SCIENCE TEACHERS' CONCEPTUAL UNDERSTANDING OF INDIGENOUS KNOWLEDGE IN THE PRIMARY SCHOOLS OF ESWATINI

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ABSTRACT

The taught science curriculum in Eswatini schools predominantly projects a western worldview, which assumes superiority over Indigenous Knowledge (IK). The science curriculum-in-use is prescriptive in nature and that undermines teachers' and learners' everyday life experiences and knowledge. The study seeks to elicit science teachers' conceptual understanding of IK. The study has adopted the positivist paradigm, framed from a case study design which allows the use of quantitative approaches. The study has also been informed by the social constructivist theory which emphasizes that meaningful learning is culture-bound and grows out of social encounters. Data were collected using a questionnaire that was administered to 110 randomly sampled primary school science teachers for the senior grades in the Southern Hhohho region of Eswatini. A validated close-ended questionnaire, with Cronbach Alpha reliability coefficient α=0.78 was developed and used for data collection. Data were analysed using percentages, descriptive and inferential statistics through the statistical package SPSS version 20.0 software. Findings reveal that Science teachers were conceptually aware of the value of IK that learners bring into the science classroom (M>3.00). Analysis further reveals that science teachers' conceptual understanding of IK was significantly influenced by gender where female teachers were more knowledgeable than males (p=.005). There were age related differences of the teachers' conceptual understanding in the lower range and displayed more similar attributes in the upper range due to the experience (p=.002). Finally, they were no statistical significant gender-age interaction effect and qualification effect on the respondents (p=.034). The paper, recommends that science teachers should be capacitated in IK both at pre-service and in-service levels in order to bridge the gap between school science and IK and to harmonise the teaching and learning of science.

KEY WORDS: Conceptual understanding, Indigenous Knowledge (IK), Science teachers

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INTRODUCTION

Teachers and learners bring a lot of indigenous knowledge (IK) to class because they come from diverse communities. Everyday life experiences become the prior knowledge to which they attach new knowledge. They cumulatively acquire prior knowledge in their daily activities as they interact with the environment; such experiences can be used in the science lessons since they are pre-existing schemas (Garbett, 2011). Ngulube (2002) asserts that African Indigenous knowledge (IK), is passed on from generation to generation orally and practically. It can easily be lost because it is neither documented nor managed properly. The author further asserts that the human mind has a limited capacity, and stored information may be eroded by failing memories, or death of practitioners. Iron and steel tool-making, medicinal herbs and interpreting animal and plant behaviour to predict weather patterns are some examples of specialised but undocumented indigenous skills that die with their practitioners.

However, classroom teaching and learning is guided by the official curriculum which is prescriptive and is dominantly influenced by the western worldview, disregarding the experiences of both teachers and learners. Science teachers implement the intended curriculum influenced by their experiences to produce the attained curriculum. Western science then tends to disregard and undermine the IK that the teachers and learners bring into the classroom. According to UNICEF (2014), the science curriculum and teaching provides an avenue for the integration of IK. One can assume that science teachers think in more than one worldview because of their interaction with different environments; hence, one acknowledges the presence of different worldviews in the classroom. People reflect in different ways in each situation. Garbett (2011) asserts that teaching science is dependent upon the understanding of complex relations between learners' prior knowledge, the science content knowledge and teaching approaches. Equally, Berkvens, Akker and Brugman (2014a) state that effective teaching requires the teacher to analyse the logical structure of a topic and to identify all the prerequisite knowledge that is required. It is therefore implied that science teachers should check if learners have the necessary prerequisite knowledge. On the basis of that knowledge, the science teacher can then introduce the new knowledge in ways that build upon the prerequisite knowledge, and at a rate that allows learners to build cognitive bridges with the prior knowledge. This paper therefore discusses primary school science teachers' conceptual understanding of IK.

Background of the study

Dlamini and Kaya (2016) studied the linkages between environmental security and indigenous knowledge systems for sustainable food security. The authors view indigenous knowledge and traditional technologies practices in Eswatini as ways of working, knowing and thinking. It is asserted that much valuable wisdom has been lost in Eswatini over the years, and an effort is needed now to rediscover it and examine its value for the present day (Simelane, 2012). According to Seehawer (2018), IK is local knowledge and the basis for decision making in areas such as agriculture, education, health care and food preparation. Seehawer (2018) further asserts that this is because indigenous people use it to produce food, provide shelter and achieve control of their own life. Barnhardt and Kawagley (2005) view IK as a system of survival as well as ways of knowing.

Dziva and Kusure (2011) assert that there are various forms in which IK and its application can be understood in different communities. This is local knowledge, which refers to the understandings, skills and philosophies developed by societies who have stayed in their natural surroundings for a long time. In other communities IK is called traditional knowledge which refers to knowledge that is embedded in the cultural traditions of a community (Dziva & Kusure, 2011). It is also known as 'peasant knowledge', 'indigenous knowledge' or 'folklore knowledge'. Chisenga (2002) accounts for the basic characteristics of IK, that it is generated within communities, such that it is location and culture specific. Chisenga (2002) further believes that it is not systematically documented, but based on experience, and that it is oral and rural in nature, hence difficult to transfer to another person by means of writing or verbalization. Ocholla and Onyancha (2005) add that indigenous knowledge is tacit or tangible knowledge which is inseparable from realistic knowledge, and lament that it is unfortunate due to ignorance and arrogance. Indigenous knowledge has been neglected, vindicated, stigmatized, illegalized, and suppressed amongst the majority of the world communities. Odora-Hoppers (2004) assert that stories, dance songs and ceremonies are important sources of knowledge in indigenous cultures, and that resources may be non-textual in nature. It is generated and transmitted by communities over time in an effort to cope with their socio-economic environment (Odora-Hoppers, 2004). While Ogunniyi (2004), views indigenous cultures to have long valued oral language to transfer knowledge, and indigenous people use a variety of complex practices and protocols to pass along oral histories such as traditional ceremonies. Furthermore, Ogunniyi (2004), assert that to promote indigenous cultures, community members are trained in communication skills from a young age so that they can effectively share stories, ideas and experiences orally.

REVIEW OF RELATED LITERATURE

Empirical studies

Studies conducted by Dziva and Kusure (2011), Mustapha (2019) and Mhakure (2014) explored teachers' conceptions of Indigenous Knowledge (IK) in secondary school Science. The studies explored the driving factors of education understanding of IK amongst teachers and students. It emerged from their studies that teachers' conception and perception of IK is greatly influenced by the covert nature of secondary school science syllabi on IK. It has been found that the school teaching and learning materials turn to mask the concepts of IK in the science teaching syllabus. It has also emerged that the factors that influence IK understanding among indigenous teachers are self-awareness and experiences of the teachers. Mhakure (2014) conducted a study in the African context about science teachers' identities on indigenous knowledge, where teachers from science and Indigenous Knowledge Systems Project (SIKSP) members participated in the study. The teachers were sampled from having been with SIKSP for three or more years, and have taught science. The data was collected using open-ended questionnaire and analysed using Ogunniyi's (2008) Contiguity Argumentation Theory (CAT) which is derived from the Aristotelian Theory. The Aristotelian Theory asserts that one or two states of mind, e.g. "western science and IK tend to recall each other in order to create an optimum cognitive state" (Ogunniyi, 2008, p. 173). For meaningful learning to occur, new ideas that already exist within an individual's cognition must have some form of commonality. If there are disparities, several responses are possible, internally or cognitively, when an individual is introduced to a new culture, in the case of IK. This may lead to the rejection of the new view; co-existence or assimilation, if the new idea is slightly linked or similar to the predominant view which leads to integration into the existing milieu and harmonization (Ogunniyi, 2008). For harmonization and adaptation to occur, Ogunniyi's (2008); CAT theory asserts that a common ground between the dominant (IK/WS-based) world views of the participant can be reached through negotiation, through both interpersonal and intrapersonal dialogue. In this study, the conflicting views of IK depend on the socio-cultural backgrounds of the participants. Findings revealed that IK is backward and uncivilized 'science' which is believed and is evident in the teaching content and activities, therefore it should not be brought into African schools. It has been asserted that the latest developments in science teaching and learning in Africa present some paradigm shift towards integration of IK ;hence, the purpose of the paper is to understand science teachers' awareness about the value of IK in the teaching and learning of science.

Theoretical Framework

Effective teaching requires the teacher to: analyse the logical structure of a topic, identify all the prerequisite knowledge that is required, verify that the learners have already learnt conventional versions of that prerequisite knowledge, introduce the new knowledge in ways that clearly build upon the prerequisite knowledge, and at a rate that does not overload learners (Berkvens, van den Akker, & Brugman, 2014a; Mathews, 1997). The study has been informed by the social constructivism theory by Vygotsky (1978) because it is founded on the socio-cultural basis of cognition. The theory asserts that pedagogical idea on social constructivism emphasize the interplay of culture and social context in the construction of knowledge and understanding of events in the social setting on which the learning takes place. According to Vygotsky (1978) theory, meaningful learning is culture-bound and grows out of social encounters. The knowledge that learners acquire in school has an important connection with the learning acquired through everyday experience. Vygotsky (1978) approach on Social Development Theory (SDT) further states that social interaction precedes development; consciousness and cognition is the end product of socialization and social behaviour. The Social development Theory can be presented diagrammatically as Figure 1 below:

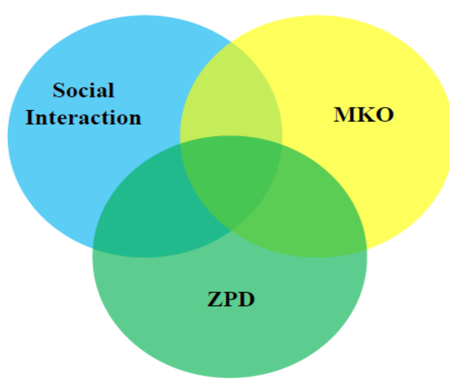

Figure 1: **The three themes of Social Development Theory: Social Interaction, More Knowledgeable Other (MKO), and Zone of Proximal Development (ZPD).**

Three major themes stated by Vygotsky (1978) socio-cultural development theory: Social Interaction (SI), More Knowledgeable Other (MKO), and the Zone of Proximal Development (ZPD). Social interaction plays a fundamental role in the process of cognitive development and it precedes development. Functions in the child's cultural development appear twice: first, on the social level, and later, on the individual level. The MKO accounts for anyone who has better understanding or higher ability level than the learner, with respect to a particular task, process, or concept. The MKO is normally thought of as being a teacher, coach, or older adult, but the MKO could also be peers, a younger person, or even computers. The Zone of Proximal Development (ZPD) is distance between the actual developmental level in independent problem solving and potential development as determined through problem solving under guidance or collaboration of peers (Vygotsky, 1978). In the ZPD, a teacher and a learner work together on a task that the learner could not perform independently because of the level of difficulty. A good deal of guided participation is required when working in the ZPD and learners bring their own understandings to social interactions and construct meanings by integrating those understandings with their experiences in the context. Social development Theory emphasises that children and adults are both active agents in the process of child's development. In the classroom, both the teacher and the learner are seen as active agents in learning. The teacher's intervention in learning is necessary, but depends on the quality of the teacher-learner interaction, which is seen as crucial in learning. The teacher should understand the learners' pre-existing conceptions, and guides the activity to address them and then build upon them. The theory is of particular importance in this research as it acknowledges both the teachers and learners' prior knowledge on which to build the content. The paper examines teachers' conceptual understanding of IK, it is therefore crucial to view the prior knowledge as continuously evolving and subject to interaction with other knowledge systems. The researchers therefore, examine constructivism as a theoretical framework to understand how teachers act as active agents in constructing knowledge.

Statement of the problem

Science teachers and learners have vast experiences of prior knowledge, called Indigenous Knowledge, which they bring to class because they come from diverse communities which influenced their upbringing. One wonders if teachers have an understanding of this vital prior knowledge, since they would automatically transfer it to the learners as they teach them the different science strands defined in western science. It would therefore be imperative to transfer knowledge they understand as science teachers to curb any conflict that might arise when the two worldviews come together. Therefore, there is a need to explore teachers' conceptual understanding of IK to align their teaching in order to avoid conflict amongst the two worldviews.

Research objectives

Based on the above background, the study is generally set out to assess science teachers' conceptual understanding of IK, and the different variables that contribute towards their knowledge of IK to use in the teaching and learning of Science curriculum. The study is set out to:

a) Explore Science teachers' conceptual understanding of IK.
b) Identify the variables that contribute towards science teachers' conceptual knowledge of IK.

Research questions

a) What are the science teachers' conceptual understandings of IK?
b) What are the variables that contribute towards science teachers' conceptual knowledge of IK?

Research Hypotheses

Question (b) on variables has been transformed to the following research hypothesis:

H_0= There is no significant difference in science teachers' knowledge of IK by gender, age and gender-age interaction effects.

METHODOLOGY

Research design

The study adopted the positivist paradigm that advocates for the use of quantitative approaches in the study. Positivist researchers use statistics and numbers and the conclusion makes inferences based on that data (Hamilton & Corbett-Whitier, 2013). According to Creswell and Cheryl (2016), a research approach is a plan of action that gives direction to conduct research systematically and efficiently. The paper utilizes the quantitative approach, which supports the positivist paradigm. The benefit of the quantitative approach according to Creswell and Cheryl (2016) is that it allows the use of large sample size for the generalisation of the findings for useful conclusions. In this study a cross sectional survey design was adopted to gather as much participation as possible (Creswell, 2014).

Population and Sampling

In this study the researcher used primary school science teachers on the basis that they teach science in the upper grades (Grade 5, 6 and 7) from both rural and urban schools in the designated zone. The sampling process came up with 120 science teachers who were given the self-administered questionnaire to complete. However, out of the 120 sampled science teachers only 110 completed the questionnaire rating 92% response.

Instrumentation

For purposes of this paper a close-ended self-administered questionnaire was used to collect data. The instrument was sub-scaled into two sections: demographic characteristics of respondents (six questions) and science teachers' conceptual understanding of IK (eleven questions). The instrument was validated and yielded a Cronbach alpha reliability coefficient of $\alpha=0.78$. The validated instrument by experts was administered amongst the sampled respondents; where close-ended questionnaire was hand delivered to and collected at a later date.

Data analysis methods

Data were analysed using descriptive and inferential statistics through the usage of SPSS software; version 20.0. The study used the frequencies, percentages, the mean, standard deviation and t-test to analyse the data in order to make conclusions through generalisations. The study used the mean to get a general overview of teachers' conceptual understanding of IK. A t-test was then applied to the data to test for differences in perceptions of male and female teachers. The p-value, which is a probability value, was also used to test the level of significance of the teachers' perceptions. The standard deviation and co-efficient of variance were also used. Analysis of covariance (ANCOVA) was then applied to test the influence of other demographic characteristics on the perceptions of teachers.

PRESENTATION OF RESULTS

Demographic profile of respondents

The section presents an analysis of the demographic information of the participants of the study. The conceptual understanding of IK in the teaching of science at primary schools in Eswatini are presented in terms of gender of participants, teachers' age, educational qualifications, area of specialization, other subjects they teach as well as their teaching experiences in years. These were variables that were used to measure the four research questions.

a) Gender

Data on the distribution of respondent teachers by gender is presented in Figure 4.6, which shows a lower participation rate amongst female teachers (*n*=43, 39.1%) than amongst their counterpart males (*n*=67, 60.9%). This is consistent with findings from Mullis, Foy and Hooper (2015), who found that there were more men than women in the science profession and that more women than men were depicted as teachers. This shows that there is a stereotypical representation of men and women in online science education resources, hence the changes needed to create a balanced representation of men and women. Similarly, it has been reported that women are under-represented in occupations requiring knowledge of or qualifications in the fields of Mathematics, Physical Sciences, Engineering, Computer Studies and allied fields at every level of education from elementary school to graduate school. It is further reported that some researchers claim that Mathematics and Science are not seen as congruent with female sex role identity. This, is due to lower self-confidence of women and girls, as well as being hesitant about their own potential and choices (Acker & Oatley, 1993). In this particular study, the participation is presented in Figure 2 below:

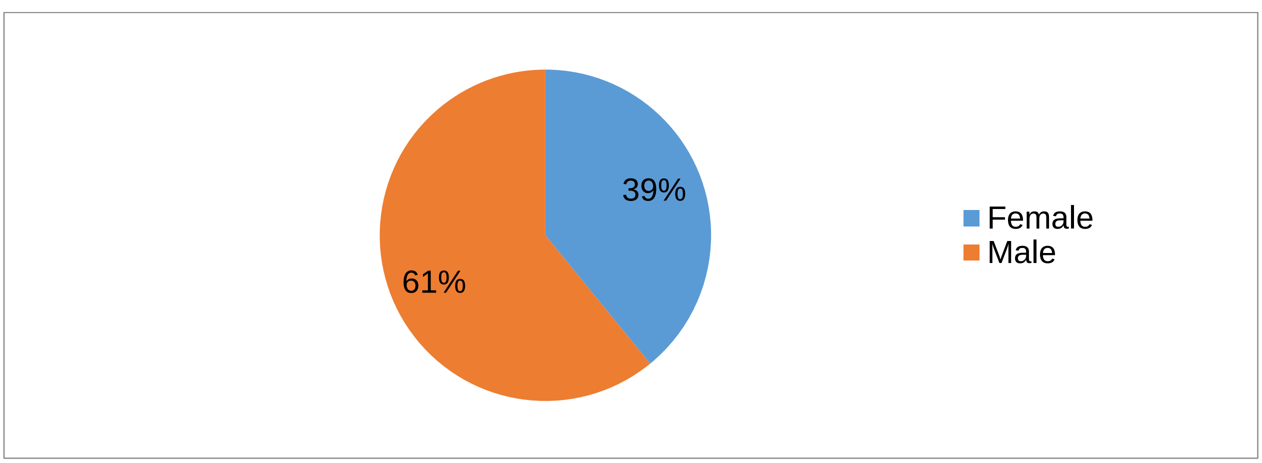

Figure 2: ***Distribution of respondents by gender***

While this distribution reflected in Figure 2 runs contrary to Annual Education Census (AEC) records of a dominance of female teachers at primary school level (AEC 2009-2017), it does reflect the dominance of males in this study. Similarly, findings presents the dominance of males in Science, Technology, Engineering and Mathematics (STEM). A recent study of females in STEM in the country indicated that the country has few female researchers in this area (Simelane, 2012).There was lower participation rate amongst female teachers than amongst their male counterpart in the study. This suggests that science curriculum at primary school upper grades 5, 6, and 7 is taught by males.

b) Teachers' age

The distribution of respondent teachers as shown in Figure 3 reflects the dominance of youthful teachers who participated in the study. Most of the teachers (77%) were below the age of 40 years old, and only about 1 in 20 respondent teachers (*n*=3, 5%) were within the 10 years or closer to retirement. Figure 3 also shows that there were gender-based differences in the distribution of respondents.

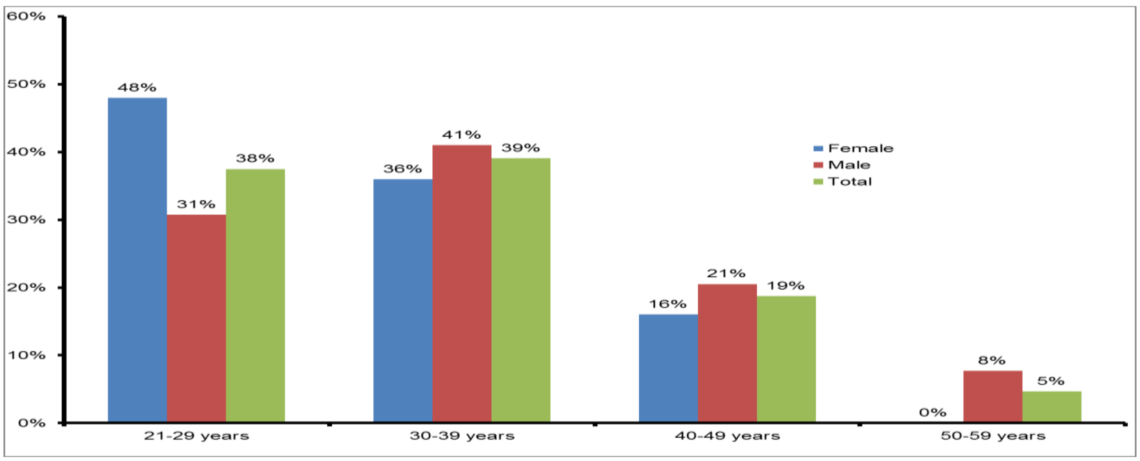

Figure 3: ***Distribution of respondents by age group and gender***

The female respondents are shown to have been generally younger than their male counter parts, hence about 1 in 2 (*n*=12, 48%) were below the age of 30 years old and only less than a third (*n*=12, 31%) of the male respondents were in this age group. Figure 3 shows that about 1 in 12 (*n*=3, 8%) of the male respondent teachers were above the age of 50, whereas all female respondent teachers were below the age of 50.

As much as the researchers thought there would be an equal representation from the participants, the National female to male ratio of 5:3 clearly comes out dominant in the study. Currently the education sector is largely dominated by young teachers less than 40 years of age. About 5% were within the range of 50 to 60 years.

a) Females are shown to be younger than their male counterparts, since about 50% were below the age of 30 years old.
b) Less than $^1/_3$ of males were young as 8% of male teachers were above the age of 50 years, whereas all female respondent teachers were below the age of 50.

c) Teaching Experience

As shown by Figure 4, there were no female teachers with science teaching experience of 10 years or more. At least half the number of female respondent teachers (*n*=13, 52%) had been teaching science for less than 4 years, and the rest had only been teaching for a period not exceeding 9 years (Figure 4). In contrast, about

1 in 5 (19%) of the male respondent teachers had been teaching science for 10 years or longer. Therefore, the male respondent teachers were not only older on average, but they also reported to have more experience in teaching the subject.

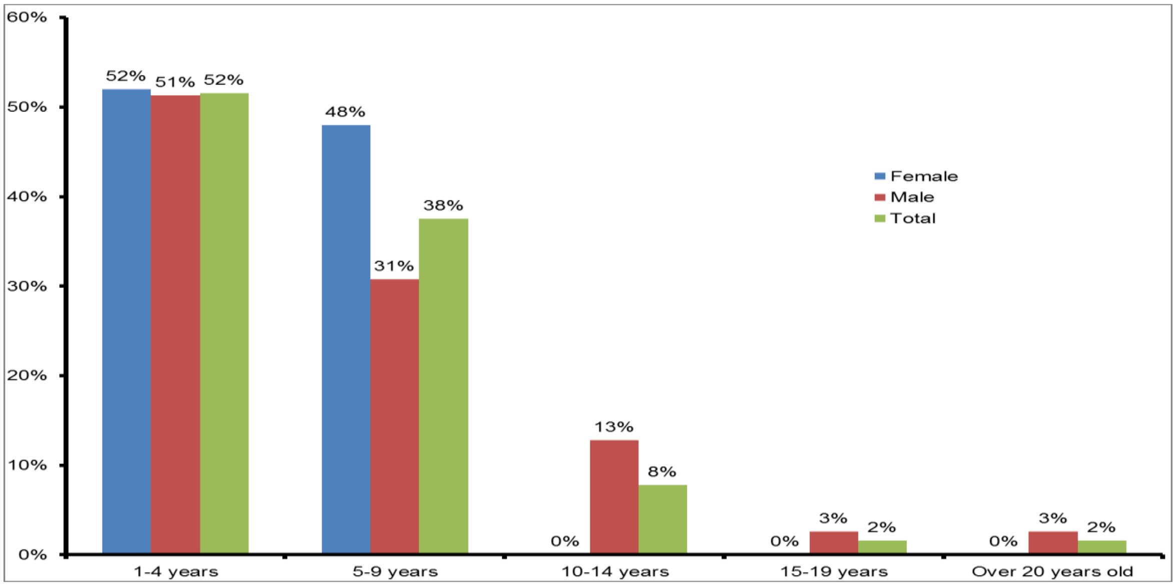

Figure 4: ***Distribution of female and male respondent teachers by science teaching Experience***

Further analysis of the data showed that the experience in teaching science could not be directly inferred from the teacher's age. For example, 2 of the 3 male teachers in the age group 50-59 years had teaching experience of less than 9 years. Of the 12 male teachers with experience of 5-9 years, about 1 in 5 (*n*=2, 17%) were of an age above the age of 50 years. Similarly, the female teachers who reported having a teaching experience of less than 5 years, at least 1 in 8 (*n*=2, 15%) were above the age of 40 years. Amongst female respondent teachers in the same age group (40-49 years), about 1 in 5 (*n*=2, 17%) had no more than 9 years' experience in teaching Science.

There were 56 (51.9%) participants who had taught for a period of 1-4 years. More than a third (*n*=41, 37.3%) of the participants had teaching experience of 5-9 years. Those who had taught from 10-14 years were 9 (8.2%). Only 4% participants had teaching experiences within the range of 15 years and longer (Figure 4).

a) There were no female teachers with science teaching experience of ten years or more since half the number of female respondent teachers had been teaching science for less than four years, and the rest had only been teaching for a period not exceeding nine years.
b) Males have been teaching science for ten years or longer. Therefore, on average, male respondent teachers were older and more experienced in teaching the subject.
c) Teaching experience cannot be directly inferred from the teachers' age, for both males and females.

d) Academic Qualifications

Amongst the female (*n*=17, 68%) and male (*n*=29, 74%) respondent teachers, most reported a Primary Teachers Diploma as the highest qualification held (Figure 4.9). Figure 4.9 also shows that there were similarities in the proportion of female (*n*=5, 20%) and male (*n*=7, 18%) reporting they held an undergraduate degree (B. Ed.).

Figure 5 indicates that most of the respondent teachers held a Primary Teachers' Diploma (*n*=46, 72%) and at least half of the respondents specialised in Applied Sciences (*n*=33, 52%). The specialists in Applied Sciences constituted more than half the group of teachers that held a PTD (*n*=26, 57%).

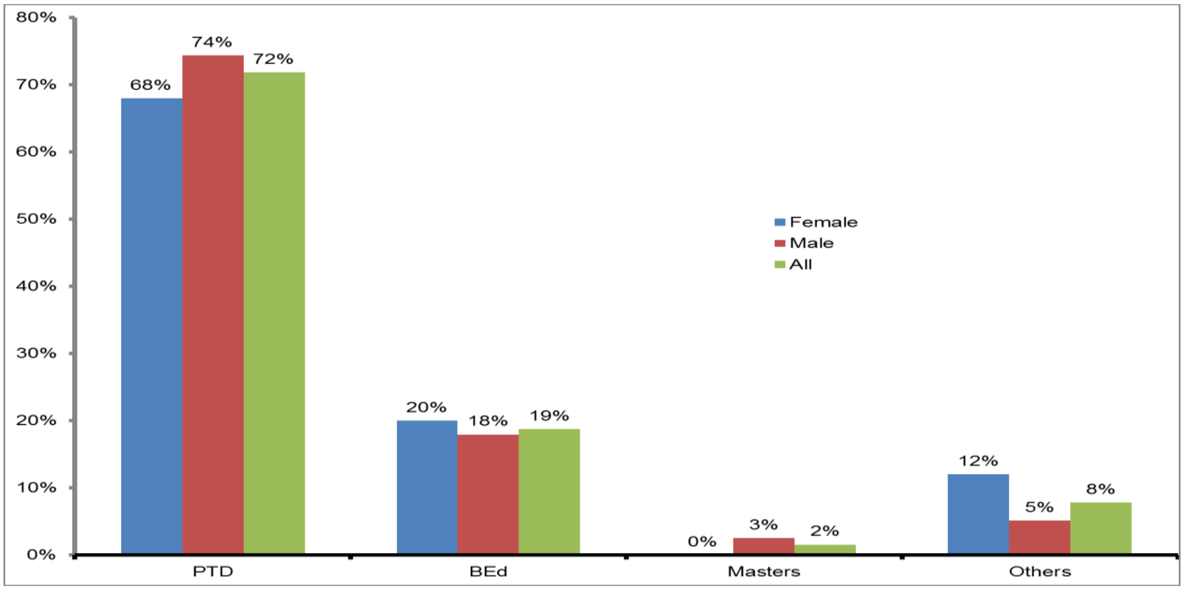

Figure 5: ***Distribution of female and male respondents by highest qualification***

Amongst the respondent teachers that reported a Bachelor of Education (B. Ed.) degree, most (*n*=8, 67%) reported specialising in the Social Studies and the rest (*n*=4, 33%) specialised in Applied Sciences (Table 4.1).

Table 1: *Distribution of respondent teachers by qualification held and area of specialisation*

Specialisation	PTD	B. Ed.	Masters	Others	Total
Languages	9	0	0	0	9
Socials	11	8	0	3	22
Applied Science	26	4	1	2	33
Total	46	12	1	5	64

Table 1 also shows that some of the science teachers specialised in Languages (*n*=9, 14%) and these held a PTD certificate as the highest qualification. Table 4.1 further indicates that some respondent teachers reported held other qualifications than a Primary Teachers' Diploma (PTD), Bachelor of Education (B Ed) or Master's degree. These qualifications included Bachelor's Degree in Humanities as well as Bachelor of

Science degree in Agriculture, or Agricultural Education. Key findings are listed below:

a) Amongst both male and female respondent teachers, most reported a Primary Teachers' Diploma (PTD) as the highest qualification held.
b) There were similarities in the proportion of female and male respondent teachers who reported they had an undergraduate degree.
c) Some respondent teachers held other qualifications other than a PTD, B Ed or Master's Degree. These qualifications include Bachelor's Degree in Humanities as well as Bachelor of Science Degree in Agriculture or Agricultural Education.

Since the number of participants shrinks as the level of qualification rises, this can be attributed to the lack of motivation from the employer in persuading the employees to further their studies. Hazelkorn (2015), reports that the quality of an education system cannot exceed the quality of its teachers. However, some education systems face teacher recruitment problems, especially in areas like Mathematics, Science and ICT. The highest performing systems internationally have teachers who are seen as important members of their communities and attract high-achieving and committed students into science teacher education. This helps to ensures that teaching is undertaken by teachers with the appropriate disciplinary, pedagogical and professional competences underpinned by suitable incentive structures and continuous professional development.

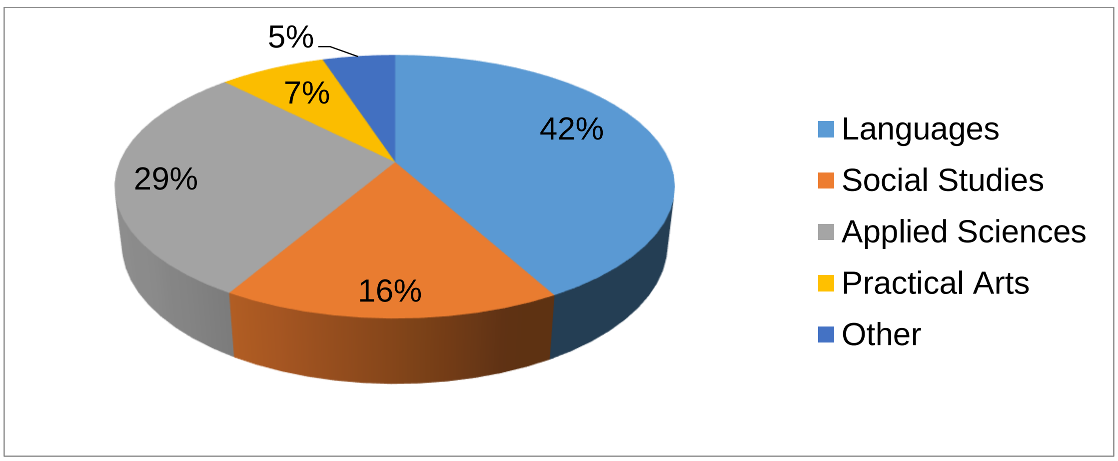

Figure 6: ***Distribution of respondents by other subjects taught***

These are the findings in terms of the variables of areas of specialisation:

a) Half of the respondent teachers specialised in Applied Sciences and these specialists in Applied Sciences constituted more than half the group of teachers that held a PTD.
b) Amongst the respondents teachers who reported to have a Bachelor of Education (B Ed), most reported to be specialising in Social Studies and the rest specialised in Applied Sciences.
c) Some of the science teachers specialised in Languages, and these held a PTD certificate as the highest qualification.

Table 2 presents a summary of the perceptions of respondent teachers with regards to their conceptual understanding of IK. The table indicates that the respondent teachers were aware of IK at a mean of

(M>3.00). A Means Separation test in the form of independent samples t-test was applied to the data to test for differences in perceptions of male and female teachers.

Table 2: *Science teachers' conceptual understanding of IK*

Statements	M	SD	CV	*t*	*p*
I encourage learners to demonstrate using IK to clarify certain concepts.	3.03	1.15	38%	0.138	0.890
I encourage learners to relate school science to IK.	3.15	1.14	36%	0.124	0.902
I encourage learners to use science concepts to explain IK.	3.15	1.14	36%	0.332	0.741
I find teaching using IK interesting.	3.47	1.22	35%	2.074	0.042
I recognise IK in the science instructional materials.	3.44	1.19	35%	1.165	0.248
IK is in the science curriculum.	3.28	1.15	35%	3.293	0.002
I encourage learners to identify IK that can be used to solve problems during science lessons.	3.40	1.13	33%	1.525	0.132
I use IK examples to illustrate scientific concepts.	3.75	1.11	30%	1.838	0.071
I give learners the opportunity to explain abstract concepts using IK.	3.51	1.02	29%	1.432	0.157
I relate science concepts to IK.	3.55	1.01	28%	0.575	0.567
I introduce my lessons by drawing from learners' IK experiences.	3.89	0.97	25%	1.440	0.155

The findings presented in Table 2 show that teachers perceptions were significantly influenced by their gender (*p*=0.005). Female respondent teachers were more positive than their counterpart males. Hence, female respondent teachers were more likely: (i) to indicate that they thought there was IK in the science curriculum (*p*=0.002), (ii) to use IK examples to illustrate Scientific concepts (*p*=0.004), (iii) to find teaching using IK interesting (*p*=0.007), and (iv) to give learners the opportunity to explain abstract concepts using IK (*p*=0.029) as compared to male respondent teachers.

Table 3: *Descriptors of female and male teachers' conceptual understanding of IK*

Statement	Gender	Mean	Std. Error
IK is in the science curriculum.	Female	3.910[a,b]	0.229
	Male	2.884[a]	0.207
I use IK examples to illustrate scientific concepts.	Female	4.415[a,b]	0.227
	Male	3.727[a]	0.206
I recognise IK in the science instructional materials.	Female	3.932[a,b]	0.230
	Male	3.308[a]	0.209
I introduce my lessons by drawing from learners' IK experiences.	Female	4.075[a,b]	0.214
	Male	3.839[a]	0.194
I relate science concepts to IK.	Female	3.717[a,b]	0.222
	Male	3.596[a]	0.201

I encourage learners to relate school science to IK.	Female	3.380[a,b]	0.233
	Male	3.298[a]	0.212
I give learners the opportunity to explain abstract concepts using IK.	Female	3.299[a,b]	0.241
	Male	3.204[a]	0.218
I encourage learners to demonstrate using IK to clarify certain concepts.	Female	3.032[a,b]	0.237
	Male	3.260[a]	0.215
I encourage learners to identify IK that can be used to solve problems during science lessons.	Female	3.683[a,b]	0.238
	Male	3.265[a]	0.216

Analysis of Covariance (ANCOVA) was then applied to the data to test the influence of teacher age and gender, controlling for other demographic characteristics on the perceptions of teachers. Age and gender were used in the Generalised Linear Model as fixed Factors, while teacher qualification, area of specialisation and science teaching experience were used as co-variants. The findings are presented in Table 4.

Table 4: *Descriptors of female and male science teachers of different age groups about conceptual understanding of IK*

Statements	Age Group	Female			Male		
		Mean	SD	N	Mean	SD	N
IK is in the science curriculum.	21-29 years	4.00	0.953	12	3.58	0.996	12
	30-39 years	4.00	0.000	9	3.07	1.335	15
	40-49 years	3.50	.577	4	2.38	1.061	8
	50-59 years	0.00	0.000	0	2.67	1.155	3
	Total	3.92	.702	25	3.05	1.207	38
I use IK examples to illustrate scientific concepts.	21-29 years	3.83	.835	12	3.83	1.030	12
	30-39 years	4.22	.441	9	3.87	1.125	15
	40-49 years	5.00	0.000	4	3.13	1.553	8
	50-59 years				4.00	1.000	3
	Total	4.16	.746	25	3.71	1.183	38
I recognize IK in the science instructional materials.	21-29 years	3.92	1.165	12	3.83	.835	12
	30-39 years	3.11	0.928	9	3.47	1.060	15
	40-49 years	4.50	0.577	4	2.88	1.356	8
	50-59 years	0.00	0.00		3.33	1.155	3
	Total	3.72	1.100	25	3.45	1.083	38
I introduce my lessons by drawing from learners' IK experiences.	21-29 years	4.50	0.798	12	3.42	0.996	12
	30-39 years	3.33	0.866	9	4.00	.756	15
	40-49 years	4.50	0.577	4	3.63	1.408	8
	50-59 years			0	4.00	1.000	3
	Total	4.08	0.954	25	3.74	1.005	38
I relate science concepts to IK.	21-29 years	3.67	1.155	12	3.92	0.793	12
	30-39 years	3.56	0.882	9	3.53	0.915	15
	40-49 years	4.00	0.000	4	3.13	1.246	8
	50-59 years			0	3.67	0.577	3

	Total	3.68	0.945	25	3.58	0.948	38
I encourage learners to relate school science to IK.	21-29 years	3.42	0.996	12	3.67	0.985	12
	30-39 years	2.67	0.866	9	3.00	1.134	15
	40-49 years	4.00	0.000	4	2.50	1.309	8
				0	4.33	0.577	3
	Total	3.24	0.970	25	3.21	1.189	38
I encourage learners to use science concepts to explain IK.	21-29 years	3.50	0.905	12	3.42	0.900	12
	30-39 years	2.67	1.323	9	3.00	1.254	15
	40-49 years	3.50	0.577	4	2.25	1.165	8
	50-59 years			0	4.33	0.577	3
	Total	3.20	1.080	25	3.08	1.194	38
I encourage learners to demonstrate using IK to clarify certain concepts.	21-29 years	3.17	0.937	12	3.67	0.985	12
	30-39 years	2.89	1.364	9	2.47	0.834	15
	40-49 years	3.00	1.155	4	2.50	1.309	8
	50-59 years			0	4.00	1.000	3
	Total	3.04	1.098	25	2.97	1.150	38
I encourage learners to identify IK that can be used to solve problems during science lessons.	21-29 years	4.17	0.389	12	3.50	1.000	12
	30-39 years	3.11	1.054	9	3.07	1.335	15
	40-49 years	3.50	0.577	4	3.00	1.414	8
	50-59 years			0	4.00	1.000	3
	Total	3.68	0.852	25	3.26	1.223	38
I find teaching using IK interesting.	21-29 years	4.42	0.793	12	3.83	0.835	12
	30-39 years	3.33	1.000	9	3.33	0.900	15
	40-49 years	3.50	0.577	4	1.88	1.356	8
	50-59 years			0	4.33	0.577	3
	Total	3.88	0.971	25	3.26	1.223	38
I give learners the opportunity to explain abstract concepts using IK.	21-29 years	3.92	0.669	12	3.58	1.084	12
	30-39 years	3.33	1.118	9	3.00	0.845	15
	40-49 years	4.00	0.000	4	3.25	1.389	8
	50-59 years			0	4.33	0.577	3
	Total	3.72	0.843	25	3.34	1.072	38

The analysis showed that there were age related differences in the teachers' self-reported practices of encouraging learners to relate school science to IK (*p*=0.034); encouraging learners to demonstrate using IK to clarify certain concepts (*p*=0.029), and encouraging learners to use science concepts to explain IK (*p*=0.048). The model used showed that the differences by either gender or age of the respondent teacher did not occur amongst different age groups of a gender. Hence, there were no statistically significant interaction (gender*age) effects, showing that differences in understanding of IK, male and female respond teachers were not related to their age and in the same way, differences in their understanding of different age groups were not influenced by their gender.

FINDINGS AND DISCUSSIONS

The findings of the study were presented following the numerical data and themes that emerged from the study. The numerical data that emerged from the study is presented in Tables1, 2 and 3 above.

The major finding was that generally, teachers are aware of IK and that their perceptions were significantly influenced by their gender (*p*=0.005). The research recognises that female respondent teachers were more positive than their counterpart males, and thus they (female respondent teachers) were more likely to indicate that they thought there was IK in the science curriculum (*p*=0.002); to use IK examples to illustrate Scientific concepts (*p*=0.004); to find teaching using IK interesting (*p*=0.007) and to give learners the opportunity to explain abstract concepts using IK. This is in line with the National female to male ratio of 5:3 which clearly comes out dominant in the study. This is contrary to a study conducted by Simelane, (2012), of females in STEM in the country which indicated that the country has very few female researchers in the area.

Qualitative analysis revealed that participants' understanding of IK varied, as some indicated that they were aware of IK whilst others responded to the negative. These differences were attributed to their different social backgrounds and upbringing.

CONCLUSIONS

Teachers' understanding of IK

i) The respondent teachers were aware of IK.
ii) Female respondent teachers were more positive than their male counterparts.
iii) There were age related differences in the teachers' self-reported conceptual understanding of IK, in favour of the more experienced teachers.
iv) There were no statistically significant gender-age interaction effects.
v) There were no statistically significant qualification effects on teachers' self-reported conceptual understanding of IK.

The research study sought to test the hypothesis (H_0) that there are no significant differences in teachers' perception and understanding of IK by the four variables. The major finding was that teachers' perceptions understanding of IK were significantly influenced by the respondents four variables of measurement; gender (p=0.005). Therefore, the H_0 hypothesis has been rejected and the H_1 alternative hypothesis accepted. The research recognises that female respondent teachers were more positive than their counterpart males. The experience of the respondent teachers presented a significant variation as far as their conceptual understanding of IK was concerned (p=0.007). Finally, There were no statistically significant effects of the qualifications on teachers' self-reported conceptual understanding of IK (p=0.001).

Recommendations

Pre-service and In-service: Pre-service and In-service departments should capacitate teachers on IK issues so that there is a gender balance in the level of confidence in exhibiting IK, and be appropriately skilled in integrating it in teaching Science, regardless of their different age groups.

Teachers: They should be extra vigilant and pro-active as they carry out their teaching in the classrooms so that they recognise the IK students bring to a science classroom. It is important that the IK be crafted and integrated harmoniously to avoid any conflict with western science. Once the IK is identified by the teachers, they should then present tasks appropriately by making material more personally relevant to students, hence also helping students develop confidence in the content. Furthermore, science teachers should teach topics which require IK effectively. They should also make consultations on how to make sense of Indigenous Knowledge integration when teaching science.

REFERENCES

Acker, S. & Oatley, K. (1993). Gender Issues in Education for Science and Technology: Current Situation and Prospects for Change. *Canadian Journal of Education*. 18(3), 123-125. Available from: http://journals.sfu.ca/cje/index.php/cje-rce/article/download/2659/1967/

Barnhardt, R. and Kawagley, A. O. (2005). Indigenous Knowledge Systems and Alaska Native Ways of Knowing. *Anthropology and Education Quarterly*, Vol. 36, (1), 8–23. Available from: http://www.fws.gov/nativeamerican/pdf/tek-barnhardt-kawagley.pdf

Berkvens, J., van den Akker, J., & Brugman, M. (2014a). Addressing the quality challenge: Reflections on the post - 2015 UNESCO Education Agenda. Netherlands: Netherlands National Commission for UNESCO.

Chisenga, J. (2002). Indigenous Knowledge: Africa's Opportunity to Contribute to Global Information Content. *South African Journal of Library and Information Science*. 68 (1), 16-20

Cresswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. California: SAGE Publications, Inc.

Cresswell, J. W., & Cheryl, N. P. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications: London.

Dlamini, N. & Kaya, H, O. (2016). Environmental Security, Indigenous Knowledge Systems and Implications for Food Security in South Africa, *Journal of Human Ecology*, 53(2),135-140, DOI: 10.1080/09709274.2016.11906965

Dziva, D. V. M. & Kusure, L. P. (2011). Teachers' Conception of Indigenous Knowledge in Science Curriculum in the Context of Mberengwa District, Zimbabwe. *African Journal of Education and Technology,* 1 (3), 88-102. Available from: http://digilib.buse.ac.zw/xmlui/bitstream/handle/11196/170/Teacher%27s%20conception.pdf?

Garbett, D. (2011). Constructivism Deconstructed in Science Teacher Education in Australian. *Journal of Teacher Education.* 36(6), 5 Available from: http://dx.doi.org/10.14221/ajte.2011v36n6.5

Hamilton, L., & Corbett-Whittier, C. (2013). Using Case Study in Education Research. Los Angeles, CA Sage.

Hazelkorn, E. (2015). *Rankings and the Reshaping of Higher Education: the Battle for World-Class Excellence*, (2nd Ed). London: Palgrave Macmillan.

Matthews, M. R. (1997). Constructivism in Science Education: A Philosophical Examination. Springer Science and Business Media Dordrecht.

Mullis, Ina V. S.; Martin, Michael O.; Beaton, Albert E.;Gonzalez, Eugenio J.; Kelly, Dana L.; Smith, Teresa A. (1998). Mathematics and Science Achievement in the Final Year of Secondary School: IEA's Third International Mathematics and Science Study (TIMSS). Boston Coll., Chestnut Hill, MA. Centre for the Study of Testing, Evaluation, and Educational Policy. International Association for the Evaluation of Educational Achievement. National Centre for Education Statistics (ED), Washington. Available from: http://wwwcsteep.bc.edu/timss

Mustapha, R., Malek, S. N. A., Mohamed, B. & Said, K. (2019). Exploring the Education Awareness among Indigenous Teachers Trainee: The qualitative Approach. *Journal of Educational Research and Indigenous Studies. 1 (1), 123-130.*

Ngulube, P., (2002) Managing and Preserving Indigenous Knowledge in the Knowledge Management Era: challenges and opportunities for information professionals. *Information Development* 18(2), 95-101, DOI: 10.1177/026666602400842486

Ocholla, D. N., and Onyancha, O. B. (2005). "The marginalized knowledge: An informetric analysis of indigenous knowledge publications (1990-2004)." *SA Jnl Libs & Info Sci* 71(3), 247-258.

Odora-Hoppers, C. A. (year) Emerging African perspectives on values in a globalising world. In K. Sporre, & J. Mannberg (Eds.), *Values, Religions and Education in Changing Societies* (147-156). Dordrecht: Springer.

Ogunniyi, M. B. (2004). The challenge of preparing and equipping Science teachers in higher education to integrate scientific and indigenous knowledge systems for learners. SAJHE 18 (3), 289-304.

Ogunniyi, M.B. (2008). Effect of an Argumentation-Based Course on Teachers' Disposition towards a Science-Indigenous Knowledge Curriculum. *International Journal of Environmental & Science Education.* 3 (4), 159-177.

Seehawer, M. (2018). South African Science Teachers' Strategies for Integrating Indigenous Knowledge and Western Knowledge in their Classes: Practical Lessons in Decolonisation. *Educational Research for Social Change (ERSC).* 7(1), 91-110.

Simelane, Q. G. (July, 2012). The State of Women in Science and Technology in Swaziland: Results of a Survey. Available from: https://www.owsdsa.org.za/files/Women_ST_Swaziland_Final_Report-July-2012.pdf.

UNICEF (2014). *Progress for children: Achieving the MDGS with Equity*. UNESCO Publishing, Paris.

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge: Harvard University Press.