validate their knowledge. An equal number of teachers were partially informed about whether elders in a community use only natural causes, or they also sometimes include supernatural causes to explain their observations. Although most teachers agreed that IK can sometimes include unnatural causes, they failed to give relevant explanations or examples to support their answers. They also gave very brief explanations of the 'wisdom-in-action' nature of IK, and could not clearly explain how the Khoi San people generated knowledge about the Hoodia gordinii plant that suppresses hunger and thirst. For effective integration of IK, it is imperative that teachers clearly understand and respect that IK also includes unnatural explanations of observations and has stood the test of time, but is fluid and can be adapted or edited to suit current circumstances and to solve environmental problems.

Amazingly, the majority (33%) of views on item 6 were uninformed, whilst 29% were partially informed about the functional application of IK. Teachers had to explain why and how they think IK can or cannot be used to alleviate some global problems like hunger, poverty and underdevelopment. If many teachers (62%) have inadequate views about this item, it means that they do not understand the value of integrating IK into their science lessons. If they do not see the affordances of the IK integration, it is not easy to implement its integration into their classroom practices.

It is impressive to note that item 7 received the highest percentage of informed views when compared with informed views from other items. This item is based on the holistic approach used in IK to solve problems. From teachers' informed views to this item, it was noticeable that teachers understood that, when solving a problem, the indigenous people would search for the trigger of the problem or disease, and most importantly consult the ancestors for help before administering the possible treatment to their patients. They were informed about the holistic approach, which entails examining social, historical and spiritual aspects.

From the assertion in item 8 on the creative and mythical nature of IK, teachers' views ranged from uninformed (24%) to partially informed views (39%). These teachers were either not sure or they agreed but failed to give reasons for their answers. This means that a total of 63% of Grade 7 science teachers did not have a clear understanding of the role of myths, rituals, imitation and demonstrations during the oral transmission of IK. IK is simplified for easy understanding through the use of stories with life lessons.

In response to item 9, teachers obtained 39% of the partially informed views, 24% of uninformed views and 20% of informed views on the social, collaborative and cultural embeddedness nature of IK. In this item, teachers were requested to explain, with examples, if they believed that IK reflects the social and cultural values of a specific community and also to explain, with examples, if they believed that IK can only be used in a specific area or it can be used in other areas or globally to solve problems. The majority of views coded as partially informed were those by which teachers agreed and gave examples to show that IK does reflect social and cultural values but said they did not believe it can be transferred, and no explanation was given as to the reason they believed so. This means that they have naive views about IK being embedded in social and cultural values of a certain group of people. This also raises concerns, as this view is critical in social constructivism, on which the South African science curriculum is based.

In the last item, 10, based on the subjective nature of IK, teachers had to explain if current practitioners of IK must use this knowledge exactly as it was passed on to them, or can they use their creativity and imagination to modify the indigenous knowledge to solve current problems. Findings from responses to this item revealed that there were more (33%) uninformed teachers' views about the creativity and innovation involved in IK than the partially informed (31%). This means that these teachers were uninformed that IK is a living and dynamic knowledge base that can be constantly adapted and modified by its practitioners to generate new knowledge that will appropriately address currently developing issues and problems, such as HIV/AIDS. The lack of this understanding shows that the teachers are far from being able to develop strategies that will be used to integrate IK in their classroom practices, as they do not understand the creative notion of IK, which they could also apply during the integration of IK.

Teachers' responses to each of the VNOIK items were coded using a scale of informed, partially informed and uninformed views on the nature of indigenous knowledge. The following table, Table 4.8, shows a summary of coded responses of each participant to the VNOIK items. The conclusion drawn from the findings is that the majority of Grade 7 natural sciences teachers in primary school are harbouring partially informed views on the nature of indigenous knowledge.

Findings presented in Figure 4.1 reveal that teachers' responses in most of the VNOIK items were partially informed. The researcher went on further to explore the frequencies of teachers views per VNOIK item so as to show in which of the tenets were the teachers informed, partially informed or uninformed. Initially, there were 80 Grade 7 NS teachers in township schools under the Johannesburg Central and Johannesburg North districts, in the Gauteng province, who completed the VNOIK questionnaires. One of the questionnaires was withdrawn from the sample. The percentages of informed' partially informed and uninformed views per question, from the 79 final number of respondents was recorded as shown in the following table, Table 4.8.

Table 4.8 Summary of overall coded responses of participants

	Informed views	Partially informed views	Uninformed views
VNOIK item			
1. The nature of indigenous knowledge	14	54	32
2. The empirical and metaphysical nature of indigenous knowledge	24	42	34
3. The inferential yet intuitive nature of indigenous knowledge	16	47	37
4. The resilient yet tentative nature of indigenous knowledge	16	47	37
5. The 'wisdom-in-action' nature of indigenous knowledge	19	47	34
6. The functional application nature of indigenous knowledge	22	37	41
7. The holistic approach to problem solving	24	47	29
8. The creative and mythical nature of indigenous knowledge	22	44	34
9. Social, collaborative and cultural embeddedness of indigenous knowledge	20	50	30
10. The subjective nature of indigenous knowledge	19	39	42
Average	**20**	**46**	**34**

Table 4.8 reveals that the question with the lowest number of informed views was item 1, with only 14% of informed views. This question is based on the explanation of what IK is and how it differs from classroom science. It must be mentioned that none of the VNOIK questions received a score rating above 50 percent for the informed views.

Findings from the analysis of partially informed views show that the question with the lowest percentage (37%) of partially informed views was 6. For item 1, teachers displayed the mostly partially informed views. The researcher also found that none of the VNOIK items received a score rating above 50 percent for the partially informed views, which are inadequate for the integration of IK into the science classroom.

Item 7 had the lowest number of uninformed views (29%). The researcher also found that none of the VNOIK questions received a number above 50 percent for the uninformed views.

The views of all the participants to each VNOIK item were also sought. They are attached in this report as Appendix I. These views were then summarised by calculating the average percentages of teachers' views regarding the nature of IK, as shown in Figure 4.2.

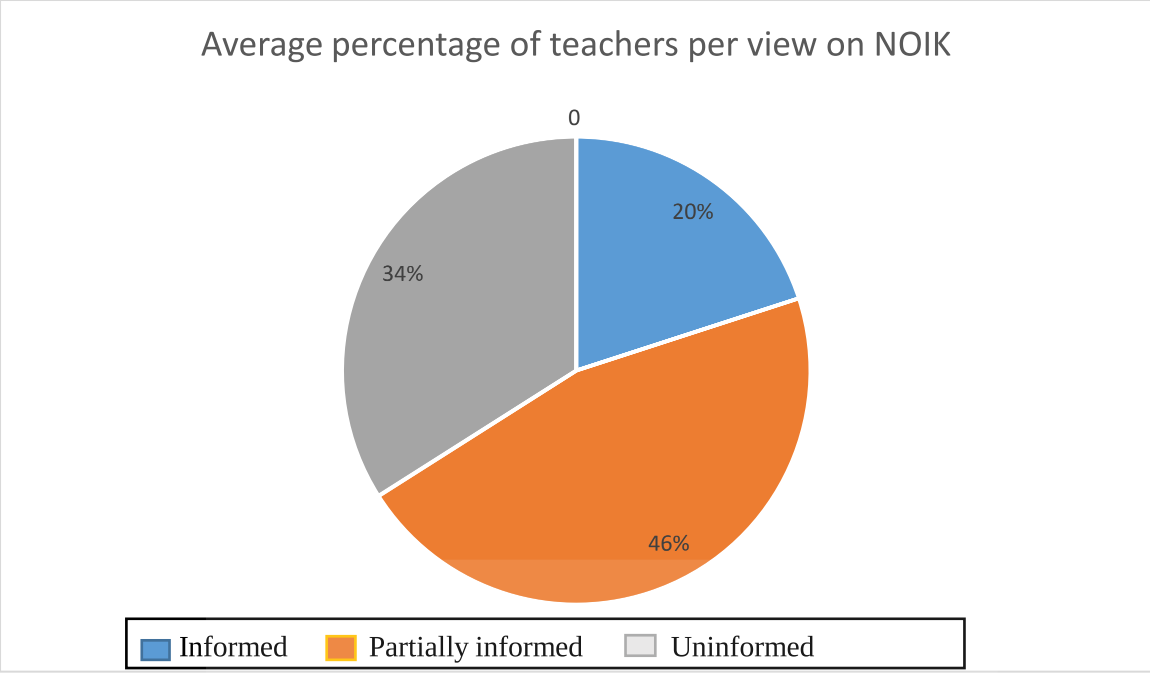

Figure 4.2 Average percentages of teachers' views on the nature of indigenous knowledge

From Figure 4.2, it was found that 20% of overall teachers' views on the NOIK were informed views, 46% were partially informed views, while 34% were uninformed views. The views generally held by Grade 7 NS teachers regarding the integration of IK in the classroom are mainly partially informed views. Figure 4.2 clearly shows that, in summary, the total percentage of inadequate, undesirable or nuanced teachers' views on the nature of IK is 80%, which is very shocking. Such views hinder the integration of IK into the science classrooms.

The following Figure 4.3 shows a summary of how research sub-question 1 was addressed.

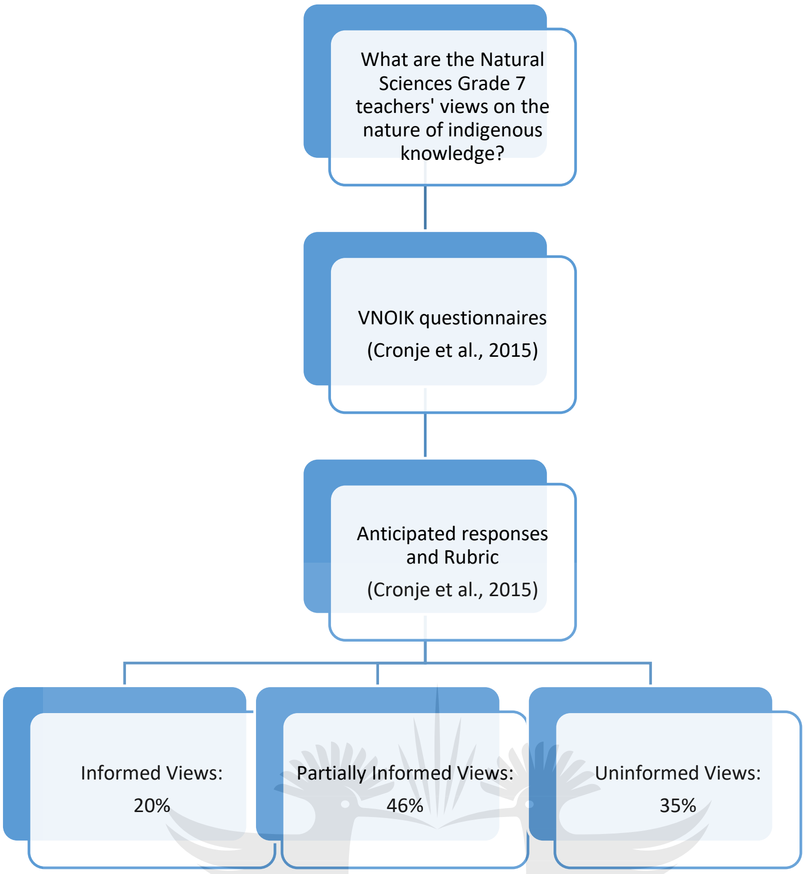

Figure 4.3 Summary of how research sub-question 1 was addressed

From Figure 4.3, it is evident that The VNOIK questionnaire was administered to Grade 7 NS teachers in order to address research sub-question 1: what are the natural sciences Grade 7 teachers' views on the nature of indigenous knowledge? Teachers responses were compared to the anticipated responses to VNOIK questionnaires and the rubric that was developed for this purpose was used to score the different views. This means that the majority of the Grade 7 NS teachers in township schools held inadequate views regarding the nature of IK.

4.3 PART B: RELATIONSHIP BETWEEN TEACHERS' VIEWS AND THEIR CLASSROOM PRACTICES

In order to determine the overall views of each of the 79 participants (Appendix I), each of the responses to the 10 VNOIK items were compared against the anticipated responses (Appendix F). The researcher then determined whether each response was informed, partially informed or uninformed. A score of either 2, 1 or 0 was allocated to each of the 10 responses to the VNOIK items (Appendix G). The scores were then added together to give a total out of 20. An example is of Nontuthuko's (one of the teachers) whose total score was 16 out of 20. In order to get an average score of each participant, this sum total was then divided by 10, which is the total number of VNOIK items per questionnaire. Nontuthuko got 1,6, which became 2 when rounded off. The final score of 2, 1 or 0 were categorised as per rubric, as informed, partially informed or uninformed, respectively, meaning Nontuthuko had an overall informed view. The six participants, Nontuthuko, Phakamani, Avhashoni, Dimakatso, Nobuntu and Dikeledi pseudonyms) were selected for the interviews as shown in Table 4.9 that follows.

Table 4.9 Coded responses to each VNOIK item for the six interviewees

Pseudonym	**View**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Total**	**Overall view**
Nontuthuko	View	UI	I	I	I	I	UI	I	I	I	I		Informed
	Weighting	0	2	2	2	2	0	2	2	2	2	16/20	1,6=2
Phakamani	View	PI	I	I	PI	PI	I	I	PI	I	I		Informed
	Weighting	1	2	2	1	1	2	2	1	2	2	16/20	1,6=2
Avhashoni	View	PI	I	I	PI	PI	UI	I	I	I	UI		Partially Informed
	Weighting	1	2	2	1	1	0	2	2	2	1	13/20	1,3=1
Dimakatso	View	UI	PI	UI	I	UI	UI	UI	PI	PI	PI		Partially Informed
	Weighting	0	1	0	2	0	0	0	1	1	1	06/20	0,6=1
Nobuntu	View	UI	UI	PI	UI	UI	PI	PI	UI	UI	PI		Uninform ed
	Weighting	0	0	1	0	0	1	1	0	0	1	04/20	0,4=0
Dikeledi	View	PI	UI	UI	PI	PI	UI	UI	UI	UI	UI		Uninform ed
	Weighting	1	0	0	1	1	0	0	0	0	0	03/20	0,3=0
Overall weighting		1	1	1	1	1	1	1	1	1	1	10/20	0,5=1

From Table 4.9, responses of the six teachers selected for interviews are presented. Nontuthuko and Phakamani were selected because their views were informed. Findings from their responses to the VNOIK questionnaire showed that Nontuthuko was uninformed about items 1 and 6. None of her responses was categorised as partially informed. For Phakamani, none of her responses was uninformed. The two teachers selected because their views were partially informed were Avhashoni and Dimakatso. It was revealed that Avhashoni had demonstrated uninformed views for items 6 and 10, while Dimakatso had shown only one informed view for item 4, and uninformed views for items 1, 3, 5, 6 and 7. Finally, Nobuntu and Dikeledi were selected because they had demonstrated uninformed views. Findings from Nobuntu's responses revealed that she was uninformed about a number of items, namely item 1, 2, 4, 5, 8, and 9, while Dikeledi was uninformed about 2, 3, 6, 7, 8, 9, and 10. Table 4.10 shows a summary of the percentage total scores for teachers selected for interviews.

Table 4.10 Percentage total scores for teachers selected for interviews

Participants (Pseudonyms)	Informed views (%)	Partially informed views (%)	Uninformed views (%)	Overall view
Nontuthuko	80	0	20	Informed
Phakamani	70	20	10	Informed
Avhashoni	10	40	50	Partially informed
Dimakatso	50	30	20	Partially informed
Nobuntu	0	40	60	Uninformed
Dikeledi	0	30	70	Uninformed

Table 4.10 shows that none of Nontuthuko's views was coded as partially informed. She had more informed views and very low (20%) uninformed views regarding the nature of IK. Phakamani had 70% informed views and 30% total of undesirable views. Avhashoni, with an overall of partially informed views, had a total of 90% undesirable views, while Dimakatso had 50% of undesirable views. Both Nobuntu and Dikeledi, whose overall views were rated as uninformed, had shockingly none of the informed views about the nature of IK. This means that they were incompetent in all the tenets of IK framework.

From the analysis of the interviews conducted with the six teachers, three themes emerged. Findings are presented under the three themes which are: 1) Township teachers' inadequate views about the nature of indigenous knowledge influence negatively on their classroom practices; 2) Teachers experiences determine how they integrate indigenous knowledge in their classrooms; and 3) Teachers lack the knowledge and skills to integrate indigenous knowledge into the natural sciences teaching.

4.3.1 Theme 1: Township teachers' inadequate views about the nature of indigenous knowledge influence negatively on their classroom practices

During interviews, teachers were asked to first express their understanding of the nature of science (NOS). From their responses, which were largely empiricist and partially informed, it emerged that they believe science is classroom-based, meaning it is acquired and learnt in the classroom. The participants did not view science as something that can be learnt through other means of learning, such as observation of natural works. The following are some of the responses from the teachers.

Phakamani: I believe that science is the knowledge that we teach to our learners in class, as well as the experiments that are performed in laboratories.

Dimakatso: Science is based on theories and law, is provable, and involves experiments that are conducted in science laboratories.

This is the view that was shared by all six participants as none of them gave a significantly different response.

When the teachers were probed further to explain their understanding of IK, their responses led to the identification of these codes: definition of IK; origin of IK; transmission of IK and uses of IK. These codes were grouped together as referring to the teachers' understanding of IK. From the teachers' expressions, it was evident that most teachers held a partially informed understanding of the meaning of IK. The responses to these two interview questions were grouped together since the focus of this study was not on NOS, but on IK.

The understanding of teachers on the role of IK in the learning of science was also sought. The responses indicated that the thinking of most teachers was that IK does support CAPS in making science content that is learnt in the classroom relevant. According to the participants, IK supports CAPS in making science content relevant, clarifying and simplifying difficult science concepts and terms, and this revealed that most teachers reckoned that NS contains many abstract terms, and if the teacher integrates IK, it would mean starting the lesson from what the child knows, thus simplifying and clarifying the many difficult terms and concepts.

Their responses included:

Phakamani: IK supports CAPS in making science content relevant.

Avhashoni: IK helps in clarifying and simplifying difficult science concepts and terms.

NS teachers, according to the findings of this study, acknowledge the differences between IK and Western knowledge on which classroom science is based. From the differences mentioned by participants, it emerged that they believed that classroom science is taught in the classroom, and involves written work and practical work in the form of experiments, while they believed that IK is transmitted orally by using folk tales, and there are no experiments to perform. They also expressed that classroom science can be proven by facts, and IK, because of the belief in supernatural powers and witchcraft, cannot be questioned or challenged, but must be taken as is. From some of their responses, it was evident that they felt that classroom science is well documented, in written format, in books while IK is not accessible from available resources, but is stored in the minds of certain members of community, usually the elderly. These knowledge systems were also found to differ in the teaching and learning methods used. For classroom science, they all subscribed to the traditional belief in the use of the scientific method, while they were not sure of teaching and learning methods of IK, except to use a narrative method, during story-telling.

In order to determine the teachers' understanding of the importance of the integration of indigenous knowledge in science lessons, teachers were asked to provide explanations on what they thought are the reasons for considering IK in the science classroom. The six responses that were received revealed that all six participants did not give the integration of IK in the science classroom the recognition it deserves. Although their responses revealed that science teachers do value the great role played by integrating IK when teaching difficult science content and concepts, none of the participants provided comprehensive reasons for the need to consider IK in the science classroom. Most of their responses, as indicated in the following responses, were partially informed, and with such inadequate views, there is a lack of IK integration in the classroom and thus limiting learners to the acknowledgement of other knowledge systems.

Nobuntu: To improve understanding of abstract concepts.

Phakamani: To make science relevant to the everyday lives of learners.

Teachers were also requested to explain if they thought their views on the nature of IK affected the way in which they integrate IK in their classrooms. This was done to determine teachers' understanding of the impact of their views on classroom practices. This was a 'two-in-one' question as it required teachers to first determine if their views on the nature of IK affected or not their integration of IK in the classroom. Second, they had to support their answer. Most of the following responses showed that science teachers are more than willing to integrate IK into their classrooms, as long as they are provided with a clear understanding of IK and are provided with the necessary support and guidelines.

Dikeledi: I am very much willing to integrate, but only if I am well informed as this will boost my confidence. I can't teach something I am not sure about.

Dimakatso: Most of my colleagues and I really want to put this implementation into practice but we don't even know where to start. We need to be developed so as to gain confidence. We can't teach something that we, ourselves, do not understand.

Phakamani: We, as teachers feel like we have been dropped in the middle of the ocean and we have to find our own way out. No one is prepared to come and rescue us from this sinking ship of confusion and frustration.

One of the teachers, Avhashoni, expressed the need for active and formal participation of community elders who are rich in IK. This was emphasised in his response as shown:

Avhashoni: Without the active and formal participation of elders in the community, our efforts to integrate will be meaningless.

From the quoted responses, it is evident that the Grade 7 NS teachers in township schools hold inadequate views on the nature of IK, and these inadequate views influence negatively on their classroom practices. The summary of coded responses (Appendix J) that led to the development of Theme 1 is attached.

4.3.2. Theme 2: Teachers' experiences determine how they integrate indigenous knowledge in their classrooms

Teachers' different experiences during the integration of IK into science classrooms was also sought. Teachers were therefore asked to explain if they found it easy to integrate IK in their lessons and also to elaborate on their experiences during the integration of IK. All the teachers highlighted that it was not easy for them to integrate IK in their lessons due to the numerous negative experiences relating to challenges that they were facing when attempting to integrate IK into their classrooms. One challenge that was highlighted is the lack of teaching and learning content and materials.

Dikeledi: It is not easy for us to integrate because so far there is no learning and teaching material that can be used to integrate IK into the current content that we teach in class.

Avhashoni: Well, to be honest, I hardly integrate IK into my classroom. At times, although very rarely, especially in term 4, where we do 'Planet Earth and beyond" strand. I would talk about IK during the lesson, like when I am talking about how the indigenous people knew times of the day and seasons, how they would observe the sky, the stars and the sun and interpret it. However, this is not indicated in my lesson planning.

This means that there is therefore no effective IK integration that takes place inside science classrooms in the absence of teaching and learning materials. Another challenge that was cited is that of textbooks that are not compliant with CAPS because they also lack IK content. This makes it difficult for teachers to integrate IK into science classrooms.

The teachers also highlighted in the following responses that they were finding it difficult to integrate IK into classroom teaching as there were no clear instructional methods to employ.

Nontuthuko: The problem with teaching IK in the classroom is that we do not know exactly how it should be done. This is different from science we normally teach in our classrooms, where there are clear guidelines of how to do it and the methods that should be followed.

The teachers indicated that they were expected to come up with their own ways of teaching IK, which makes it very difficult, as being innovative and creative is not possible if the basic comprehension of the IK concept is lacking.

Each of the six teachers, as indicated in the following responses, felt that their lack of clear understanding of what IK entails is the major challenge that hinders IK integration into their science classrooms.

Phakamani: So far we as teachers have not been provided with adequate information on IK. How then can we be expected to teach what we do not adequately understand?

Nobuntu: We can live with the other challenges, because it is not difficult to deal with them. For instance, as experienced teachers, we can try and come up with effective teaching methods to teach IK, and we can also try and design teaching aids, but the fact that we do not understand this IK makes matters worse. One does not even know where to start.

The teachers indicated that they had not been provided with training on IK and could not be expected to effectively integrate in the absence of such training that they regard as very crucial.

Another challenge that was cited by all the teachers is the way the curriculum is being implemented, which is a top-down approach. The teachers felt that they were supposed to be consulted so that they can make inputs into the curriculum, since they are the ones who are on the ground and they know what works best in the classroom.

Avhashoni: The problem is that all curriculum issues are dealt with at the top and we are only given the curriculum to implement. It is crucial for teachers to make contributions to the curriculum development if integration is to succeed.

This view was shared by all six teachers, who felt that their exclusion from making decisions that affect their work only contributes to the failure of new initiatives.

These responses reveal that teachers do value the integration of IK and are willing to integrate IK into the science classroom. The findings of this study revealed that their current experiences during actual integration are mainly negative, characterised by challenges. Because of this, teachers face uncertainty, confusion and a lack of confidence, which make them feel like they have been "dropped in the middle of the ocean, and must find their own way out". As a result, teachers end up not trying at all to integrate IK, or they plan the integration in their lessons, but abandon their plan half way through the lesson. Teachers' challenges and negative experiences during actual integration of IK into the science classroom determine how they will integrate IK into future science lessons. The summary of coded responses that led to the development of Theme 2 is attached as Appendix K.

4.3.3 Theme 3: Teachers lack knowledge and skills in integrating indigenous knowledge in Natural Sciences teaching

Teachers are convinced that, if their views on the nature of IK are enhanced, they will be in a position to better implement the integration of IK. From their responses, it was evident that all six teachers are willing to integrate IK into their classrooms; however, this is not taking place practically. This lack of integration could be attributed to teachers' partially informed views about the nature of IK. These responses also paved the way for the realisation of the teachers' cry out for help as teachers were also able to list their needs, which included the need for IK-focused intervention programmes that must be conducted by competent facilitators; the need for centralised resource distribution centres for IK-related materials and a more clear and guiding NS curriculum.

The teachers were asked to suggest some strategies that they felt could be used to deal with the negative experiences encountered during integration so that IK could be successfully integrated into classroom learning. One of the strategies that was suggested by the participants is collaboration with those who were in possession of IK in the communities. These members of the community should make some inputs into the content that will be necessary for the students to learn.

Phakamani: In order for integration to be successful, there is need to engage those elders in the community who have IK.

Nobuntu: The involvement of community members who possess IK is crucial for the success of integration as they will be there to impart such knowledge on the teachers.

The teachers also suggested that the authorities should put in place policies that recognise the value of indigenous knowledge in the science programme.

Nontuthuko: Successful integration begins with the highest authorities recognising the importance of IK in the teaching and learning of science. There is therefore need for policies that make it mandatory for schools to integrate IK into classroom science.

Once, the value of IK is recognised from the top and policies are put in place, teachers will find it easy to make efforts to ensure that these policies are implemented.

The participants also encouraged the effective training and development of teachers so that they understand IK and its benefits. Only then can teachers place comprehensive value on IK integration.

Nobuntu: It is only when teachers are trained and developed that they are able to integrate

IK in classroom learning. Successful integration cannot occur when the teacher who is supposed to be the facilitator is not sure of what to teach.

According to the teachers, it is crucial to ensure that the relevant authorities put in place meaningful development programmes that are targeted at science teachers at all levels.

Avhashoni: We need workshops to be run by facilitators that know their story. Facilitators must be knowledgeable about this IK and must be in a position to address our concerns regarding this IK so that we can be able to teach it in our classrooms.

Their responses revealed that teachers assume that, if their views are enhanced through IK-focused intervention programmes, their classroom practices will improve.

In determining the teachers' understandings of the role of intervention programmes in their teaching, they were required to share if they had attended a workshop that focused on how integration of IK in the classroom should take place or the workshop in which the integration of IK was deliberated upon and modelled or demonstrated as to how it should be done. All of the six teachers acknowledged having attended a number of development programmes organised by the Department of Education. However, teachers pointed out that none of their challenges wase addressed in these workshops, which indicates flaws in the nature of the in-service training workshops given to teachers.

Phakamani: The main focus of these development programmes had always been curriculum coverage, and such important stipulations of curriculum implementation have been ignored.

Dikeledi: I remember in one of the workshops I attended, I think in 2012, during the introductory stages of the new curriculum, the facilitator mentioned in passing that there is now a special requirement in our teaching to integrate IK into our science teaching. There was a moment of silence, hoping for more clarification, but that was it. The facilitator just went on to talk about other things that were curriculum-based. You know, nobody asked anything about that statement.

From their responses, it emerged that their expectations of what intervention programmes should be about are not met. They defined the intervention programmes and explained their roles; however, the current status of intervention programmes is that facilitators conducting these programmes appear incompetent and there is no support for teachers to implement the curriculum stipulations. Teachers, therefore, need comprehensive support and more IK-focused intervention programmes that will be conducted by competent facilitators to enhance their views and improve confidence to integrate IK effectively into their classrooms.

Individual teachers' personal reflections on how their participation in this study affected the way they think and their views about the integration of IK in the science classroom was sought. The following are some of their responses.

Nontuthuko: Yes, this IK integration now feels more possible and doable.

Phakamani: I am now considering making an effort to integrate IK into my lesson planning. This discussion has assisted in lifting the burden off my shoulders. I have sometimes felt guilty that I might be legally charged for not following the Department of Education's stipulation in the CAPS to integrate IK into my science classroom.

Avhashoni: I am still not confident to integrate it. Why is the Department of Education so silent about this need?

Dimakatso:

Nobuntu: It would really assist us as teachers a lot to integrate learners' prior knowledge of IK when teaching most of these difficult science concepts and content in general, but I still need to be developed to improve my confidence. Just imagine what would happen if I am busy teaching this IK in class, and a learners asks me a question for further clarification, and I do not know the answer and I can't even say let's go and google for the answer we will discuss it tomorrow. There is no information on the internet. None whatsoever, hence I am saying we still need to be developed on IK.

Dikeledi: This discussion has really opened my eyes. If nothing is done to improve teachers' understanding of IK, we are destroying the whole generation of future scientists, because they could have benefited from the integration of IK, and could have improve their marks in matric and beyond and could have developed an interest in science related careers.

From their responses, it emerged that most of them had not been paying attention to this stipulation by the CAPS, and were only focusing on curriculum coverage. However, after this platform to voice out their views and engage in argumentation about IK, they are now rethinking their decisions of excluding IK, and are considering giving this integration a second chance in their classrooms. They all feel the urgent need for the development of their understanding of IK and the concern about a lack of support from the Department of Education still remains in this regard. Teachers, therefore, need support and more indigenous knowledge-focused intervention programmes to enhance their views and improve confidence to integrate it practically in their classrooms. The summary of coded responses that led to the development of Theme 3 is attached as Appendix L. Figure 4.4 shows a summary of how research sub-question 2 was addressed.

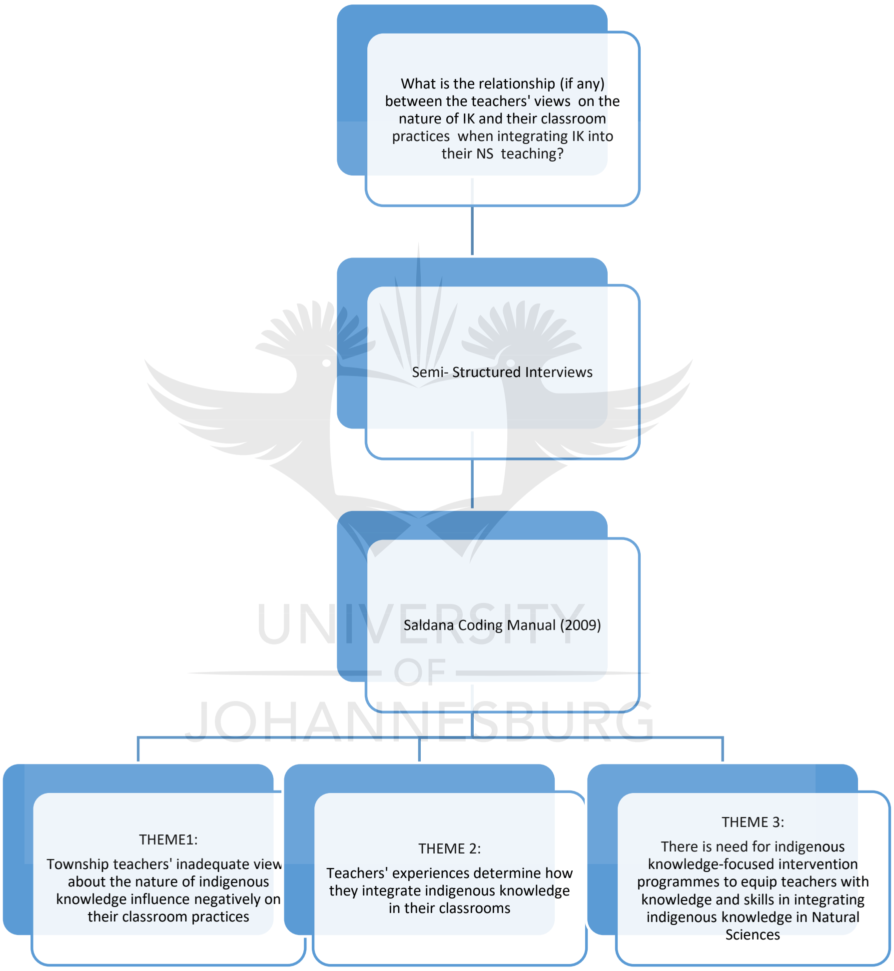

Figure 4.4 Summary of how research sub-question 2 was addressed

From Figure 4.4, it is evident that the semi-structured interviews were conducted with the six teachers selected after the analysis of responses to VNOIK questionnaires. The audio-recorded interviews were analysed by using the Saldana coding manual (2009) in order to address the research sub-question 2: what is the relationship (if any) between the teachers' views on the nature of IK and their classroom practices when integrating IK into their NS teaching? Three themes emerged: township teachers' inadequate views about the nature of indigenous knowledge influence negatively their classroom practices; teachers' experiences determine how they integrate indigenous knowledge in their classrooms; and there is a need for indigenous knowledge-focused intervention programmes to equip teachers with knowledge and skills in integrating indigenous knowledge in natural sciences

4.4. SUMMARY OF CHAPTER 4

This chapter has presented the findings of both the quantitative and the qualitative data. The quantitative data were collected from the 79 Grade 7 NS teachers from 78 township schools, by using the VNOIK questionnaire. These data were analysed by using the anticipated responses and the rubric designed for this purpose (Cronje et al., 2015). The findings indicated that most township teachers harbour partially informed views about the NOIK. The qualitative data were collected from the six-teacher sample, by using semi-structured interviews. Two teachers from the sample had shown informed views regarding the NOIK, two had shown partially informed views and the last two had shown uninformed views. These interviews were conducted to afford the interviewees an opportunity to elaborate on the quantitative results, as well as to triangulate the quantitative data, thus ensuring that valid and trustworthy results were produced. The Saldana coding manual (2009) was used to analyse the interviews. Three themes emerged from the analysis of interviews: township teachers' inadequate views about the nature of indigenous knowledge influence negatively their classroom practices; teachers experiences determine how they integrate indigenous knowledge in their classrooms and there is a need for indigenous knowledge-focused intervention programmes to equip teachers with knowledge and skills in integrating indigenous knowledge in natural sciences. The last chapter, Chapter 5, will highlight the discussion of the findings under these three themes, recommendations and conclusion.

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Chapter 4 presented the findings and interpretation from the analysis of data gathered by means of VNOIK questionnaires and semi-structured interviews administered on Grade 7 natural sciences teachers in township schools. Chapter 5 is a discussion of these findings which answer the main research question: *how do natural sciences senior-phase teachers' views about the nature of indigenous knowledge influence their teaching?* This discussion will be done using social constructivist theory which underpins this study. A discussion of each research sub-question is done separately and then merged at the end when discussing the overall findings that address the main research question. Conclusions and recommendations for enhancing the integration of IK into the learning of natural sciences in the classroom are then made.

In this study, the VNOIK questionnaire was used to collect quantitative data, and semi-structured interviews were used to collect qualitative data. Results from the statistical analysis of the quantitative data, together with the results of the qualitative data analysis provided a comprehensive picture of teachers' views regarding the integration of IK in science classrooms in township schools in the Gauteng Province. The results obtained from questionnaires and interviews are presented to address the following first and second research sub-questions and later to establish whether the biographical differences had any impact on teachers' views about the nature of indigenous knowledge.

5.2 TEACHERS' VIEWS ABOUT THE NATURE OF INDIGENOUS KNOWLEDGE

The research sub-question 1, What are natural sciences Grade 7 teachers' views on the nature of indigenous knowledge?, took the assumption that Grade 7 natural sciences teachers in township schools are integrating IK in their lessons, as stipulated by the Department of Education in the CAPS document. In order to provide answers to this research sub-question, the researcher went deeper into the Grade 7 NS teachers' lived experiences in order to get a more comprehensive picture of their views on the NOIK. This was achieved by administering the VNOIK questionnaire to the grade 7 NS teachers to establish whether their views demonstrated good and desired understandings of IK. For the purposes of this study, it is believed that the way the teachers understand IK has an impact on their efforts to integrate IK into the science classroom.

Findings from the analysis of data from the VNOIK questionnaires revealed that teachers' views on the nature of IK are generally partially informed, and these views are inadequate for the successful integration of IK into the science classroom. For a view to be categorised as partially informed, the teacher would have failed to support his or her answers to the open-ended questions of the VNOIK items. The teacher would have provided either a 'yes' or a 'no' answer without any further clarification or elaboration. The VNOIK items that received the highest of partially informed views were items 1 (54%), which was based on the teachers' views about what the term *IK* means, and item 9 (50%), which was based on the social, collaborative and cultural embeddedness of IK. Findings from analysis of responses to first part of VNOIK item 1, where the participants had to explain what they understood by IK, revealed that the majority of participants were not clear about and had limited understanding of what IK is. Similar results have been reported in previous studies (Timba, 2000; Shizha, 2007; Dziva, Mpofu & Kusure, 2011; Mothwa, 2011; Akerele, 2016) where teachers were found to harbour inadequate views and have a limited conception of IK. Most of the teachers' responses to VNOIK item 1 were based on the origin, transmission and uses of IK. Although the teachers managed to mention that metaphysical plays an important role, none of the teachers focused on explaining IK as a way of knowing, derived by people living in a certain area, at a specific time, interacting with one another and their environment.

The second part of VNOIK item 1 further requested participants to explain how IK differs from classroom or Western science. Although they mentioned differences, they failed to explain that IK and Western science do have some areas in common. Their explanations mainly placed the two knowledge systems as separate worldviews. Le Grange (2004, 2007) highlighted the need for teachers to view both IK and Western science as complementary rather than as competing knowledge entities. In concurrence, Onwu and Mosimege (2004) indicated that the two are dialogical. Teachers were able to describe the oral mode of transmission of IK, but they did not realise and hence failed to indicate that IK transmission also involves modelling, storytelling, ritual and cultural activities, paintings, writings and other artefacts. Most of the responses failed to identify IK as science, as the teachers mentioned that IK was mythical and involved the use of evil spirits. The reason for this could be that the majority of the teachers were Christians, and most of them believe IK involves witchcraft and were therefore uncertain about its integration into the formal classroom science. Most teachers are of the belief that IK generation cannot be proven or tested as is the case with Western science, whose experiments are conducted either in formal classrooms or in science laboratories. This is contrary to the postulation that IK is generated through trial-and-error means, which are rigorously tested in the 'laboratory of survival' (Senanayake, 2006; Aikenhead & Ogawa, 2007; De Beer & Van Wyk, 2011). Accordingly, most teachers were unable to recognise that IK is embedded in the socio-cultural and collaborative milieu, that is, the values, norms, culture and society on which IK is practised have a great impact on the manner in which IK is constructed, generated, interpreted, shared, accepted and applied to everyday living (Agrawal, 1995).

Though very few, some of the responses to the VNOIK items were categorised as informed views. However, none of these informed views was above 25%, with the lowest being VNOIK item 1 that received only 14% of the informed views. This means that, in each of the VNOIK items, there were less than 25% of the teachers that were informed. The uninformed views were also recorded, especially for VNOIK items 6 which was based on the functional application nature of IK, and item 10 which was based on the subjective nature of IK, that received above 40% each for uninformed views. Therefore, the quantitative overall findings from the VNOIK questionnaires revealed that the majority (46%) of the teachers held partially informed views regarding the nature of IK. Over and above this, another 35% of views were categorised as uninformed, because the teachers had either given an unexpected response or had just indicated that they were not sure of the appropriate answer. Both the partially informed and uninformed views made up 81% of the undesired understandings and views regarding the nature of IK which hindered the successful integration of IK into the science classrooms. This position is consistent with findings from a number of researchers. An example is a study conducted by Dziva, Mpofu, and Kusure (2011) which revealed that science teachers have a limited conception of IK. Nnadozie (2009) emphasised the need for teachers to be well-informed about the concept and practice of IK and the place that it has in education today. This shows the need for teachers to conduct research on IK, especially in the localities where they teach and where their learners come from so that they can be well informed. The views of the teachers in this study therefore confirmed the notion that there is a limited understanding of IK among teachers and this has a bearing on the success of the integration of IK into the classroom.

In order to get thick and rich details about teachers' views regarding the nature of IK, the study then endeavoured to explore what informs these teachers' views. It was noted that there were varying amounts of biographical description, and the study then explored what the impact was of these biographical differences to teachers' views on the nature of IK. The relationship between each of the three biographical descriptions from the first part of the VNOIK questionnaires, namely, gender, teaching experience and religious beliefs, on teachers' views was analysed and interpreted.

Most societies regard gender as one of the basic means of social differentiation, as it offers unique experiences, knowledge and skills that are acquired during the execution of the individual's daily duties and allocated responsibilities (Feldstein, Poats, Cloud & Norem, 1989). On that note, the study then assumed that this social differentiation could therefore lead to differences in the IK and skills held by men and women, thus impacting male and female teachers' views on the nature of IK. The possibility of the existence of any gender-based relationship between male and female teachers' views on the nature of indigenous knowledge was then explored. In this study, the finding that there were more females (57%) than males (43%) came as no surprise as it is consistent with the profile stated by Skosana (2018) that women make up 72,5% and men make up the remaining 27,5% of teachers in South African public schools. Table 4.1 shows the different views of male and female teachers to each VNOIK item.

It was interesting to note that the overall total of informed views to most of the VNOIK items were responses from females (20%), as compared to their male counterparts (9%). This was more noticeable on responses to item 1, which is based on what IK is; item 6, which is based on the functional application nature of IK; item 7, which is based on the holistic approach to problem solving nature of IK; and item 9, which is based on the social, collaborative and cultural embeddedness nature of IK. For item 1, which is based on the teachers' understanding of what IK is and how it differs from Western knowledge, the findings revealed that more females (39%) than males (6%) had a desired understanding of what IK is, while males were harbouring views ranging from partially informed (65%) to uninformed (29%) about what IK is. This means that there are more females than males who have the desired understanding of what IK is. It is crucial that teachers, both males and females, develop the desired understanding of what IK is and how it differs from classroom science for its effective integration into the classroom. The study believes that this is so as a result of gender specialisation, which eventually affects hierarchies and levels of accessing, using and managing IK among the two genders in society.

More females (27%) than males (15%) were informed about the functional application nature of IK in terms of their responses to VNOIK item 6. This means that more females agreed, and provided reasons to support, that IK is a source of wealth and is usable in solving contemporary problems, especially where Western science has failed, for example in the treatment of certain diseases and ailments. Accordingly, responses to item 7 showed the majority (42%) of female teachers having more informed views than male teachers (6%). This concurs with the study by Torres-Avilez, de Medeiros and Albuquerque (2016), which revealed that there is a gender-based knowledge difference in relation to medicinal plant knowledge, as women know more about medicinal plants than males. This is because women's roles in most households entail being in charge of family health related issues, diagnosing illnesses and their causes and eventually finding the best medicinal treatment for their children. This is corroborated in a study by Sharma, Chakrabarti and Grover (2016) who found that several societies and cultures demand that females adopt family-caregiver roles.

The social, collaboration and cultural embeddedness nature of IK, as revealed by item 9, emphasises the roles of females, which entail being in charge of socialising and bringing up children and spending more time with them as they grow. This means that women assume the roles of being primary guardians and transmitters of traditional culture in most local communities. Storytelling is also known as the part played mostly by women and it therefore came as no surprise that more males (50%) than females (22%) demonstrated uninformed views to item 8, which is based on the creative and mythical nature of IK. Although most females failed to explain and give examples of the mythical and creative nature of IK, they all agreed that myths and rituals do play an important role in IK. This was to be expected as most females are generally of the view that it is best to teach a life lesson by incorporating it within a folktale, as it stays longer in the mind of a child. Men are naturally not fond of speaking, and therefore would find the myths, storytelling and other modes of transmitting indigenous knowledge irrelevant as compared to females. The male teachers' responses to this item included the following: "myths are techniques of scaring young children- they instil fear among children"; "they are time-wasters"; "they are too fictitious and include things that do not happen in real life, like animals talking". However, this was unlike the female teachers' responses which included positive statements, such as "passes a life lesson in a funny way"; "children listen attentively to a story and are so keen to hear the ending of a story, and the message that is being sent is received with ease"; "learners can relate to the character in the story"; and "the story is told at a learners' level of understanding".

Teachers' teaching experience is another factor that could impact knowledge differentiation (Grenier, 1998). In order to establish the influence of teaching experience on teachers' views, four groups of teaching experiences were identified, namely, less than one year; between 1 and 5 years; between 5 and 15 years and more than 15 years. An interesting finding was that the longer the teaching experience the less informed are the views regarding the nature of IK. Findings revealed that teachers with less than one year of teaching experience (the novice) showed the highest percentage on informed views (70%), especially for items 5, 6, 8 and 9. This calls for the need to salute and congratulate the higher education institutions for their efforts and contributions towards introducing their pre-service teachers to IK and familiarising them with the CAPS Department of Education's stipulations in the natural sciences CAPS document. At the entry level, the teachers are well-conversant with IK and their views are adequate regarding the nature of IK. The uninformed views increased between 6 and 15 years of experience. It is important to note that teachers with more than 15 years of experience demonstrated the lowest percentage of informed views and the highest of uninformed views. It should be noted that these teachers have been in the teaching field for many years and have experienced changes in the education curricula. They were not taught about IK and its integration in science teaching during their pre-service teacher education period, and are experiencing several challenges in terms of IK integration in the classroom. An interesting finding was that the longer the teaching experience the less informed are the views regarding the nature of IK. This is unfortunate because, when teachers enter the teaching field, they do have some knowledge from teacher education programmes at various universities; however, the lack of support by district officials to professionally develop teachers on the new information and trends as new curricula unfold is problematic.

Religious beliefs were also found to impact negatively on the integration of IK into the science classroom. The majority of partially informed views regarding item 3 revealed that teachers were of the view that IK practices are based on witchcraft and consultations with evil spirits of the dead, which enables them to perform evil practices like killing people with lightning. This belief heavily impacts negatively on IK integration in the science classroom. It should, however, be noted that the majority of the teachers were Christians, and this is their strong belief which is usually not open for negotiation or discussion. Christianity does not promote visiting traditional healers for treatment of ailments. It was therefore not surprising to find that most Christians' teachers' views varied from partially informed to uninformed regarding the functional application nature of IK demonstrated by item 7. Among the Christians, traditional healing is again associated with witchcraft and communication with the dead evil spirits. A visit to the sangoma is against their belief system, so is the use and administration of traditional medicine. The teachers who belonged to the African traditional religion demonstrated the highest informed views in this regard, because a visit to the sangoma or traditional practitioner is their way of life. Most of them would rather consult a sangoma in case of a sickness, before visiting a doctor, and most of the time doctors' visits are rarely made. Therefore, to answer the first research sub-question it can be said that Grade 7 natural sciences teachers in township schools, who participated in this study, have limited understanding regarding the nature of IK because they displayed partially informed views in their responses to the VNOIK questionnaire.

The quantitative data from the questionnaires was only able to provide limited information on teachers' views; therefore, a qualitative enquiry done through the administration of individual semi-structured interviews to a few selected teachers created a more in-depth understanding of the teachers' views. Teachers were afforded an opportunity to elaborate on and clarify their responses to the questionnaire. It was then established that the majority (5 out of 6 interviewees) of the teachers were of the view that IK is different from other types of knowledge, such as Western knowledge. This means that the teachers appreciate the fact that IK cannot be treated in the same way as other types of knowledge, meaning that there is a need to come up with unique ways of incorporating IK in the classroom. This view concurs with the assertion by Onwu and Mosimege (2004), that IK is unique to a given location, culture, or society. This calls for the need to ensure that IK is applied in the context of the community to which it relates.

The analysis of interview data showed that four teachers from the six that were selected for interviews were not well-informed about the inferential yet intuitive nature of IK as they were of the view that IK practitioners do not conduct experiments and tests to verify their knowledge. This is, however, contrary to the views of Porter et al. (2011), who held the notion that IK facts are not necessarily proven, but are testable and can be experimentally observed.

5.3 RELATIONSHIP BETWEEN TEACHERS' VIEWS AND THEIR CLASSROOM PRACTICES

In providing answers to research sub-question 2: what is the relationship (if any) between the teachers' views on the nature of IK and their classroom practice when integrating IK into their teaching practices?, it was realised that this question was actually two questions in one. First, it asks about whether there is a relationship between teachers' views on the NOIK and classroom practices. Second, it asks how these views on the nature of IK influence the teachers' classroom practice. The quantitative results from the questionnaires was only able to provide limited information about teachers' views and they were integrated with and woven into the qualitative results of the semi-structured interviews so as to get a clear and comprehensive picture of teachers' views regarding the integration of indigenous knowledge in science classrooms in Soweto township schools in the Gauteng province. The analysis of the data from interviews yielded three themes. These three themes were: 1) Township teachers' inadequate views about the nature of indigenous knowledge influence negatively their classroom practices; 2) Teachers experiences determine how they integrate indigenous knowledge into their classrooms; 3) There is a need for indigenous knowledge-focused intervention programmes to equip teachers with the knowledge and skills in integrating indigenous knowledge into the natural sciences. Each of the three themes is discussed in the following sections.

5.3.1 ***Theme 1: Township teachers' inadequate views about the nature of indigenous knowledge influence negatively on their classroom practices***

This theme is two-fold, as it reveals that, firstly, the teachers' views about the nature of IK are inadequate, and that, secondly, these inadequate views impact negatively on the teachers' classroom practice. Just like the findings from VNOIK questionnaires, most teachers are partially informed about the nature of IK. Just like the previous studies which revealed that teachers had generally inadequate understanding about the nature of IK, the current study established that the Grade 7 NS teachers in township schools hold partially informed views and inadequate understanding of what IK is. The interview responses showed that the teachers were not aware of the real meaning of IK and could therefore not meaningfully integrate IK into their classroom practices. In their definitions of IK, they did not include the characteristics and some of the most crucial tenets of IK as identified by Cronje et al (2015) in the IK framework. All six teachers did not view IK as something that was qualified to be taught in a formal science classroom set up, as they said it was only passed informally and had neither books nor any other resources to use as a means of references or teaching aids. This supported the claims presented by Msimanga and Shizha (2014), who pointed out that the efforts to document and avail the relevant indigenous knowledge for teachers are still at an infant stage and until now science teachers are in receipt of Western education, which regards IK as inferior.

It also emerged during the interviews, when the interviewees were asked to explain if they find it easy to integrate IK into their lessons, that they did not effectively integrate IK into their lessons. They explained that there would be times (very rarely) when the IK would be integrated, and this happened usually in Term 4 work, that deals with the NS strand: Planet Earth and Beyond. When probed further as to whether there is any evidence that would be an indication to a visitor to the class that IK does get integrated into the science lessons, all six teachers pointed out that there was no evidence, as this integration was not included in their lesson planning. This could be attributed to the teachers' uncertainty and confusion about which natural sciences content or concepts could be integrated with IK as there is no guidance and direction from the CAPS document or the subject facilitators. The teachers, however, expressed their willingness to integrate IK into their lessons.

All six teachers indicated that they understand the value of IK in the teaching and learning of science, although they confessed that their understanding is limited. However, they find it difficult to teach something to the learners that they themselves are not sure or clear about as they also voiced out their frustrations in being expected to implement the curriculum that they themselves do not understand. One of the teachers, Phakamani went on further to state that teachers feel like they "have been dropped in the middle of the ocean, and have to find their own way out". They find this situation very difficult to deal with.

This means that teachers do not have adequate or desired views and understanding of the nature of IK, and are therefore not able to integrate IK into their lessons. According to Sakayombo (2014), the impact of teachers' views on the science teacher's integration of IK is premised on the assumption that the knowledge that the teacher has is directly translated into the classroom. Teachers' views are, therefore, very important for classroom practice and will have implications for approaches that the teachers will follow and consider in an attempt to integrate IK into their lessons. To answer the first part of research sub-question 2, the study found that there is a relationship between teachers' views and their classroom practice. The inadequate views that teachers hold about the nature of IK make it difficult for them to integrate IK into their science lessons. As a result, teachers end up not trying at all or they plan the IK integration into their lessons but abandon their plan half way through the lesson. In providing answers to the second part of research sub-question 2, again, it was revealed that teachers end up being faced with all the uncertainty, confusion and a lack of confidence to integrate IK in their science lessons, despite the curriculum stipulations. This means that the inadequate views that teachers hold make them lack the confidence to integrate IK into their lessons, despite this being stipulated in the CAPS document (DBE, 2011). As such, this leads to a lack of IK integration in science lessons. The manner in which the science teachers integrated IK in their lessons was largely dependent upon how the teachers viewed the nature of IK.

5.3.2 ***Teachers experiences determine how they integrate indigenous knowledge in their classrooms***

The findings from interviews in this study revealed that teachers are willing to integrate IK into their science lessons but are not well-informed about the nature of IK. They partially understood some of the affordances of IK in the teaching and learning of science, but this integration is not taking place practically. Teachers, however, have challenges when it comes to the actual integration of IK in their classroom practices. One of the challenges that was commonly highlighted in the interviews is the lack of teaching and learning content material. Khupe (2014) highlighted that the origin of IK is oral cultures and it mainly abides in the minds and hearts of elders, as well as specialist knowledge keepers in particular areas. The people who possess the IK do not necessarily publish it, which makes it even more difficult to discern the IK suitable for integration into the classroom teaching and learning. This absence of teaching and learning material demands that teachers become more innovative and design or come up with something new that they can teach. To most teachers, however, this is too much of a burden, especially when one considers the amount of paperwork and other administrative responsibilities that they are expected to perform on a daily basis. This challenge has therefore influenced negatively the actual classroom integration of IK.

In science classrooms, teachers are also faced with diverse learners, who bring along their different IK worldviews, which might be in conflict with the science worldview presented in the classroom, and considering at the same time the fact that teachers have their own views. This challenge was also highlighted by Reddy et al. (2017), who noted that most classrooms in South Africa are multicultural, with Xhosa, Zulu, Shona, and other learners in one classroom. Suggestions from the curriculum are that the teacher should include IK examples from different cultural groups in South Africa. This has implications for teachers as they need to take full responsibility to acquire the knowledge and skills for each cultural group represented in the classroom, which is a mammoth task. Teachers need to acknowledge that the main holders of IK are the community elders and traditional healers, and therefore, need to work hand-in-hand with them in order to access the information. This therefore places an extra burden on teachers in efforts to integrate IK into the classroom.

Another challenge that emerged from the interviews relates to the ways that the curriculum is being implemented, which is a top-down approach. This approach implies that all the decisions that relate to the curriculum are made at the top and teachers are only expected to implement the curriculum. The teachers expressed the view that they expected to be involved in the designing of the curriculum as they were able to make valid inputs. The exclusion of teachers from the designing of the curriculum means that the designing is done solely by people who have no knowledge of the classroom situation. Mothwa (2011) also emphasised the need for a bottom-up approach in the process of designing a curriculum that aims at integrating IK into classroom practice, as the input of those on the ground is crucial. The first step in designing such a curriculum should therefore involve consultative meetings with teachers.

The absence of instructional methods to employ in the teaching of IK in the classroom was also cited as a major challenge that hinders integration. Teachers are therefore not sure of what they are supposed to do as they are expected to come up with their own methods of instruction. The result is that there is no uniformity in the teaching of IK in the classroom. According to Khupe (2014), the implementation of IK in the classroom has been left entirely to teachers. Teachers and researchers are therefore uncertain about the future of IK in school science. Nel (2005) pointed out that the successful integration of IK in science education requires educators to understand the integration and also to be able to properly integrate IK in the teaching of science. Teachers, therefore, need support and more IK-focused intervention programmes to enhance their views and improve confidence to integrate it practically in their classrooms. These responses also paved the way for the realisation of the teachers' cry out for help as teachers were also able to list their needs, which included the need for IK-focused intervention programmes that will be conducted by competent facilitators; the need for centralised resource distribution centres for IK-related materials, a much clearer and guiding NS curriculum.

5.3.3 *Teachers lack knowledge and skills in integrating indigenous knowledge in natural sciences teaching*

During interviews, teachers made suggestions for overcoming challenges associated with IK integration. Teachers mentioned the need for an IK-focused professional development programme which ought to be conducted by competent subject facilitators. Teachers felt it was crucial for them to have professional development programmes aimed at directly enhancing their knowledge of the nature of IK. Five of the six teachers were not trained in methods that catered for IK integration into the lesson. Teachers voiced their need for support. When probed further to determine if there had been any professional development programmes organised previously for them, all six teachers acknowledged having attended a number of development programmes organised by the Department of Education. However, teachers pointed out that none of their challenges was addressed, which indicates flaws in the nature of the in-service training workshops given to teachers. The main focus of these development programmes had always been curriculum coverage, and such important stipulations of curriculum implementation have been ignored.

One of the strategies that were suggested by the teachers is collaboration with those who were in possession of IK in the communities. This calls for teachers, school authorities, and curriculum developers to engage elders and other people in the communities who possess IK. Teachers suggested that the community members should be involved in identifying IK suitable for integration and then assisting teachers in the integration. Sakayombo (2014) supported the idea of collaboration and highlighted that there are great benefits for integration that can be obtained from collaborating with those who have the knowledge.

The teachers also suggested that the education authorities should put in place policies that recognise the value of indigenous knowledge in the science programme and make it mandatory to integrate IK in science teaching. Successful integration begins with the highest authorities recognising the importance of IK in the teaching and learning of science.

The teachers also encouraged the effective training and development of all teachers so that they understand IK and its benefits. Without a full understanding of IK, teachers cannot meaningfully integrate IK into the classroom as they will keep on struggling to make it work. It is only when teachers are trained and developed that they can integrate IK into classroom teaching and learning. The need for the training and development of teachers is also highlighted by Khupe (2014), who advocated for workshops that are intended to equip teachers with the relevant knowledge on IK so that they can have the willingness and confidence to pass this knowledge on to learners.

5.4 Recommendations

Based on the findings of the current study, there are a number of implications to teacher practices, for policy, pre- and in-service teacher training programmes, and for future research. It is imperative that the teaching and learning of science in the classroom results in learners developing more interest in science and thereby viewing science as being relevant to their everyday lives. It is therefore recommended that science teachers must encourage learners to appreciate the information that is learnt in class and be able to discuss its relevance in their daily lives. This means that teachers must open platforms for discussions on how the science content can be made relevant to the learners' context. Accordingly, teachers must familiarise themselves with the IK that learners bring into the science classroom, as it will assist in making sense of the content to be learnt in class. Teachers, therefore, need to use innovative teaching strategies, and also involve IK experts within communities for the successful integration of IK. The science classrooms have become multicultural spaces, and it is recommended that teachers become sensitive and very considerate as learners' IK is being elicited in the classroom, as there might be differences between this IK and the science knowledge taught in class.

The CAPS document stipulates the need to integrate IK into science teaching and learning. Previous research has revealed that there are, however, no guidelines as to how this could be done. It is recommended in this study that the current curriculum policy be reviewed once again, and should include guidelines on IK integration that are clear and explicit. It should also suggest various instructional strategies that could assist to promote the integration. It is assumed that, if teachers receive clear guidelines on IK integration, this could help clear out the confusion and improve the level of confidence to implement the curriculum as stipulated. The Department of Education should also put in place strategies to monitor the successful implementation of the curriculum and provide effective support to teachers through professional development and IK resources suitable for the science classroom.

The findings of this study revealed that teachers experience a number of challenges during the integration of IK in science classrooms. The pre-service teacher training programmes, through which many teachers in science classrooms today were trained, did not include the interpretation of the curriculum in a culturally sensitive manner. It is therefore recommended that the teacher training institutions in South Africa review their programmes and ensure that a compulsory module at both undergraduate and postgraduate levels is introduced, so as to equip teachers with the necessary knowledge and skills to integrate IK in natural sciences teaching and learning. From the findings it also emerged that some of the science teachers were trained a long time ago under the Western knowledge-based system; hence they lack the knowledge and skills to interpret the curriculum in a culturally sensitive manner. There is therefore a need to up-skill these teachers. It also emerged that the many intervention programmes that teachers are expected to attend do not address the integration of IK into the science classrooms. They are more concerned about content coverage, and not specifically about how to address important issues such as IK integration. It is recommended that the intervention programmes be more IK-focused, by firstly conducting a needs analysis of the teachers. These programmes should not be a once-off thing, but should have a duration of between six months to a year, so as to identify and address integration challenges that may arise from time to time. In order to improve attendance, there should be some certification or acknowledgement of attendance at the end of these programmes.

This study also provides some recommendations for future research. There is a need to investigate the teachers' views and understanding of learners' indigenous knowledge that they bring to the classroom. Second, there is a need to investigate the effect of the culturally sensitive instructional methods in integrating IK into science classrooms. Third, this study has revealed that most teachers in township schools hold partially informed views regarding the nature of IK. It is therefore recommended that future research focuses more on how these views could be improved, using a larger scale of teachers. It emerged that teachers are crying out for the enhancement of their views on the nature of indigenous knowledge and there is an urgent need for indigenous knowledge-focused intervention programmes to equip teachers with the knowledge and skills in integrating indigenous knowledge in natural sciences.

It is therefore recommended that IK-focused intervention programmes are organised for science teachers in township schools to attend, and there is a need to investigate the effect of these IK-focused intervention programmes on teachers' views and on teachers' ability to integrate IK into the science lessons. Fourth, the present study involved teachers from Soweto township schools in Gauteng province. Teachers from other township schools in other South African provinces were not involved. Thus, the focus on other township schools in other provinces may also provide further insights on how teachers could integrate IK into their lessons. Lastly, the study could be repeated among teachers in rural schools, where a comparison could be made on the integration of IK in science classrooms teaching in township and rural school environments, shedding more light on the challenges experienced in both environments.

5.5 Conclusion

This study primarily sought to establish how the Grade 7 natural sciences (NS) teachers' views about the nature of IK influence their teaching practices. This study firstly determined what the Grade 7 NS teachers' views on the nature of IK were and secondly investigated the relationship between these views and their classroom practices when integrating IK into their teaching. The results from the analysis of data from VNOIK questionnaires and semi-structured interviews were used to address the two research sub-questions asked at the beginning of this study.

In providing answers to research sub-question 1: What are natural sciences Grade 7 teachers' views on the nature of indigenous knowledge?, findings from quantitative revealed that that the majority (46%) of the Grade 7 NS teachers teaching in township schools held partially informed views, while 34% harbour uninformed views about the nature of IK, thus making a total of 80% of inadequate and undesired teachers' views on the nature of IK. They held undesirable understandings of the origin, the transmission and uses of IK. The existence of these views can be ascribed to teachers' different biographical features pertaining to gender, teaching experience and religious beliefs and teachers' experiences were found to determine whether or not they integrate IK into their science classrooms.

In providing answers to research sub-question 2: What is the relationship (if any) between the teachers' views on the nature of IK and their classroom practices when integrating IK into their NS teaching?, findings from the qualitative showed that the township teachers' inadequate views about the nature of indigenous knowledge influence negatively their classroom practices. Teachers were, however, found to be willing to integrate IK into their classrooms, but they faced a number of challenges, uncertainties and confusion, which prevented them from integrating IK into their science classrooms. Such challenges were brought about by the fact that, when this integration was introduced in the new curriculum in schools, the science teachers who are responsible for the actual integration of IK did not have adequate knowledge of the value of IK nor the instructional strategies to use when integrating IK into their classrooms. Moreover, teachers were not well informed by the Department of Education about the relevant IK content to be taught and integrated during the teaching and learning of science. This has resulted in a lack of confidence among NS teachers, thus leading to poor classroom practice regarding the integration of IK. The researcher also wishes to bring to the fore the fact that this new curriculum came at a time when a number of curricula reforms were introduced and recalled, one after the other, and most teachers were therefore frustrated and confused during these years. The patterns that emanated from the individual interviews highlighted, therefore, the urgency of addressing and enhancing these views, so as to equip teachers with relevant knowledge and skills to overcome IK-integration challenges, thus developing confidence to integrate IK effectively in their classrooms.

The findings of the study have shed light on the reasons for the lack of integration and have raised the alarm regarding the township teachers' cry for help. Teachers are of the view that the Department of Education should design the curriculum explicitly, and ensure that the IK-related content to be integrated in the science classroom is clearly stated. The findings also showed that teachers can integrate IK successfully provided that their views on NOIK are enhanced through IK-focused in-service teacher-development programmes, which are conducted by competent facilitators that fully understand the integration process. Furthermore, it is hoped this study contributes to the improvement of the teaching and learning of science to all teachers and learners in South African townships.

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APPENDIX A

UNIVERSITY OF JOHANNESBURG

ETHICS CLEARANCE

Dear Lindiwe Ngcobo

Ethical Clearance Number: Sem 2 2018-012

South African township teachers' views on the integration of indigenous knowledge in Natural Sciences teaching

Ethical clearance for this study is granted subject to the following conditions:

- If there are major revisions to the research proposal based on recommendations from the Faculty Higher Degrees Committee, a new application for ethical clearance must be submitted.
- If the research question changes significantly so as to alter the nature of the study, it remains the duty of the student to submit a new application.
- It remains the student's responsibility to ensure that all ethical forms and documents related to the research are kept in a safe and secure facility and are available on demand.
- Please quote the reference number above in all future communications and documents.

The Faculty of Education Research Ethics Committee has decided to

☒ Grant ethical clearance for the proposed research.

☐ Provisionally grant ethical clearance for the proposed research

☐ Recommend revision and resubmission of the ethical clearance documents

Sincerely,

Dr David Robinson

Chair: FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE

APPENDIX B: LETTER OF APPLICATION TO CONDUCT THE RESEARCH AT SCHOOL

P.O. Box 6133
WESTGATE
1734
13 November 2018

TO: THE PRINCIPAL

DATE: 13 November 2018

SUBJECT: REQUEST TO CONDUCT RESEARCH FOR MASTERS IN SCIENCE EDUCATION (Med) DEGREE

I am Lindiwe Patience Ngcobo, a Natural Sciences educator at Funda UJabule Primary School, under Johannesburg Central District (D14) and I am currently studying towards a Masters in Science Education degree with the University of Johannesburg. I hereby request for your permission to conduct research in your school.

The research will explore South African township teachers' views on the integration of indigenous knowledge in Natural Sciences teaching.

Attached please find the ethical clearance for the study which indicates the aim and the background of the study.

Thanking you in advance for your cooperation.

Yours in education

____

Ngcobo L.P. (909807915)
Contact No.: 0797327462

E-mail Address: nothakhona@yahoo.com

APPENDIX C: TEACHER'S CONSENT FORM

SECTION D: Signatures required to indicate consent/assent
(For all participants, parents, guardians and other stakeholders)

Faculty of Education Research Ethics Committee
NHREC Reference Number REC-110613-036

INFORMED CONSENT/ASSENT FORM

Project Title:
South African township teachers' views on the integration of indigenous knowledge in Natural Sciences teaching.

Investigator:
Lindiwe Ngcobo

Date:
30 May 2019

Please mark the appropriate checkboxes. I hereby:

☐ Agree to be involved in the above research project as a **participant**.
☐ Agree to be involved in the above research project as an **observer** to protect the rights of:
  ☐ Children younger than 18 years of age;
  ☐ Children younger than 18 years of age that might be vulnerable*; and/or
  ☐ Children younger than 18 years of age who are part of a child-headed family.
☐ Agree that **my child**, ________________________ may participate in the above research project.
☐ Agree that **my staff** may be involved in the above research project as participants.

☐ **I have read the research information sheet pertaining to this research project (or had it explained to me) and I understand the nature of the research and my role in it.**
I have had the opportunity to ask questions about my involvement in this study.
I understand that my personal details (and any identifying data) will be kept strictly confidential.
I understand that I may withdraw my consent and participation in this study at any time with no penalty.

Signature: ....

Please provide contact details below ONLY if you choose one of the following options:

☐ Please allow me to review the report prior to publication. I supply my details below for this purpose:
☐ Please allow me to review the report after publication. I supply my details below for this purpose:
☐ I would like to retain a copy of this signed document as proof of the contractual agreement between myself and the researcher

Name: ....

Phone or Cell number: ....

e-mail address: ....

* Vulnerable participants refer to individuals susceptible to exploitation or at risk of being exposed to harm (physical, mental, psychological, emotional and/or spiritual).

SECTION E: Separate signatures required for consent/assent to use video, audio or photographic recording

(For all participants, parents, guardians and other stakeholders)

UNIVERSITY OF JOHANNESBURG

Faculty of Education Research Ethics Committee

NHREC Reference Number REC-110613-036

VIDEO, AUDIO OR PHOTOGRAPHIC RECORDING

By law, separate consent or assent must be provided to indicate willingness to be video / audio recorded or photographed. Please provide your consent / assent on this form:

Where applicable:

☐ I willingly provide my consent/assent for using **audio** recording of my/the participant's contributions.

☐ I willingly provide my consent/assent for using **video** recording of my/the participant's contributions.

☐ I willingly provide my consent/assent for the use of **photographs** in this study.

Signature (and date): ....

Signature of person taking the consent (and date): ....

APPENDIX D: THE VNOIK QUESTIONNAIRE FOR NS EDUCATORS IN THE SCHOOL

SECTION A: PERSONAL DATA

The aim of this questionnaire is to collect information about how Grade 7 Natural Sciences teachers in township schools view the nature of African indigenous knowledge and their practices when integrating it into their teaching. The first section of this questionnaire deals with the personal or biographical data. Although the researcher is aware of the sensitivity of these questions, the information requested is very crucial for her as it will allow her to compare different groups of respondents. Once again, you are assured that your response will remain anonymous. You are kindly requested to complete this questionnaire in full, either by **drawing a cross (X)** in the relevant block or **writing your answer** in the spaces provided. No questions should be left unanswered, and there are no wrong or right answers. Your contribution is highly valued. Thank you.

NB: Please DO NOT write your name on any part of this questionnaire.

1. I am a:

Male	Female

2. I am _____ years old.

(my age in complete years)

3. My home language is:

4. My religious affiliation is:

Christian	
African Traditional Religion	
Jehovah's Witness	
Muslim	
Other (Specify)	

5. I live in a:

Township	City	Rural

6. I am working as a Natural Sciences teacher in a school under the _______District.

7. My school is in a ____________ setting

Township	City	Rural

8. Years of experience in the teaching profession?

Less than a year.	
Between 1 and 5 years	
Between 6 and 10 years	
More than 10 years	

9. My highest qualification:

Matric plus Further/Higher Diploma (M+4)	
Bachelor of Education (BEd) Degree	
Post-graduate Degree(s)	

10. My post level is:

PL 1	
PL 2	
PL 3	
PL 4	

SECTION B: VIEWS-ON-THE-NATURE-OF-INDIGENOUS-KNOWLEDGE (VNOIK) QUESTIONNAIRE

Instructions:

- Please answer each of the following questions. Include relevant examples whenever possible.
- There is no 'right' or 'wrong' answer to the questions. We are only interested in **your opinion** on a number of issues regarding indigenous knowledge.

1.	In your view, what is indigenous (or traditional) knowledge? What makes indigenous knowledge different from other types of knowledge systems (such as Western knowledge)? ____________________ ____________________

2.	Practitioners of indigenous science (e.g. elders, herbalists, traditional healers) observe nature to generate knowledge. Do they do experiments and tests in order to verify or validate this knowledge? • If yes, explain how they test or validate their knowledge. • If no, explain why not.
3.	Practitioners of indigenous knowledge observe nature and give explanations about their observations. Elders in a community can, for example, explain where lightning comes from. Do the elders always use natural causes to explain their observations such as lightning, or do they sometimes include supernatural causes in their explanations? • If they only use natural causes, explain why and give examples of some of the causes. • If they sometimes use supernatural causes, explain why and give examples of some of the causes.
	Indigenous knowledge is transferred from one generation to the next over many decades and centuries. Does this knowledge stay the same or does it change over time? • If yes, explain why it stays the same. • If no, explain the causes of such changes.

4.	
5.	*Hoodia gordinii* is a plant that was used by Khoi-San hunters to suppress their hunger and thirst when they went on hunting expeditions. How **do you think** the Khoi-San people came to know that this particular plant has these properties?
6.	Sustainable development is an emerging concept that includes topics such as hunger, poverty and underdevelopment. Globally governments and organizations struggle to find solutions for these important issues. **Do you think** indigenous knowledge can be used to alleviate some of these problems? • If you say yes, please explain why and how indigenous knowledge can be used to solve these problems. • If you say no, please explain why it cannot be used to solve these problems.
7.	An athlete regularly competing in marathons struggles with pain in his legs during the last part of a marathon and can sometimes not complete a marathon due to this. The athlete decides to consult a traditional healer to determine why his legs pain during the last part of a marathon. • What methods do you think the traditional healer will apply to diagnose the problem when consulting with the athlete?

	• What possible treatment or advice do you think he will give the athlete?
8.	Myths are stories that are told in different cultures by elders from one generation to the other. Do you think myths and rituals play any important role in indigenous knowledge systems? Explain your answer with examples if possible.
9.	Some claim that indigenous knowledge is infused with social and cultural values. That is, indigenous knowledge reflects the social and political values, philosophical assumptions and intellectual norms of the specific culture in which it is practiced. Indigenous knowledge is thus generated locally and can only be used in a specific area. It cannot be used universally in other contexts or globally to solve different problems. • Do you believe that indigenous knowledge reflects the social and cultural values of a specific community? Explain with the use of examples how indigenous knowledge reflects the social and cultural values of a local community. • Do you believe that indigenous knowledge can only be used in a specific area or do you believe it can be used in other areas or globally to solve problems? Explain your answers with examples.

10.	Indigenous knowledge is passed from one generation to the other by elders. The elders are deemed very important and some people believe their ways of knowing (knowledge) is truth and cannot be challenged. Does this mean that current practitioners of indigenous knowledge must use this knowledge exactly as it was passed on to them, or can they use their creativity and imagination to modify the indigenous knowledge to solve current problems? • If you say yes and believe that indigenous knowledge practitioners cannot change this knowledge, explain why. Use examples if possible. • If you believe that indigenous knowledge practitioners can change and modify their knowledge, explain why. Use examples if possible.

The VNOIK questionnaire (Source: Cronje et al, 2015)

APPENDIX E: RELATING VNOIK ITEMS TO IK FRAMEWORK

TENET NO.	EXPLANATION OF TENET	RELATED VNOIK QUESTION	CORE COMPONENTS RELATED TO THE TENET
1	That indigenous knowledge is empirically and metaphysically based	1, 2, 3, 5	Observing nature, doing experiments and explaining observations
2	That indigenous knowledge is resilient yet tentative	1, 4 ,10	Change over time, can be modified
3	That indigenous knowledge is inferential yet intuitive	1, 2, 3, 5	Generating knowledge, explaining observation, including supernatural causes
4	That indigenous knowledge is creative and mythical	1, 6, 8, 10	Alleviating problems, myths, rituals, creativity and imagination
5	That indigenous knowledge is subjective	1, 9, 10	Social and cultural values, contextual
6	That indigenous knowledge is social, collaborative and cultural	1, 8, 9, 10	Orally transmitted to new generations, social and cultural values
7	That indigenous knowledge is wisdom in action	1, 5, 6	Trial and error, laboratory of survival
8	That indigenous knowledge is applicable and functional	1, 5, 6, 7	Practical application, addressing needs
9	That indigenous knowledge is holistic by nature	1, 7	Psychomatic origin of disease, blurred boundaries with metaphysical, data interpreter

(Source: Cronje et al, 2015)

APPENDIX F: ANTICIPATED RESPONSES TO VNOIK QUESTIONNAIRE

QUESTION	ANTICIPATED RESPONSES TO THE QUESTIONS
1	***WHAT INDIGENOUS KNOWLEDGE IS?***
	* Ways of knowing nature and skills by people living in a particular area (local) and society in order to enhance everyday lives * Derived from interactions between people and environment * Result of practical rendezvous in everyday life * Folk knowledge of flora and fauna * Cultural beliefs and history of their people- includes songs, rituals, dances, holy places * Spiritual beliefs (metaphysical) plays a big role, ancestors are important * Includes rituals, myths, customs and values * Mostly passed from one generation to the other orally, through imitation and demonstration, by paintings and artefacts * Collection of knowledge systems such as language, medicine, ecology, science, religion, agriculture, astronomy, architecture- more than just medicinal plants * Holistic and inclusive in nature- co-existence of spiritual, natural and human worlds
2	***ROLE OF EXPERIMENTS?***
	* Facts generated by indigenous knowledge are derived through experimental observation and tests * Generated through trial and error experiments, success and failure * Tested over many generations in the laboratory of life * Indigenous knowledge is empirical rather than theoretical knowledge * Relies on intuition and evidence
3	***NATURAL AND UNNATURAL CAUSES***
	* Cannot separate indigenous knowledge from spirituality, beliefs and metaphysics * Explanations for observations on indigenous knowledge do not always have natural or logic causes that are predictable. Can refer to eg. Evil spirits, visions and myths in explanations * Honouring of ancestors in explanations * The use of medicinal plants, for example, goes deeper than focussing on the chemical reactions occurring in the body, but consists of a holistic approach that includes the metaphysical and spiritual
4	***STAYS THE SAME OR CHANGES OVER TIME?***

	* Most of this wisdom-in-action is passed on over generations and has stood the test of time (resilience), but each generation also adapts and adds change to this knowledge as their circumstances and environment changes in order to survive and solve problems * This new way of knowing is then passed on to the next generation * Indigenous knowledge is fluid and transforming, constantly changing but often represented as static
5	***HOW IS KNOWLEDGE GENERATED? (Hoodia gordinii)***
	* It is based on experience and needs that exist in everyday life * It is generated through trial and error * Tested over many generations and passed on from one generation to the next * Collective data base of observable knowledge * Repetition assists with retention * Ancestors or dreams inform traditional healers or elders on which plants to use
6	***USED TO SOLVE CONTEMPORARY PROBLEMS?***
	* Indigenous knowledge is a source of wealth to solve current problems * Has a large role to play where modernisation has failed societies * Has stood the test of time, tested over centuries and can be used to solve contemporary problems
7	***METHODS AND ADVICE?***
	METHODS OF DIAGNOSIS:
	* Holistic approach- physical systems are examined holistically from social, Historical and spiritual aspects * Importance of asking ancestors for help * Search for trigger that has created the disease in order to establish healing- may Be metaphysical
	ADVICE/TREATMENT GIVEN:
	* Provide medicinal plants or *muthi* * Healing goes deeper than the medicine *(muthi),* includes energy and spirituality * Rituals and beliefs also play a role * Treatment is also holistic, addressing spiritual and physical
8	***ROLE OF MYTHS***
	* Indigenous knowledge is transmitted orally through stories and myths * Imitation, demonstration and rituals play an important role * Use of metaphors * Indigenous knowledge is made understandable through stories containing lessons

9	***REFLECTION OF SOCIAL AND CULTURAL VALUES?***
	*Indigenous knowledge does reflect social and cultural values of specific community * Knowledge is a critical part of cultures, and adapted for a specific culture and environment * Embedded in local social and cultural values of a certain group of people * Indigenous knowledge is situated within cultural traditions-it is not culture-free
	APPLIED LOCALLY OR UNIVERSALLY?
	* Indigenous knowledge is transferred across communities, cultures and countries * Threat of exploitation * Can be adapted to solve contemporary problems, but is unique to a given culture * If applied to other communities, functionality must be kept in mind * Sometimes distributed in fragments and not in totality * Contributions can be used to solve problems in different fields such as ecology, medicine, agriculture, mathematics, fisheries
10	***IMAGINATION, CREATIVITY***
	*Indigenous knowledge is a living knowledge base and is dynamic and continually applying creativity and innovation to sustain the lives of people * Generates new knowledge as new issues develop e.g. HIV/AIDS *Indigenous knowledge is constantly being produced and reproduced * Undergoes constant adaptation as needs of community change

(Source: Cronje et al, 2015)

APPENDIX G: RUBRIC FOR CODING OF PARTICIPANTS RESPONSES TO THE VNOIK QUESTIONNAIRE

WEIGHTING	(2)	(1)	(0)
RESPONSE	**INFORMED VIEW (I)**	**PARTIALLY INFORMED VIEW (PI)**	**UNINFORMED VIEW (UI)**
QUESTION			
1	Mentions at least four of the anticipated answers or other tenets of indigenous knowledge	Mentions at least two of the anticipated answers or other tenets of indigenous knowledge	Mentions one or none of the anticipated answers or other tenets of indigenous knowledge
2	Answers yes, with an acceptable reason or example	Answers yes without explanation or with reason that is not acceptable Answers no, with acceptable explanation	Answers no, or not sure
3	Can include supernatural to explain causes. Gives examples of possible unnatural causes	Can include supernatural to explain causes. Does not give examples of possible unnatural causes or gives irrelevant explanations	Answers yes or not sure without any explanation
4	Answers yes and no or yes, but, and explains the resilience of indigenous knowledge but that indigenous knowledge can be modified as needs of society changes	Answers just yes with correct explanation of why it stays the same or no with correct explanation of why it changes	Answers yes or not sure without any explanation
5	Comprehensive suitable explanation including at least two examples relating to everyday life	Short suitable explanation including at least one example relating to everyday life	Not sure or unsuitable explanation

	needs or trial and error methods	needs or trial and error methods	
6	Yes with suitable explanation/example	Yes with no explanation or unsuitable explanation	Not sure or no
7	Provides one holistic method including physical and spiritual systems and treatment including medicinal plants or rituals	Provides either method or treatment suggested in column one of question seven in this table	Not sure or unsuitable explanation
8	Answers yes with explanation or example	Answers yes without suitable explanation or example	Not sure or unsuitable explanations
9	Yes it reflects social and cultural values plus explanation/example. Believe it is universal/transferrable with suitable explanation/example	Yes it reflects social and cultural values plus explanation/example. Does not believe it can be transferred with no explanation	No to both questions or unsuitable explanations
10	Yes it can change with suitable explanation or it can be modified with explanation and/or example	Yes or partially but explanation is not suitable	Not sure or no

(Source: Cronje et al, 2015)

APPENDIX H: SEMI-STRUCTURED INTERVIEW SCHEDULE

NO	INTERVIEW QUESTION
1	The Curriculum and Assessment Policy Statement (CAPS) stipulates the '*Nature of Science'* (NOS) and *Indigenous Knowledge* (IK) be integrated into the science classroom. What's your understanding of the NOS?
2	What do you understand by 'indigenous knowledge'?
3	Why should indigenous knowledge receive consideration in the science classroom?
4	Explain how indigenous knowledge influences the way learners understand what they are being taught in a science classroom?
5	According to CAPS document, teachers are urged to teach science in such a way that learners see its relevance in their everyday lives. Does the integration of indigenous knowledge in science support this statement? Motivate your answer.
6	How do you think indigenous knowledge differs from Western science knowledge?
7	Do you find it easy to integrate indigenous knowledge in your lessons? If a visitor were to come to your class, what would he or she see that would be an indication of your indigenous knowledge integration in your science lessons?
8	What challenges or problems have you experienced with the integration of indigenous knowledge in your lessons?
9	Have you ever attended a workshop where the integration of indigenous knowledge in a science classroom was modelled, discussed or demonstrated to you? If so, please tell me briefly about it.
10	Do you think your views on the nature of indigenous knowledge affect the way you incorporate indigenous knowledge in your lessons? If yes, in what way? If not, why will they stay the same?
11	Do you think if your views were enhanced, your incorporation of indigenous knowledge could also improve? Please explain.
12.	Do you think that your participation in this research affected the way you think and your views about indigenous knowledge? Explain your answer.

APPENDIX I: SUMMARY OF CODED RESPONSES TO VNOIK QUESTIONNAIRE

KEY:

P=PARTICIPANT UI=UNINFORMED VIEW (0)

PI=PARTIALLY INFORMED VIEW (1) I=INFORMED VIEW (2)

PARTICIPANT'S VIEW & WEIGHTING		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	TOTAL	OVERALL VIEW
P1	**VIEW**	**PI**	**I**	**PI**	**UI**	**PI**	**UI**	**PI**	**PI**	**UI**	**PI**		**PI**
	WEIGHTING	1	2	1	0	1	0	1	1	0	1	08/20	0,8=1
P2	**VIEW**	**PI**	**I**	**I**	**I**	**PI**	**I**	**PI**	**I**	**I**	**PI**		**I**
	WEIGHTING	1	2	2	2	1	2	1	2	2	1	15/20	1,5=2
P3	**VIEW**	**UI**	**UI**	**UI**	**PI**	**UI**	**UI**	**UI**	**PI**	**UI**	**UI**		**UI**
	WEIGHTING	0	0	0	1	0	0	0	1	0	0	02/20	0,2=0
P4	**VIEW**	**PI**	**PI**	**PI**	**UI**	**I**	**UI**	**UI**	**PI**	**UI**	**PI**		**PI**
	WEIGHTING	1	1	1	0	2	0	0	1	0	1	07/20	0,7=1
P5	**VIEW**	**UI**	**UI**	**PI**	**PI**	**PI**	**UI**	**I**	**I**	**I**	**UI**		**PI**
	WEIGHTING	0	0	1	1	1	0	2	2	2	0	09/20	0,9=1
P6*	**VIEW**	**PI**	**I**	**I**	**PI**	**PI**	**UI**	**I**	**I**	**I**	**UI**		**PI**
	WEIGHTING	1	2	2	1	1	0	2	2	2	0	13/20	1,3-1
P7*	**VIEW**	**UI**	**UI**	**PI**	**UI**	**UI**	**PI**	**PI**	**UI**	**UI**	**PI**		**UI**
	WEIGHTING	0	0	1	0	0	1	1	0	0	1	04/20	0,4=0
P8	**VIEW**	**I**	**PI**	**UI**	**UI**	**PI**	**UI**	**UI**	**PI**	**UI**	**PI**		**PI**
	WEIGHTING	2	1	0	0	1	0	0	1	0	1	06/20	0,6=1
P9	**VIEW**	**PI**	**I**	**UI**	**UI**	**PI**	**UI**	**PI**	**PI**	**UI**	**PI**		**PI**
	WEIGHTING	1	2	0	0	1	0	1	1	0	1	07/20	0,7=1
P10	**VIEW**	**PI**	**UI**	**PI**	**PI**	**UI**	**UI**	**PI**	**UI**	**PI**	**I**		**PI**
	WEIGHTING	1	0	1	1	0	0	1	0	1	2	07/20	0,7=1
P11	**VIEW**	**PI**	**PI**	**UI**	**UI**	**PI**	**UI**	**PI**	**UI**	**UI**	**I**		**PI**
	WEIGHTING	1	1	0	0	1	0	1	0	0	2	06/20	0,6=1
P12	**VIEW**	**PI**	**I**	**PI**	**UI**	**UI**	**PI**	**I**	**UI**	**PI**	**UI**		**PI**
	WEIGHTING	1	2	1	0	0	1	2	0	1	0	08/20	0,8=1
P13	**VIEW**	**I**	**I**	**PI**	**I**	**I**	**I**	**I**	**PI**	**I**	**PI**		**I**
	WEIGHTING	2	2	1	2	2	2	2	1	2	1	17/20	1,7=2
P14	**VIEW**	**UI**	**PI**	**UI**	**UI**	**I**	**PI**	**PI**	**UI**	**UI**	**PI**		**PI**
	WEIGHTING	0	1	0	0	2	1	1	0	0	1	05/20	0,5=1
P15	**VIEW**	**PI**	**UI**	**I**	**UI**	**UI**	**PI**	**PI**	**UI**	**UI**	**I**		**PI**
	WEIGHTING	1	0	2	0	0	1	1	0	0	2	07/20	0,7=1
P16	**VIEW**	**UI**	**PI**	**PI**	**UI**	**I**	**PI**	**UI**	**UI**	**UI**	**I**		**PI**
	WEIGHTING	0	1	1	0	2	1	0	0	0	2	07/20	0,7=1
P17	**VIEW**	**PI**	**PI**	**UI**	**UI**	**PI**	**UI**	**I**	**UI**	**PI**	**PI**		**PI**
	WEIGHTING	1	1	0	0	1	0	2	0	1	1	07/20	0,7=1
P18	**VIEW**	**UI**	**UI**	**UI**	**PI**	**UI**	**UI**	**PI**	**UI**	**PI**	**UI**		**UI**
	WEIGHTING	0	0	0	1	0	0	1	0	1	0	03/20	0,3=0
P19	**VIEW**	**I**	**PI**	**PI**	**PI**	**PI**	**PI**	**PI**	**I**	**PI**	**I**		**PI**

	WEIGHTING	2	1	1	1	1	1	1	2	1	2	13/20	1,3=1
P20	**VIEW**	**PI**	**PI**	**UI**	**UI**	**PI**	**UI**	**PI**	**PI**	**PI**	**PI**		**PI**
	WEIGHTING	1	1	0	0	1	0	1	1	1	1	07/20	0,7=1
P21	**VIEW**	**PI**	**UI**	**PI**	**PI**	**UI**	**UI**	**UI**	**PI**	**I**	**UI**		**PI**
	WEIGHTING	1	0	1	1	0	0	0	1	2	0	06/20	0,6=1
P22	**VIEW**	**UI**	**UI**	**UI**	**PI**	**UI**	**UI**	**UI**	**UI**	**UI**	**PI**		**UI**
	WEIGHTING	0	0	0	1	0	0	0	0	0	1	02/20	0,2=0
P23	**VIEW**	**PI**	**I**	**UI**	**PI**	**UI**	**PI**	**PI**	**I**	**PI**	**I**		**PI**
	WEIGHTING	1	2	0	1	0	1	1	2	1	2	11/20	1,1=1
P24	**VIEW**	**UI**	**UI**	**PI**	**UI**	**UI**	**PI**	**UI**	**PI**	**UI**	**UI**		**UI**
	WEIGHTING	0	0	1	0	0	1	0	1	0	0	03/20	0,3=0
P25	**VIEW**	**PI**	**PI**	**UI**	**PI**	**PI**	**PI**	**I**	**I**	**PI**	**PI**		**PI**
	WEIGHTING	1	1	0	1	1	1	2	2	1	1	11/20	1,1=1
P26	**VIEW**	**PI**	**UI**	**PI**	**I**	**UI**	**UI**	**PI**	**PI**	**PI**	**UI**		**PI**
	WEIGHTING	1	0	1	2	0	0	1	1	1	0	07/20	0,7=1
P27	**VIEW**	**I**	**PI**	**I**	**PI**	**PI**	**UI**	**UI**	**I**	**UI**	**PI**		**PI**
	WEIGHTING	2	1	2	1	1	0	0	2	0	1	10/20	1,0=1
P28	**VIEW**	**PI**	**UI**	**UI**	**UI**	**PI**	**PI**	**PI**	**UI**	**PI**	**PI**		**PI**
	WEIGHTING	1	0	0	0	1	1	1	0	1	1	06/20	0,6=1
P29	**VIEW**	**PI**	**PI**	**UI**	**PI**	**UI**	**UI**	**PI**	**PI**	**I**	**UI**		**PI**
	WEIGHTING	1	1	0	1	0	0	1	1	2	0	07/20	0,7=1
P30	**VIEW**	**PI**	**UI**	**UI**	**UI**	**I**	**PI**	**UI**	**PI**	**PI**	**PI**		**PI**
	WEIGHTING	1	0	0	0	2	1	0	1	1	1	07/20	0,7=1
P31	**VIEW**	**PI**	**PI**	**UI**	**PI**	**PI**	**UI**	**UI**	**PI**	**PI**	**UI**		**PI**
	WEIGHTING	1	1	0	1	1	0	0	1	1	0	06/20	0,6=1
P32	**VIEW**	**I**	**PI**	**PI**	**UI**	**I**	**I**	**I**	**PI**	**PI**	**I**		**PI**
	WEIGHTING	2	1	1	0	2	2	2	1	1	2	14/20	1,4=1
P33	**VIEW**	**PI**	**UI**	**PI**	**PI**	**UI**	**UI**	**PI**	**PI**	**UI**	**UI**		**PI**
	WEIGHTING	1	0	1	1	0	0	1	1	0	0	05/20	0,5=1
P34	**VIEW**	**I**	**I**	**I**	**PI**	**PI**	**I**	**I**	**I**	**PI**	**I**		**I**
	WEIGHTING	2	2	2	1	1	2	2	2	1	2	17/20	1,7=2
P35	**VIEW**	**UI**	**UI**	**PI**	**UI**	**UI**	**PI**	**UI**	**UI**	**PI**	**UI**		**UI**
	WEIGHTING	0	0	1	0	0	1	0	0	1	0	03/20	0,3=0
P36	**VIEW**	**I**	**PI**	**I**	**I**	**PI**	**I**	**PI**	**PI**	**PI**	**PI**		**PI**
	WEIGHTING	2	1	2	2	1	2	1	1	1	1	14/20	1,4=1
P37	**VIEW**	**PI**	**UI**	**PI**	**PI**	**UI**	**PI**	**PI**	**PI**	**PI**	**PI**		**PI**
	WEIGHTING	1	0	1	1	0	1	1	1	1	1	08/20	0,8=1
P38	**VIEW**	**PI**	**UI**	**PI**	**UI**	**PI**	**PI**	**PI**	**PI**	**PI**	**UI**		**PI**

	WEIGHTING	1	0	1	0	1	1	1	1	1	0	07/20	0,7=1
P39*	VIEW	UI	I	I	I	I	UI	I	I	I	I		I
	WEIGHTING	0	(2)	(2)	(2)	(2)	(0)	(2)	(2)	(2)	(2)	16/20	1,6=2
P40	VIEW	UI	PI	UI	PI	UI	PI	UI	PI	PI	PI		PI
	WEIGHTING	0	1	0	1	0	1	0	1	1	1	06/20	0,6=1
P41	VIEW	UI	PI	I	PI	I	I	I	PI	PI	PI		PI
	WEIGHTING	0	1	2	1	2	2	2	1	1	1	13/20	1,3=1
P42	VIEW	UI	UI	PI	UI	PI	PI	UI	UI	PI	UI		UI
	WEIGHTING	0	0	1	0	1	1	0	0	1	0	04/20	0,4=0
P43*	VIEW	UI	PI	UI	I	UI	UI	UI	PI	PI	PI		PI
	WEIGHTING	(0)	(1)	(0)	(2)	(0)	(0)	(0)	(1)	(1)	(1)	6/20	0,6=1
P44	VIEW	PI	UI	PI	PI	UI	PI	UI	PI	PI	PI		PI
	WEIGHTING	1	0	1	1	0	1	0	1	1	1	07/20	0,7=1
P45	VIEW	UI	UI	UI	PI	UI	I	PI	UI	PI	UI		PI
	WEIGHTING	0	0	0	1	0	2	1	0	1	0	05/20	0,5=1
P46	VIEW	PI	I	PI	PI	PI	PI	PI	I	I	PI		PI
	WEIGHTING	1	2	1	1	1	1	1	2	2	1	13/20	1,3=1
P47	VIEW	UI	PI	PI	UI	PI	PI	UI	PI	PI	PI		PI
	WEIGHTING	0	1	1	0	1	1	0	1	1	1	07/20	0,7=1
P48	VIEW	PI	PI	UI	PI	PI	UI	PI	UI	PI	UI		PI
	WEIGHTING	1	1	0	1	1	0	1	0	1	0	06/20	0,6=1
P49*	VIEW	UI	PI	PI	I	PI	I	I	UI	I	I		PI
	WEIGHTING	(0)	(1)	(1)	(2)	(1)	(2)	(2)	(0)	(2)	(2)	13/20	1,3=1
P50	VIEW	UI	UI	UI	PI	UI	UI	PI	PI	UI	UI		UI
	WEIGHTING	0	0	0	1	0	0	1	1	0	0	03/20	0,3=0
P51	VIEW	PI	UI	UI	PI	PI	I	I	UI	PI	I		PI
	WEIGHTING	(1)	(0)	(0)	(1)	(1)	(2)	(2)	(0)	(1)	(2)	9/20	0,9=1
P52	VIEW	PI	I	PI	UI	UI	PI	PI	PI	PI	UI		PI
	WEIGHTING	1	2	1	0	0	1	1	1	1	0	08/20	0,8=1
P53	VIEW	PI	I	I	UI	I	I	I	I	UI	PI		PI
	WEIGHTING	1	2	2	0	2	2	2	2	0	1	14/20	1,4=1
P54	VIEW	UI	PI	UI	I	I	I	PI	I	I	PI		PI
	WEIGHTING	0	1	0	2	2	2	1	2	2	1	13/20	1,3=1
P55	VIEW	PI	PI	PI	PI	PI	PI	I	PI	I	UI		PI
	WEIGHTING	1	1	1	1	1	1	2	1	2	0	11/20	1,1=1
P56	VIEW	PI	UI	UI	UI	PI	UI	I	UI	UI	UI		UI
	WEIGHTING	1	0	0	0	1	0	2	0	0	0	04/20	0,4=0
P57*	VIEW	PI	I	I	PI	PI	I	I	PI	I	I		I
	WEIGHTING	1	2	2	1	1	2	2	1	2	2	16/20	1,6=2
P58	VIEW	PI	PI	UI	PI	UI	UI	I	PI	UI	PI		PI
	WEIGHTING	1	1	0	1	0	0	2	1	0	1	07/20	0,7=1
P59	VIEW	PI	UI	PI	PI	PI	UI	PI	I	PI	UI		PI
	WEIGHTING	1	0	1	1	1	0	1	2	1	0	07/20	0,7=1

P60	**VIEW**	----	----	----	----	----	----	----	----	----	-----	--------	------
	WEIGHTING	-----	----	----	----	----	----	-----	-----	-----	------	-------	------
P61	**VIEW**	**UI**	**UI**	**PI**	**PI**	**PI**	**I**	**PI**	**PI**	**I**	**UI**		**PI**
	WEIGHTING	0	0	1	1	1	2	1	1	2	0	09/20	0,9=1
P62	**VIEW**	**PI**	**UI**	**UI**	**I**	**UI**	**PI**	**UI**	**PI**	**UI**	**UI**		**PI**
	WEIGHTING	1	0	0	2	0	1	0	1	0	0	05/20	0,5=1
P63	**VIEW**	**UI**	**PI**	**I**	**PI**	**PI**	**UI**	**UI**	**PI**	**PI**	**UI**		**PI**
	WEIGHTING	0	1	2	1	1	0	0	1	1	0	07/20	0,7=1
P64*	**VIEW**	**UI**	**UI**	**PI**	**UI**	**UI**	**PI**	**PI**	**UI**	**PI**	**UI**		**UI**
	WEIGHTING	(0)	(0)	(1)	(0)	(0)	(1)	(1)	(0)	(1)	(0)	04/20	0.4=0
P65	**VIEW**	**PI**	**PI**	**UI**	**PI**	**PI**	**PI**	**PI**	**UI**	**PI**	**PI**		**PI**
	WEIGHTING	1	1	0	1	1	1	1	0	1	1	08/20	0,8=1
P66	**VIEW**	**I**	**I**	**PI**	**PI**	**PI**	**I**	**PI**	**UI**	**I**	**PI**		**PI**
	WEIGHTING	2	2	1	1	1	2	1	0	2	1	13/20	1,3=1
P67	**VIEW**	**PI**	**PI**	**PI**	**UI**	**PI**	**UI**	**PI**	**I**	**UI**	**UI**		**PI**
	WEIGHTING	1	1	1	0	1	0	1	2	0	0	07/20	0,7=1
P68	**VIEW**	**PI**	**I**	**PI**	**PI**	**PI**	**PI**	**PI**	**I**	**I**	**UI**		**PI**
	WEIGHTING	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(2)	(2)	(0)	12/20	1,2=1
P69	**VIEW**	**UI**	**PI**	**PI**	**PI**	**I**	**UI**	**PI**	**UI**	**UI**	**PI**		**PI**
	WEIGHTING	0	1	1	1	2	0	1	0	0	1	07/20	0,7=1
P70	**VIEW**	**PI**	**UI**	**UI**	**PI**	**PI**	**UI**	**UI**	**UI**	**UI**	**UI**		**UI**
	WEIGHTING	1	0	0	1	1	0	0	0	0	0	03/20	0,3=0
P71	**VIEW**	**I**	**PI**	**PI**	**UI**	**UI**	**PI**	**UI**	**UI**	**PI**	**PI**		**PI**
	WEIGHTING	2	1	1	0	0	1	0	0	1	1	07/20	0,7=1
P72*	**VIEW**	**UI**	**I**	**PI**	**I**	**I**	**I**	**PI**	**I**	**I**	**I**		**I**
	WEIGHTING	(0)	(2)	(1)	(2)	(2)	(2)	(1)	(2)	(2)	(2)	(16/20)	1,6=(2)
P73	**VIEW**	**PI**	**PI**	**UI**	**PI**	**UI**	**I**	**UI**	**PI**	**UI**	**I**		**PI**
	WEIGHTING	1	1	0	1	0	2	0	1	0	2	08/20	0,8=1
P74	**VIEW**	**I**	**PI**	**I**	**I**	**PI**	**PI**	**PI**	**I**	**PI**	**UI**		**PI**
	WEIGHTING	2	1	2	2	1	1	1	2	1	0	13/20	1,3=1
P75	**VIEW**	**PI**	**PI**	**I**	**I**	**I**	**I**	**UI**	**UI**	**PI**	**I**		**PI**
	WEIGHTING	1	1	2	2	2	2	0	0	1	2	13/20	1,3=1
P76	**VIEW**	**PI**	**I**	**PI**	**UI**	**UI**	**UI**	**I**	**PI**	**PI**	**UI**		**PI**
	WEIGHTING	1	2	1	0	0	0	2	1	1	0	08/20	0,8=1
P77	**VIEW**	**UI**	**PI**	**PI**	**PI**	**PI**	**UI**	**I**	**PI**	**UI**	**UI**		**PI**
	WEIGHTING	0	1	1	1	1	0	2	1	0	0	07/20	0,7=1
P78	**VIEW**	**PI**	**PI**	**UI**	**UI**	**I**	**PI**	**PI**	**UI**	**PI**	**UI**		**PI**
	WEIGHTING	1	1	0	0	2	1	1	0	1	0	07/20	0,7=1
P79	**VIEW**	**I**	**I**	**PI**	**I**	**I**	**PI**	**PI**	**PI**	**PI**	**PI**		**PI**
	WEIGHTING	2	2	1	2	2	1	1	1	1	1	14/20	1,4=1
P80	**VIEW**	**PI**	**I**	**PI**	**UI**	**PI**	**UI**	**UI**	**UI**	**PI**	**UI**		**PI**
	WEIGHTING	1	2	0	0	1	0	0	0	1	0	05/20	0,5=1

APPENDIX J: CODED RESPONSES FOR THEME 1

<table>
<tr><th>QUOTES FROM INTERVIEWS</th><th>CODES</th><th>CATEGORIES</th><th>THEME</th></tr>
<tr><td rowspan="5">“is local knowledge”
“started in Africa many years ago, by traditional people..”
“is something that is passed by word-of-mouth-not by books”
“informal”
“is to teach about way of living”
“ lacks scientific classroom content”
“not tested”
“lacks proof”
“taught amongst community members, hardly in school”</td><td rowspan="2">*definition of IK
*origin of IK
*transmission of IK
*uses of IK
*IK supports CAPS in making content relevant</td><td>1. Understanding of IK</td><td rowspan="5">1.Township teachers’ inadequate views about the nature of indigenous knowledge influence negatively on their classroom practices</td></tr>
<tr><td rowspan="2">2. Relationship between IK and CAPS</td></tr>
<tr><td rowspan="3">*partially informed views
*lack of clear understanding
*lack of confidence
*no support
*poor resources
*lack of funding</td></tr>
<tr><td>3. Inadequate teachers’ views</td></tr>
<tr><td>4. Poor classroom practice</td></tr>
</table>

APPENDIX K: CODED RESPONSES FOR THEME 2

QUOTES FROM INTERVIEWS	CODES	CATEGORIES	THEMES
“to improve understanding of abstract concepts” *“to make science relevant to everyday life”* *“to increase learner interest”* *“do not know which teaching strategy to use”* *“not sure of actual content to include”* *“teacher training programmes* “	*improvement in understanding science *adding relevance to science in everyday life *recognition of learners’ prior knowledge *increase interest *lack of learning and teaching strategies *in-service development programmes *textbooks not CAPS compliant *teacher training	1. Value of integrating IK 2. Challenges experienced during integration 3. Evidence of integration 4. Teachers’ cry-out for help	**2. *Teachers’s experiences determine how they integrate IK in their Natural Sciences classrooms***

APPENDIX L: CODED RESPONSES FOR THEME 3

QUOTES FROM INTERVIEWS	CODES	CATEGORIES	THEME
"are programmes designed to assist teachers" *"to address confusion and misunderstandings"* *"no value anymore"* *"no support anymore"* *"integration of IK is avoided topic"* *"never seen demonstration of integration in classroom"* *"parents and older community members to participate"* *"intervention programmes to improve"* *"competent facilitators"* *"textbook selection"* *"centralised resource centre for*	* to improve their teaching * addressing confusion * filling in the gaps from teacher training *no support *facilitators lack understanding *time-factor *relevant workshops to address specific problems *facilitators who know and understand this integration process well *textbooks that are CAPS compliant *more resources with central	1. Definition of intervention programmes 2. Role of Intervention programmes 3. Current status of intervention programmes 4. Parental involvement 5. IK-focussed intervention programmes 6. Competent facilitators 7. Availability of resources 8. Increased funding 9. Reducing paperwork 10.Increased support 11. Teacher training	**3.*There is a need for indigenous knowledge-focused intervention programmes to equip teachers with knowledge and skills in integrating indigenous knowledge in Natural Sciences***

IK-related materials"	distribution centre *funding for invitation of community elders *more employees to do administrative duties *peers *SMT *district *department *community *introduction of a compulsory IK module during teacher training		