Chapter # 6

TEACHERS' VIEWS ON INFUSING INDIGENOUS KNOWLEDGE INTO CHEMISTRY TEACHING AT THE JUNIOR SECONDARY OF OMUSATI REGION

Tomas Asino[1], Kgomotsego Samuel[2], & Washington Dudu[3]
[1]*Ministry of Education, Namibia*
[2]*North West University, South Africa*
[3]*University of South Africa, South Africa*

ABSTRACT
This study focused on the views of Natural Sciences teachers in infusing indigenous knowledge (IK) in teaching of Chemistry concepts at the junior secondary school. IK remains an afterthought in many Omusati region classrooms especially at grades 8 and 9 level. This is despite the National Curriculum for Basic Education promoting the inclusion of indigenous knowledge into teaching to empower learners to actively participate in making Namibia a knowledgeable-based society. Five grades 8 and 9 Physical Sciences teachers were purposefully selected from one circuit in the Directorate of Education, Arts and Culture of Omusati region, Namibia. Researchers employed an interpretivist qualitative research approach. This qualitative study used CHAT to understand the teachers' views and classroom practices through integrating IK in teaching of Chemistry. Saldana (2013) was used to guide thematic analysis of data. The findings indicated a slight change of views by the Physical Science teachers. Some remained attached to certain practices where they held strong beliefs. The infusion of certain Chemistry concepts depended on the school support. The study recommended that teaching and learning policies be clear on the 'how' of infusing IK into the classroom, and adequate support through ongoing developmental workshops be provided to the Science teachers.

Keywords: physical science teachers, views, indigenous knowledge, chemistry concepts, continuous professional development (CPD).

1. INTRODUCTION AND PROBLEM

This chapter focuses on Natural sciences teachers' views in the infusion of indigenous knowledge (IK) into Chemistry teaching. IK is "considered an entry point in incorporating knowledge and its relevance into the abstract world of science" (Sotero, Alves, Arandas, & Medeiros, 2020, p. 18). This statement underscores the importance of linking science with learners' daily experiences at their environment where they generate knowledge through the engagement with community members and their socio-cultural practices in eventually making meaningful learning experiences. Mandikonza (2019, p. 2) concurs that "learners bring tacit as well as explicit and conceptual knowledge into learning contexts." He (Mandikoza, 2019, p. 2) also notes that due to lack of recognition and infusion of IK in the classrooms, "learners from rural and disadvantaged communities tend to find a poor fit between their home experiences and what they learn at school." Moreover, science teachers at junior secondary level still believe that learners enter science classrooms as tabula rasa, and disregards whatever knowledge learners have (Buma, 2018; De Beer, 2016). As part of colonised generation, teachers find it difficult to relate IK to science during teaching in a

meaningful way, they instead overlook IK related concepts (Yeseraw, Melesse, & Kelkay, 2023). Generally, the world over, indigenous knowledge is considered less important, particularly in the science classrooms. Mukwambo (2017) in Zambezi region of Namibia found that learners' cultural practices were distanced from their science practices in schools, as such many find science to be out of this world and difficult to learn. Though many African countries still believe strongly in the western worldview that marginalises the indigenous culture and practices, new curriculum reforms such as CAPS for South Africa and NCBE for Namibia advocate for the integration of indigenous knowledge in teaching, particularly science (De Beer, 2016). The intention being to contextualise science methods and optimize on promoting local productions for self-sustenance (Nwokocha & Legg-Jack, 2024). The integration of indigenous knowledge is a complex multifaceted issue that demands attention and action from educators and researchers (Andrew, Girma, Gabriel, & Petros, 2023). However, Mavuru and Makhunga (2020) found that there has been no concerted effort in assisting teachers to identify relevant teaching strategies to infuse indigenous knowledge into science concepts. The uncertainties around the 'how' of infusing IK remain a hurdle for many teachers. This study found it necessary to tap into teachers' space and solicit their views on infusing IK into Chemistry teaching and learning, particularly the distillation concept. The following question guided data collection for this paper: *What views do Physical Science teachers have with regards to infusing indigenous knowledge into Chemistry teaching?*

2. THE PURPOSE OF THE STUDY

The purpose of this study was to solicit teachers' views on infusing IK in the teaching and learning of Chemistry concepts. A four-week intervention based PDI on indigenous knowledge integration in the teaching of Chemistry concepts by junior secondary schools Physical Science teachers was ran to provide guidance. The world over, IK has been alienated from school curricula for a long time (Aikenhead, 2000; Ogunniyi, 2007; Gundry & Cameron, 2008; Battiste, 2018). It is seen as odd and limited in the eyes of Western science. According to Aikenhead (2020), Western science that is taught in schools is a subculture of Western culture and their worldviews that seldom forget social activity in real life environment. This creates problems on the imbalances in societies where cultural values and local wisdom are marginalised (Handayani, Wilujeng, & Prasetyo, 2018). Additionally, Cronje (2015) argues that majority of learners in South Africa come from indigenous background, but the science they are taught in schools is informed by Western culture, using Western teaching strategies. Similarly, Namibia as a developing country, has many learners who hail from indigenous background but their teachers who were trained through a western science curriculum have a similar problem in their teaching. This makes the learning of Chemistry abstract; hence the need to find out from teachers how they deal with the infusion of IK in their classrooms?

3. RESEARCH DESIGN

The study utilised interpretive qualitative case study research design. This is a single case study in which the schools involved are from one regional directorate of Education, Omusati region, in Namibia. They are all rural schools from the same geographical area and share similar characteristics of being located in previously disadvantaged communities. Teachers who participated used the same syllabus, resources and circuit-based tests and

examinations. Additionally, the learners are non-borders, and they commute every day to and from schools. Therefore, all schools represent one phenomenon and only one unit of analysis is used. This paper reports on the 5 grades 8 and 9 purposively selected Physical Science teachers to investigate multiplicity of perspectives (Ritchie & Lewis, 2003) of the phenomenon within its real-life context (Yin, 2003). This assisted to gather different views from diverse backgrounds and experiences of the research participants. Moreover, using case study design assisted to gain in-depth insight of this case's current issues within its real-life setting.

4. METHOD

4.1. Data Collection Instruments

Data were collected through open-ended questionnaires, one-on-one interviews, lesson observations, and document analysis. Instruments used included VNOIK and SDLI questionnaires, interview protocols, and observation schedules.

The instrument (VNOIK) was adopted from Cronje, De Beer, and Ankiewicz (2015) developed to determine the views of science teachers on Indigenous Knowledge in South Africa. It consists of ten open-ended questions regarding teachers' opinions about the nature of indigenous knowledge. The other instrument (SDLI) was adapted from Cheng Kuo, Lin, & Lee-Hsieh (2010). This instrument was used to measure the self-directed ability of Grade 8-9 Physical Science teachers in integrating IK when teaching Chemistry. It measures perceptions of self-directed learning in four domains of learning motivation (LM), planning and implementing (PI), self-monitoring (SM) and interpersonal communication (IC). The two instruments were administered pre- and post-intervention to solicit the teachers' views of infusing IK into Chemistry concepts teaching. It is worth mentioning that adapting this instrument could not compromise the reliability and validity of the instrument (Daunert & Seel, 2020). The adaptation of the instrument involved slight modification of terms to contextualize it to suit the Namibian participants. Otherwise, all factors were identical to the original SDLI. For the lesson observation, the Reformed Teaching Observation Protocol (RTOP) (Sawada, Piburn, & Judson, 2002) was adopted for data collection. This instrument was developed to provide a standardized means for detecting the degree to which classroom instruction in mathematics or science is reformed (Piburn & Sawada, 2000; Sawada et. al., 2002). For this study, the 25 aspects of this instrument were grouped into main five categories namely, lesson design and implementation, content- propositional pedagogic knowledge, content- procedural pedagogic, classroom culture - communicative interaction and learners-teacher relationship; helped to evaluate classroom instruction and teaching approach. It provided insight into whether the five (5) teachers observed created an atmosphere that is conducive for SDL and elicitation of indigenous knowledge to enhance learning of Chemistry concepts. It also assisted in observing other teaching and learning activities that might arise in line with the study's interest during the lesson observation. Like the questionnaires, these two instruments were also administered pre and post intervention.

4.2. Data Collection Procedure

The 5 purposively selected teachers individually completed the two open-ended questionnaires (VNOIK and SDLI) before and after intervention in a common location. No one influenced the other, as everyone answered and expressed themselves from their own knowledge and experience.

4.3. Presentation of the Results

The Code-to-Theory model of thematic analysis by Saldana (2013) as an analytical tool guided the identification patterns of meaning across dataset. It became essential for describing and interpreting the meaning and importance of the emerging themes in different ways. Since this tool is not tied to any specific ontological and epistemological anchors (Braun & Clarke, 2006) it allowed for flexibility in reporting participants' ideas, meanings and experiences. Data coding and categorization gave 67 codes and 11 categories. Though six themes emerged from the 11 categories, the results reported for this paper focused only on the two themes that were directly related to the teachers' views. The two themes reported on are: (i) Myth of IK as non-scientific and (ii) Subjectivity of human enterprise as influenced largely by indigenous knowledge system.

4.3.1. Theme I): Myth of IK as Non-Scientific

The theme - myth of IK as being non-scientific is operationalised as including rituals, beliefs and spiritual elements of IK and are seen as non-scientific. It emerged as science teachers engaged each other in speaking out their individual ideas about IK as inherited from ancestors.

Pre-intervention when completing the VNOIK instrument, teacher 5 mentioned something about the 'healing' of lightning when it strikes either a house, a tree or animals. She said *"….adults will call a healer who is in touch with ancestors to cure lightning by removing its urine (Omasita)…the meat of an animal struck by lightning cannot be eaten before it is treated."* 'Urine of lightning' is given this name from the waste product of animal excretion. She further said, *it is believed that animals always urinate where others urinated before, as such the waste product of the previous lightning may attract the next lightning, so that spot is believed to still have power to attract other charged materials (lightning), causing danger to the surroundings.* This phenomenon refers to properties of a charged object in Physical Science Grade 8 syllabus.

During pre-intervention interviews, not much was shared in terms of myths. However, whilst on the lightning issue, during the intervention, the discussion got heated. Teachers 4 and 3 also highlighted some of myths about lightning. Teacher 4 said *"…during thunder and lightning, an adult tells children not to be close to animals, not to put on red-coloured clothes and not to shelter under trees."* These myths are said to prevent children from being struck by lightning, he further added. However, the admonition to children not to shelter under the trees when it is raining is connected to the scientific knowledge that lightning strikes the tallest point, and trees in most cases are taller that any construction in rural areas. Teacher 3 added *"…Traditionally, people used traditional earth wire, such as dry branch of Omulavi tree placed on the high point of traditional hut."* He further explained that this tree has unique properties of electric induction, thus protecting against lightning striking huts where people live. Though not tested, Omulavi tree might have negative charges that are capable of repelling and diverting or distributing electric charges of lightning.

Although the discussions during the intervention pointed to some myths being scientifically aligned as in the responses above, and the fact that they promote certain good practices such as hygiene, for an example the indictment not to urinate in any pond of water as this makes one a victim of snakebites, promotes hygiene among young children. Many participants expressed understanding myths as rumours spread by elders, other participants expressed their concerns that some myths hinder the integration of IK into teaching, Teacher 2 said *"…some of the traditional ways of doing things are associated with magic, sorcery and witchcraft."* He further indicated that young people do not want to inherit such wisdom due to the negative labelling attached to the practices. Teacher 1 concurred in

most cases as common practices from her culture and space. Post intervention, all the participants retained their stance on the myths.

This study found that although myths cannot be scientifically proven due to lack of empirical evidence, myths are important in society as they can prevent certain ills. Apart from keeping order, myths emanate from events and activities experienced before. However, during the intervention participants expressed their opinion that indigenous knowledge and practices (including myth) are valuable sources of scientific knowledge. They believed that western scientists stole or plagiarized the IK and modified these in order to fit their situation, hence no new knowledge was generated.

4.3.2. Theme II): Subjectivity of Human Enterprise as Influenced Largely by Indigenous Knowledge System

This theme is operationalised in this study as personal opinions on how Physical Science teachers construct and express their sense of self-identity values and emotions in relation to the social and material context they live in. The VNOIK questionnaire confirmed that most of the participants believe that indigenous knowledge can alleviate some Sustainable Development Goals (SDG) related to problems such as hunger, poverty and underdevelopment. For instance, in pre-intervention VNOIK, teacher 5 responded to How their own views of self-directed learning influence their subjectivity to human enterprise: "*…nowadays we depend too much on western way of life which is very expensive in terms of livelihoods. Only if we can reverse and follow the traditional way of living like our forefathers who depended on their natural environment only…only if we can gather food and medicine from our natural environment as it was done before".* In support, Teacher 1 added that *"alternative to western ways of living is the indigenous way of life. There are plenty of indigenous foods such as palm fruit and forest food…. carving and making traditional artefacts such as omatiti and uuholo (traditional plates and cups made from roots of the omukanga tree). They can be used at home instead of modern cups/glasses and plates. Traditional neckless (made from small round pieces of snail shells) be used by woman and girls for decoration."* This was indicative of how much the participants still value their artefacts and IK life. This increases confidence and respect within a given community. This was evidence of an element of SDL in science teachers. Similar findings emerged post-intervention VNOIK. For example, when VNOIK questionnaire sought participants' views on whether IK can alleviate some problems, Teacher 2 answered *"…yes, because in harmonising it with western knowledge, it helps to address challenges such as climate change and sustainable agriculture to new pathway for sustainable development for ensuring livelihood of indigenous and local communities."* Teacher 5 concurred *"…indigenous people need to be encouraged to sustainably use their natural resources available in their environment or the knowledge they inherited from their forefathers to eradicate poverty and hunger. Traditional way of life is cheaper compared to western way of life."* They all agreed that IK way of life has the capacity to improve the environment for the communities in term of survival, agriculture, and medicine. Teacher 1 also highlighted on one of the traditional practices of IK artefacts, pottery making (ceramics) by girls and women only. This practice allowed girls to learn and interact with IK artefacts. It was to the advantage of schoolgirls to understand the properties and behaviour of ceramics (as articulated in the syllabus) in schools. However, a concern was raised during the intervention that the traditional practice of pottery is slowly diminishing due to modern technology and fast adaption of western culture within communities.

Of the five participants of this study, not all advocated for the incorporation of IK into teaching Chemistry concepts due to the absence of scientific terminology. However, they all felt that local and indigenous knowledge is essential and should be encouraged and included into human enterprise activities such as collaboration with pharmaceutical companies. Through post-interviews, participants indicated the need to incorporate IK and its practices into essential discussions such as climate change, adaptations and sustainable development. The use of vernaculars (code-switching) in class pre- and post-intervention in explaining indigenous knowledge in line with scientific knowledge made learning live, participatory and active. This was seen as educating the community, which can enhance in the integration and transmission of IK to complement the mainstream education system.

4.4. Ethical Considerations

In conducting this study, the researchers endeavoured to "foreground dignity, respect, trust and welfare of the respondents that were involved as well as honesty with other professional colleagues" (Leedy & Ormrod, 2010, p. 101). Ethical clearance was obtained from NWU-EMELTEN-REC (NWU 01057-21-A2). Formal permission request letters were then sent to the gatekeepers such as school principals and school governing bodies (SGBs), Acting-inspector of education responsible for Onesi circuit and to the Omusati Regional Director of Education, Arts and Culture (Office of the Director) requesting their consent to conduct the research in the specified region.

5. DISCUSSION OF FINDINGS

Pre-intervention VNOIK and interview there was limited knowledge in terms of myths in IK amongst all the teachers. This was also observed at the beginning of their professional development intervention. During the intervention, teachers discussed and used a variety of IK activities and practices, as they became aware of the myths and whether they are scientific (Bugingo, Yadav, Mugisha, & Mashood, 2024).

Post intervention there was knowledge build up and refinement on IK myths and their influences on society particularly the young generation, this showed a deep understanding of some practices and stories they were told when they grew up and how they could now link those with the curriculum as well as how they could make use of that for learners' prior knowledge. Sebotsa, et al, (2018) found that though teachers value IK, they have under developed knowledge of IK thus their reluctance of infusing it in their teaching. All the five (5) teachers demonstrated how they value IK and its influential practices which are still valid today as a way to sustain one's livelihood which link to SDG. Like Samuel (2020) and Atanga (2022) findings, post intervention not all teachers could improve instantly post intervention. They need to gradually and consistently practice before they get perfect.

VNOIK and interviews showed that some teachers believe that IK was generated and validated a long time ago through trial and errors method. Other teachers (including Teacher 3) felt that IK can be validated using western knowledge to create a sense of respect. This concurs with De Beer and Van Wyk (2019) who assert that validation of IK by western scientists is empowering and creates respect for the rigour of IK in the broader society. Few participants of this study through interview and intervention showed that some of indigenous knowledge and practices could not be validated but can only be experimentally observed. Though not all-indigenous knowledge practices can be scientifically validated, some practices are directly linked to the scientific concepts such as the use of Omulavi tree with its properties to protect their huts (houses) from lightning.

6. CONCLUSION

Based on the findings, although Physical Science teachers had basic knowledge and views about indigenous knowledge pre-intervention, they could not fully integrate IK into their teaching. This study's limitation was the sample size. Only 5 Physical Sciences teachers were used from the whole circuit of 12 schools, thus the results cannot be generalized. Even though two of 5 struggled to incorporate it into their classroom post intervention, 3 teachers (1, 4, and 5) managed to fulfil the sociocultural aspects of Ministry of Education, Arts and Culture (2015), which encourages the use of cultural and social aspects of learners' environment as meaning–making tools and teaching resources for a knowledge-based society. Based on the results given here, this study opines that the way teachers' attitude towards IK influences their effort to integrate it into their classrooms. Fortunately, post- intervention things were not as severe as pre-intervention. At least 3 of the 5 teachers showed a general improvement in their views of infusing IK into teaching Chemistry. As such, teachers were able to identify appropriate indigenous knowledge and practices that can fit into the teaching of Chemistry concepts. Observations also showed an improved willingness to learn from each other's experience. This indicated a shift in terms of self-directed learning dimension of learning motivation and self-monitoring. Post intervention interviews indicated continuous communication and interaction amongst them community, this implies an urge for continuing professional development need that may see effective implementation of revised curriculum (Ministry of Education, Arts and Culture, 2015). Thus, this study recommends, ongoing professional developments trainings.

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AUTHORS' INFORMATION

Full name: Tomas Asino
Institutional affiliation: North West University
Institutional address: 11 Hoffman Street, Potchefstroom Campus
Short biographical sketch: Tomas Asino has been a lifelong learner and educator. He has PhD and Master Degree qualification in the field of Natural Sciences Education. Tomas has spent over 17 years teaching Natural science across all grades within the Basic Education curriculum. His areas of research interest include teachers' professional development in the integration of indigenous knowledge in the teaching of Chemistry concepts. He writes to share the lessons learned and wisdom gained from his diverse teaching experiences.

Full name: Kgomotsego B. Samuel
Institutional affiliation: Faculty of Education, North West Province
Institutional address: C/o Albert Luthuli and University Drive, Mmabatho, Mahikeng, 2745, North West Province
Email address: Kgomotsego.Samuel@nwu.ac.za
Short biographical sketch: Kgomotsego Brenda Samuel, is a PhD holder in Curriculum Studies and senior lecturer in Natural Sciences education. Her research focus is on curriculum design and implementation, research interest is in exploring science teachers' pedagogical content knowledge (PCK) in Natural Sciences and Indigenous Knowledge (IK). She is interested in seeing teachers incorporating different teaching strategies (problem-based learning and inquiry-based learning) that enhance critical thinking skill in learners. Her publications focus mainly on science teaching, learning and pedagogies. She is a member of Self-Directed-Learning (SDL) Research Unit in the North-West University, affiliated with research associations such as SAARMSTE, and also hold Golden Key membership. ORCID: https://orcid.org/0000-0002-8118-5080

Full name: Washington T. Dudu
Institutional affiliation: College of Education, UNISA
Institutional address: 12 Joubert Rd, Muckleneuk, Pretoria, 0002
Short biographical sketch: Washington T. Dudu is a C2 NRF rated researcher and Professor in Science Education whose areas of interest include teachers having a nuanced understanding or well developed PCK to foster inquiry learning in the classroom; the role of cooperative learning during inquiry learning; teachers' development in terms of critical thinking skills and learning about indigenous knowledge as well as understanding of inquiry-based instruction and nature of science through self-directed learning.