

Teaching life sciences while integrating teachers' and learners' cultural belief systems

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Abstract

The paper reports a study, which explored teachers' perceptions and experiences on integration of cultural belief systems when teaching life sciences. Beliefs have been found to influence teachers' pedagogical practices and ultimately impact on learning and understanding of concepts. These beliefs can be classified as originating from one's religion or one's culture. Life sciences is a subject that deals with real life issues hence has topics that challenge or impact on one's belief systems. In a qualitative case study research design, 20 experienced life sciences (biology) teachers were purposively selected for the study. Each teacher was interviewed, and data was subjected to content analysis. Findings showed that though teachers strive to suppress their own belief systems in the classrooms, both teachers' and learners' beliefs need to be integrated when teaching certain topics. The practice enhances development of critical thinking skills and ultimately learner understanding. These findings allude to the need for teachers' development in employing contextually relevant pedagogical strategies.

Keywords: cultural belief systems, contextual knowledge, life sciences, teachers' understandings

INTRODUCTION

The integration of beliefs in the science classrooms is dependent on how teachers conceive culture, what they know and understand about cultures different from theirs and how they view classrooms as social and cultural contexts (Cochran-Smith, 1997). Belief systems are a subset of culture, which in the current context refers to religious and cultural beliefs that guide spiritual, mental, moral behaviors and ultimately how one views phenomena. A point to note is that good teaching incorporates learners' worldviews, which Nisbett (2003) presented as not only a collection of values and beliefs but also the lens through which one views and experiences one's life. Worldviews refer to assumptions individuals and cultures hold about the physical and social world (Koltko-Rivera, 2006).

Beliefs may pose challenges to those science teachers who strive to inculcate a culture of inquiry in science to the learners (Lambie, 2014) and especially critical thinking and analytical skills, which are an important aspect of the nature of science. In his study on science teachers' cultural beliefs and diversities from a

sociocultural perspective in science education, Mansour (2013) reported that teachers' religious beliefs affected their pedagogical beliefs in general and their subject-specific pedagogical beliefs in particular. Likewise, as early as 2008, Martin-Hansen pointed out that some teachers and many of their learners hold religious beliefs, which negatively impact on their understanding of science concepts. He coined them 'rigid theistic' worldviews. Taber (2013) reiterated that in situations, where science and religious beliefs fail to reach a common ground, learners would not explore further the scientific concepts.

The argument in the current study is based on the premise that the improvement of learners' critical thinking skills, scientific literacy skills, and problem-solving abilities, can be meaningfully achieved through the integration of both learners' and teachers' belief systems during the teaching and learning of specific life sciences topics or concepts. This aligns with Cobern's (1994) argument that because learners bring beliefs to the science classrooms emanating from their diverse cultural backgrounds, teachers need to recognize them if they are to effectively support learners.

Contribution to the literature

- Life sciences is a subject that has topics and concepts embedded with controversial socio-scientific issues that influence the teaching, learning, and understanding of those concepts.
- The controversy comes from the cultural belief systems ingrained in some individuals' lives that act as the lens through which individuals make sense of new information and may impact on the decisions that one makes in terms of teaching and learning opportunities. These belief systems emanate from sociocultural practices, experiences, and religions that one is socialized in.
- The current study provides opportunities for the integration of beliefs in life sciences teaching and learning to enhance the relevance and applicability of these concepts in learners' lives. It also argues that ignoring such beliefs may impact negatively on the acquisition of scientific knowledge and skills as development of critical thinking would be suppressed.

The current study sought to explore teachers' perceptions and experiences on the integration of beliefs when teaching life sciences. It was underpinned by two research questions:

1. What are teachers' understandings of beliefs in relation to life sciences teaching and learning?
2. How do teachers perceive the role of beliefs in relation to learners' understanding of specific life sciences topics?

LITERATURE REVIEW

All religious beliefs attribute powers to some supernatural agents (Atran & Norenzayan, 2004; Saroglou, 2011). Some researchers (e.g., Pyysiainen, 2009) contend that believing in supernatural agents is universally cultural and these agents may include gods, spirits, ancestors, ghosts, demons, angels, etc. Religious beliefs relate to intuitive thinking (Northover & Cohen, 2017); therefore, it is not easy to change such thinking (beliefs) in human beings, let alone in young high school learners who have been indoctrinated or taught to believe certain aspects in their lives. Thus said, these beliefs are very strong and powerful because believers attribute misfortunes that befall them such as illness, death, or scarcity of necessities to punishment for transgressing from their beliefs (Bering, 2011).

Previous studies done in the USA and Canada three decades ago showed that many learners with strong religious values and beliefs tend to hold negative attitudes towards school science (Ebbenshade, 1993; Roth & Alexander, 1997). The studies also found that those learners tend to have difficulties in learning science and have low inclination to choosing science-related careers. This is explained by some researchers who hold views that learners bring to the science classroom some social-cultural beliefs that create gaps between what they are taught and what they learn (Eniayeju, 2010; Okafor, 2001). It comes from the contention that some beliefs that learners hold may defy scientific knowledge and reasoning and as a result learners become confused with what to follow or believe. There is an argument that open-mindedness, which is

essential in science learning, is always conflicted with religious faith from the scriptures and religious leaders (Wilson, 2018).

In the African context, there are researchers who have explored how cultural beliefs influence the learning of science by the African child. For instance, Keraro and Okere (2008) averred that in many developing countries in Africa learners' sociocultural background tends to militate against learners' meaningful learning and understanding of science more than other factors normally blamed for (Annuah-Mensa, 1998; Keraro & Okere, 2008; Shumba, 1995). The authors argued that cultural beliefs tend to limit learners' critical or analytical thinking skills yet science on the other hand promotes inquisitive minds in learners. A point to note is that by the time learners go to school, they have acquired a repertoire of cultural beliefs, myths, and explanations for the various natural phenomena, which in most instances, may be at loggerheads with the scientific principles (Keraro & Okere, 2008).

There are certain beliefs, which make it difficult for the life sciences teacher to engage learners in a scientific discourse or practical investigations. An example in the Zimbabwean context is the belief that handling bones or anything to do with nocturnal animals such as mice, owls, etc., is associated with witchcraft and its taboo (Shumba, 1995). Related to these beliefs are the protection of beliefs or theories that fail to agree with observations made and the strong belief in natural forces controlled by spirits (Ogunniyi, 1998).

As one factor that influence scientific knowledge production and scientific practice, religion should be considered in the science classrooms as Reiss (2013) contends that it helps learners "better understand why certain things come under the purview of science and others do not" (p. 321). According to Reiss (2013), teachers should be tolerant and accept any of their learners who do not accept the theory of evolution for instance be it for religious reasons or anything. They should however still teach those learners as they could understand it though not accepting it.

According to Taber (2013), teachers need to engage learners in dialogue about issues of religion and science.

Many learners from faith backgrounds hold worldviews that there is a supernatural being that guide their lives (Taber, 2013). An argument Taber (2013) made that science does not dispute the existence of this supernatural helm, but however requires that when dealing with scientific matters, it should be put aside, creates an elitist view of science, where it should be treated in isolation of what people believe in. This therefore marginalizes other forms of knowledge, which is not science hence portraying science as absolute truth. Whilst teachers are expected to correct this narrative when teaching, Hodson (2009) noted that teachers are not well knowledgeable about the nature of science and its philosophical underpinnings, implying that the elitist view of science is perpetuated in the classroom thereby disregarding the religious values and beliefs learners hold. Learners feel alienated in such science classrooms.

As early as 2001, Ridgeway indicated that issues of gender behaviors, expectations, competences, incompetencies and inequalities in society depend on the cultural beliefs. He pointed out that these beliefs are influential in the development and behaviors of learners' ways before they enter the science classrooms. When they come to the science classrooms learners bring in a wide range of pre-existing information, beliefs, abilities, and attitudes. These are referred to as learners' prior knowledge, which David (2017) found as influencing how learners process and make sense of new information. Some of the knowledge may impede meaningful learning and understanding of new content taught and in certain instances may come in as misconceptions. On the other hand, Zietsman and Naidoo (1997) opposed the above narration when they pointed out that not all the learners' preconceptions may be misconceptions but rather some may be adapted and used as platforms to meaningfully learn new scientific concepts. In other words, some of the prior knowledge learners bring to the science classrooms in the form of beliefs and belief systems, may be filters and facilitators of learners' acquisition of new ideas and skills taught in the science classrooms.

Thus, said cultural or religious beliefs are sometimes ignored in the science classrooms as they are referred to as pseudoscience (Wilson, 2018) because they tend to defy the empirical evidence (Reiss, 2009). Hansson (1996) characterized pseudoscience as something that is non-scientific and yet creates an impression that it is science. Pseudoscience can be categorized as pseudo-theory promotion, which seeks to promote its own theory e.g., homeopathy and as science denialism, which seeks to deny scientific ideas by producing false controversies with legitimate science e.g., vaccination denialism (Hansson, 2017).

In the context of African belief systems this may be explained by earlier researchers (e.g., Odhiambo, 1972; Ogunniyi, 1988) who noted that African worldviews may not be compatible with modern western science.

Other researchers contend that due to beliefs learners hold, they lack critical thinking skills, which could help them to be skeptical and question some of the cultural belief systems and practices in their lives (Bensley et al., 2014). The current study therefore proffers the integration of those beliefs in the teaching and learning process in order to develop learners' critical and analytical skills thereby enhancing understanding and relevance of science in learners' lives.

THEORETICAL FRAMEWORK

The study is informed by sociocultural perspectives, which Lemke (2001) described as a stance, where science, science education and research is viewed "as human social activities conducted within institutional and cultural frameworks" (p. 296). Uniqueness is of essence as what one believes, values, and how one learns, and makes meaning is dependent on the self and the occasion (Lemke, 2001). Consequently, Vygotsky (1963) emphasizes the important role that social interaction and cooperation play in the learning process. According to Lemke (2001), the determinants of learner interest in science, learner attitudes toward science, motivation to study science and learner willingness to engage in some scientific discourses are community beliefs, learner beliefs, acceptable identities, and what affects their lives outside the science classrooms. Changing one's beliefs is not easily undertaken. As such, "beliefs about natural and social world have coevolved in cultures along with entire complex network of social practices that bind community together" (Lemke, 2001, p. 301). Lemke (2001) elaborates to show the difficulty in this when he pointed out that changing one's thinking is not just a rational decision-making process but a social one, which has social consequences. This has implications in the teaching and learning process because what a teacher believes in may impact the way he or she teaches, explains, or addresses certain concepts in the classrooms.

METHODOLOGY

Paradigm & Research Design

The present study is located within the interpretive paradigm. A paradigm is a framework that includes a set of interrelated assumptions that provide philosophical values and beliefs for the study at hand in a social environment (Ponterotto, 2005). The study is underpinned by the interpretive paradigm, which provides insightful explication of the identified units of analysis, which helps in identifying the meaning and understanding of the subjectivity of the social relations associated with the study (Mattila & Aaltio, 2006). This paradigm helps to explore the richness, depth, and complexity of phenomenon under study, which are beliefs in life sciences teaching and learning in this case. The researcher harnessed the strength of the interpretive

paradigm to characterize how people experience the world, the ways they interact together and the settings in which these interactions take place (Packer, 1999). The study adopted a qualitative case study research design (Creswell, 2014). Due to its characteristics, the design provides tools to study complex phenomena within their contexts (Baxter & Jack, 2008). The researcher could explore teachers' understandings about the integration of beliefs when teaching life sciences, wherein beliefs are complicated to understand let alone to utilize them in the teaching and learning context.

Selection of Participants

Using purposive sampling technique (Merriam & Tisdell, 2016), 20 life sciences teachers were selected to participate in the study. The criteria for selection included teachers who have taught grade 10-12 life sciences for more than five years. The assumption was that having taught the three grades (10-12), a teacher will be knowledgeable about the various topics or concepts, where belief systems matter in the teaching and learning process. The teacher could also have experienced the benefits or challenges thereof of engaging with and integrating belief systems in the teaching and learning of specific life sciences concepts.

Data Collection

During data collection, each teacher was interviewed individually via a platform of their choice. Nine teachers opted to be interviewed face to face and 11 were interviewed via MS Teams. When asked for the reasons of their choices, the former nine teachers cited their availability on campus, where the researcher worked since they were part time postgraduate students. The other 11 indicated the convenience of online interviews as they could do it in the comfort of their homes instead of travelling to a convenient and neutral venue.

The interviews sought information that would address the following constructs based on each teacher's social, epistemic and cognitive beliefs and experiences when teaching life sciences in diverse school contexts:

1. Teachers' contexts, which have a bearing on their belief systems and those of the learners,
2. Teachers' understandings of beliefs in relation to teaching life sciences,
3. Teachers' perspectives on the role of beliefs when teaching specific science topics, and
4. Teachers' explanations of how integration of specific belief systems could enhance learners' understanding of the science concepts.

Each interview took approximately 45 minutes and was recorded with permission from the teachers. Out of the 20 teachers, only two did not consent to being recorded hence the researcher wrote field notes and relied on her memory of some of the uncaptured

information. There were glitches in terms of network and internet connectivity during interviews with three of the teachers, which resulted in rescheduling to complete the interviews.

Data Analysis

Data was subjected to qualitative content analysis. Hsieh and Shannon (2005) described qualitative content analysis as "the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (p. 1278). Because data analysis began soon after the commencement of data collection, it allowed the researcher to revisit each data repeatedly. The eight steps to data analysis (Hsieh & Shannon, 2005; Patton, 2002) were followed. These included transcribing recorded interviews verbatim into textual data, defining the coding unit, developing categories and coding scheme etc. Four themes emerged.

Reliability & Validity

To ensure the reliability and validity of the qualitative data collected through open ended interviews, trustworthiness measures such as credibility, transferability, dependability, and confirmability proposed by Lincoln and Guba (1985) were considered.

FINDINGS

The findings of the study are presented under the four themes that emerged from the analysis of data to answer the two research questions.

Theme 1. Teachers' Profiles, Which Have a Bearing on Their Belief Systems & Those of Learners

From the 20 life sciences teachers who took part in the study, eight were males and 12 were females. All were of African origin and were teaching in township schools. Township schools are South African schools located in urban areas originally reserved for the Black populace during Apartheid. The distribution of the different ethnic groups was, as follows: four Zulus, two Pedi, two Colored, and three in each of the following: Sotho, Tswana, Tsonga, and Venda. This means that their home languages constituted seven of 11 official languages in South Africa.

Seven of the teachers had a master's in education (MEd) degree as their highest qualification with six of them pursuing PhD studies in science education. There were only four with a Bachelor of Education honors degree in STEM Education and the rest (nine) had a first degree (Bachelor of Education). All the teachers were experienced with half having taught life sciences for six-eight years and half for 17-25 years. Such extensive experience implies that the teachers were knowledgeable about the nature of belief systems and

how beliefs could be harnessed in teaching specific life sciences concepts. The majority (14) indicated that they were Christians belonging to various denominations, whilst the rest indicated that they followed their African traditions. Teachers indicated that they had belief systems upheld by their different ethnic and religious groups. The profiles of the participants provided a rich context for diversity in belief systems. Each participant was assigned a pseudonym.

Theme 2. Teachers' Understandings of Beliefs in Relation to Teaching Life Sciences Topics

The participants had diverse understandings of the concept of beliefs, which ranged from being their personal way of viewing issues that helped them in making judgements and decisions, personal values, and attitudes towards the teaching of life sciences.

Some teachers clearly argued that beliefs have a significant relevance and effect on life sciences teaching and learning as they bring in varied misconceptions that are contradictory to science facts and concepts taught. According to Kumo (one of the teachers), beliefs help to bring an understanding of how the society represent and interpret some of the scientific concepts that may not be explained in the environments learners live. She appreciated that as a teacher, discussing beliefs provide a better understanding of what learners perceive and think before teaching particular concepts. As such, she then used their beliefs to scaffold the learning of scientific content knowledge.

The participants pointed out that beliefs are a central part of humans, and they emerge from people's backgrounds, culture, upbringing, and society. Phuthi stated that learners come to class with different beliefs and as a science teacher it is important to take note of the different beliefs, which may either facilitate or stifle learner understanding of concepts taught. In her argument Phuthi said that science should not be treated as a foreign subject; this means teachers should try to make science more relatable to the learners by bringing in and considering their beliefs.

One participant Guthi understood beliefs as important in motivating learners to learn scientific concepts as they see relevance and applicability in their lives. To this she said that before teaching a topic, she asks learners to engage with the beliefs related to the topic so that they have an opportunity to harness their belief systems that have a bearing on the topic. She however bemoaned the challenges associated with the coverage of the curriculum content and assessments in time for final examinations. The issue of time management was also raised by Kwanda who explained that learners tend to participate and interact more in class if their belief systems are integrated in the teaching and learning process. On the positive some teachers acknowledged how even the introvert learners come out

of their cocoons to share or discuss if their belief systems are brought in the teaching and learning process, hence confirming how learners can be motivated when their prior knowledge is tapped into during the teaching and learning process.

Whilst the teachers acknowledged the need to integrate religious and cultural beliefs in the teaching and learning of life sciences one of the participants Masi indicated his reservations about the reliability of some beliefs in other contexts. He argued that beliefs could be biased or result in narrow-mindedness in individuals who hold them. Masi dispelled the validity of certain beliefs, which defy logic that is associated with scientific principles.

In agreement with Masi's reservations, Amo explained how he has witnessed colleagues who had no passion in teaching life sciences topics considered as controversial. He gave an example of teachers who are Christians who tended to shy away from teaching evolution and reproduction as they considered the topics to be contrary to their religious beliefs. Tembi remarked that for effective teaching of science a teacher should adapt to a scientific framework of thinking in order to explore concepts without biases.

Theme 3. Teachers' Perspectives on Role of Beliefs When Teaching Specific Life Sciences Topics

Participants perceived beliefs as playing a fundamental role in the teaching and learning of life sciences. In particular, Amo pointed out that in life sciences there are topics that invoke emotions in learners due to the belief systems they hold. He added that teachers should therefore capitalize on those feelings of emotions to discuss the intersection between the learners' beliefs and the concepts to be taught. Teachers argued that ignoring the beliefs may jeopardize learner understanding of the concepts or negatively influence the discussions for the progression of the lesson. Amo made a justification when he said:

Learners will hold their own point of view about certain concepts such that they may differ with the science concept being taught, thus as a teacher I have to relate the scientific concept to their beliefs without disregarding their viewpoints. In this way teaching and learning can progress.

One of a crucial point made by Phuthi was that when teaching, one's beliefs may influence how one explains or emphasizes certain concepts and the examples used to authenticate the teaching. However, each learner has his/her own set of beliefs sometimes different from or even conflicting with the teachers' beliefs about certain science concepts. In such a context those learners are excluded in the learning process as discussions and examples are imbued in the teachers' beliefs. In certain instances, teachers tend to avoid certain concepts that

conflict with their own beliefs, which then disadvantages learners from acquisition of such knowledge. Masi suggested that a teacher should be neutral and respect the beliefs of all learners regardless of their opinions about them.

According to the participants' conceptions, beliefs have a dual role in the life sciences classrooms. Firstly, they have the potential to enhance the learners' understanding of specific concepts, which the teacher may take advantage of and open discussions, where the same beliefs may be authenticated by scientific explanations. Secondly, certain topics may be offensive to the learners because of their beliefs hence by providing learners with opportunities to share their own belief systems and those of others may help in reconciling their beliefs with those of the scientific beliefs or alternately helps in making the beliefs to coexist with the scientific beliefs. To this Phuthi pointed out that the teacher needs to approach such concepts carefully in a non-offensive way, which does not place scientific concepts at a pedestal and learners' beliefs at a lower level.

On the other hand, Basi vehemently argued that beliefs can act as a hindrance to science concept formation. He presented his argument, as follows:

There is a concept under the topic of evolution 'comparative embryology' as evidence for evolution. It is my judgement that the individual who first came up with the evidence manipulated the results to suit his narrative, but the content is still taught in the South African curriculum. This makes it difficult to teach a concept that I believe is false. When a teacher holds positive beliefs about a topic he/she delivers the lesson in an impactful manner to learners.

Kgadi supported Basi's argument when she pointed out that a teacher's belief about particular concepts or topics has potential to influence how the concepts or topic is taught in the classrooms. Kumo acknowledged the role beliefs play in the teaching and learning of certain science topics but however cautioned that sometimes learners come with contradictory beliefs in science that can bring in misconceptions or misunderstanding of the phenomenon in question. She gave an example of the beliefs associated with genetic conditions such as albinism, where in some cultures they believe it is due to a curse or witchcraft. Due to the nature of the condition people with albinism tend to struggle in so many ways e.g., skin disorders due to lack of melanin, and poor eyesight. Henceforth the learners' beliefs are fulfilled when they observe such challenges. In the positive, Kumo explained that learners' beliefs can be used in scaffolding learner acquisition of scientific knowledge and use it to integrate science and beliefs in the phenomenon that exists in society.

Ntabi pointed that knowledge of learners' beliefs can inform the teacher of the appropriate teaching strategies to be used to teach concepts in a bid to curb any misunderstandings that can arise because of the beliefs. In support Teb explained:

I think beliefs play a major role in the conceptual formation of learners. From what I have observed in my classroom, learners struggle to relate science with their indigenous knowledge as they are conflicted with the notion that there is a scientific explanation behind every life process. This results in learners having misconceptions.

In support Valerio explained that beliefs shape one's way of thinking, behaving, and reaction towards situations. Therefore, learners also have their own beliefs, and they too shape their thinking. He therefore suggested that when teaching certain sensitive science topics, the teacher should take into consideration the diverse beliefs of learners rather than disregarding them in the learning process.

Theme 4: Teachers' Perspectives of How Belief Systems Can Be Integrated in Some Life Sciences Topics

In the interviews, teachers were first asked to identify topics in life sciences, where the integration of religious or cultural beliefs was crucial. Secondly, they were asked to explain how such beliefs could be integrated in specific concepts and whether learning and understanding can be enhanced. Thirdly, they were probed on how they viewed or have experienced how failure by teachers to consider these beliefs could impact learners' understanding of concepts.

The topics mentioned by the participants, where beliefs could be integrated during the teaching and learning were those that can be categorized as controversial. These are topics that evoke emotions, challenge, and question people's practices whether religious or cultural. In fact, these are topics, where ethical issues could be raised. **Table 1** shows the topics repeatedly identified by the participants and the associated belief systems. Based on the topics and beliefs identified by the teachers in **Table 1**, it shows that it is difficult to separate belief systems from myths or taboos. Another issue is that most of the belief systems identified have negative connotations on the females. This may cause discrimination or marginalization of girls in the life sciences classrooms if such beliefs are not tackled.

The participants were also asked to reflect on whether the curriculum gives expression to the integration of beliefs in the science classrooms. It was noted that the South African curriculum and assessment policy statement document stipulates that learners should be assisted to acquire and apply knowledge and skills in ways meaningful to their own lives.

Table 1. Some of identified topics associated with cultural belief systems

Topic & concepts	Grade	Associated beliefs
Mitosis: Cancer	10	Cancer is caused by family curses or witchcraft.
Transport systems: Treatments of heart diseases, e.g., stents, valve replacements, bypass surgery, pacemakers, & heart transplants	10	Bringing foreign objects into human body taint heart. Introducing someone's heart into one's body brings donor's aura & alters one's perspectives as donor's spirit would be brought in as well. Ancestors would be confused as to where spirit of recipient of organ belongs to (donor's or recipient's).
Human nutrition: Different diets due to cultural, religious, personal, & health choices	11	Young girls at puberty stage should not eat eggs. Pork should not be consumed as it harbors evil as evidenced by possessed swine in Bible.
Human evolution	12	Some theories on human evolution dehumanize human beings.
Human reproduction: Structure of male & female reproductive systems	12	Sex is sacred, hence should not be discussed anyhow but should be left in hands of assigned community, religious, or family leaders.
Menstrual cycle	12	A menstruating female is dirty & in certain instances evil is associated with them. Evil is associated with menstruation. In Bible, menstruating females were not allowed to go to religious or sacred places, & if they go, they were supposed to sit at back. Traditionally menstruating females should not cook for males as this may weaken males.
Abortion & use of contraceptives	12	This results in a curse/punishment from God or ancestors hence individual may become infertile thereafter.
Invitro fertilization	12	Results in babies that are outcasts & have no origin in form of ancestors, hence they have no spiritual protection. Human beings are taking role of Creator, which is a sin.
Meiosis: Abnormalities, e.g., down syndrome	12	A curse or punishment from ancestors for wrongdoing. This could be because of mother of affected child who may have cheated on husband, or she could have been bewitched.
Genetics & inheritance: sex determination & genetic diseases & conditions, e.g., albinism, & sex linked diseases	12	Mother of affected baby is believed to be problem, e.g., being accused of cheating or practicing witchcraft.
Genetic engineering: Cell research, genetically modified organisms, biotechnology, & cloning	12	These are immoral & unethical practices that may result in unexplained diseases & pandemics.
Human impact on environment	11 12	Human beings were created to conquer (show dominance) over all other living & non-living things. There are environmental spaces, which are sacred such as mountains, forests, & rivers hence humans should not tamper with. Certain trees should not be used as firewood as this can cause conflicts within families involved.

The participants however bemoaned the lack of guidance in terms of how each learner's cultural background can be taken into cognizance when teaching science. They indicated that the curriculum does not explicitly provide for the integration of beliefs in the teaching and learning of life sciences. They mentioned that only in very few instances are beliefs referred to e.g., grade 10 concepts on 'abnormal cell division,' which results in cancer, where learners are supposed to discuss beliefs and attitudes concerning cancer. The participants also indicated that in grade 11 the curriculum requires learners to discuss different diets due to cultural, religious, personal and health choices; and in grade 12 mention is made on the different cultural and religious beliefs about the origin and development of life on earth.

The different participants identified various teaching strategies that could be used when integrating beliefs in specific life sciences concepts. An example is of Amo who indicated that inquiry-based learning would be effective in ensuring that beliefs are integrated when teaching controversial concepts such as cloning, mutations and genetic modification. He pointed out that the strategy gives learners an opportunity to research and interrogate what they believe in and what the scientific explanations are. His argument was that it is crucial to understand the learners' perspective to elicit their prior knowledge about these concepts. To Amo, ignoring learners' beliefs may impede their ability to learn effectively.

On the topic of genetics and inheritance, Phuthi pointed out that within their families or societies learners have heard or witnessed women being incarcerated for bearing either girls only or boys only. These learners end up believing that since the mother is the one who carries the baby in her uterus, she automatically determines the gender of the child. She emphasized that a teacher needs to employ teaching strategies, which enable learners to interrogate and understand, where the cultural belief stems from and the reasons behind it so that they can accept the scientific explanations on sex determination. Phuthi specifically challenged life sciences teachers to employ teaching approaches that create cognitive conflicts in learners in the classrooms, which can then be addressed for meaningful learning to occur. She however did not identify any specific strategies other than indicating that the strategies should be learner centered if learners must be engaged meaningfully with the content.

Regarding the topic evolution of humankind, some participants such as Guthi and Masi clearly expressed their stance regarding beliefs. They indicated that whilst it is highly rational to the human mind that evolution occurred, it goes against what learners believe. An example of the beliefs or rather misunderstandings or insinuations learners hold are that human beings evolved from apes. The participants suggested that strategies that help learners understand that science and religion are two different ways of knowing the world should be utilized. Masi identified argumentation as a strategy that would help learners to realize that the different views or theories about evolution of humankind are not necessarily in conflict but are rather "different perspectives or different lenses", he said. Masi reiterated that through argumentation learners get to understand that science develops explanations for the natural world by gathering evidence. Explanations that are supported by evidence stand and those that are not, are discarded. Guthi supported the point when she said, "Unlike beliefs, science does not include supernatural explanations that cannot be tested by scientific processes".

On that note Kgadi explained how she manages to integrate beliefs when teaching this topic. She explained how she allures her learners from their fears or discomfort of having their beliefs challenged. Kgadi pointed out that she explains to her learners that religion is a system of beliefs based on faith, not bound by evidence from nature like science. The following is how and what she says to her learners.

Religion is a distinctly different path for understanding the purpose of the natural world and our place in it. It is not better or worse than science; it is just different. As such, people do not need to choose between the two.

According to this participant, acknowledging and explaining the different knowledge systems creates a conducive learning environment. She pointed out that learners would feel that their belief systems are recognized and acknowledged, as such they may not feel neglected during the teaching and learning of the evolution of humankind. This creates harmony in the learning of the concepts.

During the interviews, the participants were asked about the impact of disregarding learners' belief systems on learners' understanding of the concepts taught. Some indicated that this would not impact on learners' understanding of scientific concepts, but rather impacts negatively on learners' interest in the content and the subject. Others pointed out that because learners will be disinterested in learning the content, they will be disengaged hence understanding is affected.

Some participants such as Cassy pointed out that some cultural and religious beliefs are very conservative, so certain concepts would be taboo to teach. They indicated that if such beliefs are taught, learners may not fully understand the scientific concepts as the beliefs may bring misconceptions into the teaching and learning process. They suggested that disregarding belief systems and presenting scientific facts and evidence might be in the best interests of the learners.

DISCUSSION

From the findings teachers showed an understanding of the need to integrate beliefs in the teaching and learning of specific life sciences topics. They however identified beliefs associated with certain topics, which make it difficult to inculcate scientific understanding in learners. These findings are explained by Lambie (2014) who noted that beliefs may pose challenges to science teachers who strive to inculcate a culture of inquiry in science to the learners. Some of the belief systems learners bring to the science classrooms create misconceptions, which may be difficult to address during the teaching and learning process. This is confirmed by David (2017) who found beliefs influencing how learners process and make sense of new information. The argument thereof is that beliefs limit open-mindedness, which is essential in science learning as they are conflicted with religious faith from the scriptures and religious leaders (Wilson, 2018).

What came out strongly from the findings is that the goal of science teaching and learning should not just be the acquisition of scientific knowledge and skills. Rather learners should be taught scientific concepts by relating them to their sociocultural belief systems. Such findings are corroborated by Zietsman and Naidoo (1997) who refuted the negativity associated with belief systems as they argued that beliefs may not always be misconceptions but can be platforms or channels that teachers may adapt to facilitate meaningful teaching and

learning of science concepts. Likewise, some of the findings from the current study found that integration of beliefs helps learners in realizing the relevance in what they learn.

Whilst some participants found value in integrating learners' belief systems in the teaching process, others viewed belief systems as nothing but diverting and even blocking learners' chances of acquiring the scientific concepts as they saw beliefs as nothing but hubs of misconceptions. These differences are also portrayed in previous studies (e.g., Annuah-Mensa, 1998; Keraro & Okere, 2008; Shumba, 1995) who found cultural or religious beliefs affecting proper learning of science concepts.

From the findings learner centered approaches or strategies of teaching and learning were identified as suitable when integrating beliefs when teaching specific life sciences topics. These include the use of inquiry-based teaching and learning strategies, argumentation, and debating, which provides learners with an opportunity to share, research, question, and interrogate the prior knowledge they possess from their belief systems. Such learner engagement is important because Lemke (2001) explained the difficulty teachers may face in changing learners' thinking. This stance aligns with Reiss' (2013) suggestion that teachers should not shy away from teaching concepts that defy learners' beliefs because those learners could still understand the concepts though not accepting them.

Though not the focus of the study, the identified life sciences topics/concepts and associated belief systems are mostly centered on the females. They however portray females as having done some wrong for example having cheated on the partner, being dirty, and being a witch, which is quite denigrating on the female gender. Such beliefs may be responsible for the societal gender inequalities, which could contribute towards gender discrimination and gender-based violence prevalent in some communities. These findings confirm earlier findings by Ridgeway (2001) that issues of gender behaviors, expectations, competences, incompetencies and inequalities in society depend on the cultural beliefs. Most of these beliefs identified may lean more towards pseudoscience that Hansson (1996, 2017) categorized as pseudo-theory promotion and science denialism, which teachers should be wary about in the life sciences classrooms.

CONCLUSIONS

When growing up learners are socialized through cultural belief systems, which impede the development of critical and analytical thinking skills. Through these belief systems learners may become myopic in their analysis of scientific phenomena. By integrating belief systems that relate to specific science concepts using learner centered pedagogies, learners get to explore and

question their belief systems and may reframe their thinking. Through the integration of beliefs in the teaching and learning of controversial life sciences topics, scientific literacy skills, problem solving skills, and critical thinking skills can be developed in learners. The study findings therefore confirm the author's argument that cultural beliefs can be platforms to engage learners in critical thinking. The notion that beliefs have no space in science classrooms is centered on marginalizing and excluding some learners in meaningful science learning. These findings have implications for both pre- and in-service teachers' professional development on how to employ suitable strategies and activities when integrating belief systems in the science classrooms. The findings also challenge curriculum policy makers to provide guidance on how curriculum stipulations may be implemented in the classrooms instead of placing the responsibilities on the teacher. Whilst the study obtained teachers' understanding and experiences of integrating belief systems when teaching life sciences topics, a more nuanced conclusion could have been made had the study included learners' voices. This could be the limitation of the study findings, which can be considered as lacking a balanced view.

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