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

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Abstract

This study focused on the views of Natural Sciences teachers on infusing indigenous knowledge in teaching Chemistry concepts at the junior secondary school level. National Curriculum for Basic Education (NCBE) promotes the inclusion of indigenous knowledge into teaching to empower learners to actively participate in making Namibia a knowledgeable-based society. However, IK remains an afterthought in many Omusati region classrooms especially at grades 8 and 9 level. Thus, learners neither associate it with classroom nor Chemistry syllabus. This creates an assumption amongst the learners that their environment has nothing to do with science generally or Chemistry in particular. Moreover, lack of emphasis and clear guidelines on the 'how' of implementation of IK in classroom enforces the neglect of IK infusion by teachers. This paper therefore tapped into teachers views on IK and Chemistry teaching. Five (5) grades 8 and 9 Physical Sciences teachers were purposefully selected from Onesi circuit in the Directorate of Education, Arts and Culture of Omusati region, Namibia. The researcher employed 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 the 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. Moreover, the approval of Physical Science textbooks should be dependent on the inclusion of a portion of indigenous knowledge systems with relevant local examples and visuals to encourage and strengthen interest among both teachers and learners.

Keywords: *Physical science teachers, views, indigenous knowledge, chemistry concepts, Continuous Professional Development (CPD).*

1. Introduction and problem

This paper presents on the Natural sciences teachers' views in the infusion of indigenous knowledge (IK) into Chemistry teaching. Indigenous knowledge (IK) is considered an entry point in incorporating knowledge and its relevance into the abstract world of science (Sotero et al., 2020). This statement underscores the importance of linking science with learners' daily experiences, their community members and socio-cultural practices in making learning a meaningful experience. Mandikonza (2019: 2) concurs that "learners bring tacit as well as explicit and conceptual knowledge into learning contexts," however due to lack of recognition and infusion of IK in the classrooms, learners from rural 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 (De Beer, 2016). Generally, indigenous knowledge is considered less important, particularly in the science classrooms. Mukwambo (2017) 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 integration of indigenous knowledge is a complex multifaceted issue that demands attention and action from educators and researchers (Andrew et. al, 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. 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, indigenous knowledge (IK) has been alienated from school curricula for a long time (Ogunniyi, 2007; Battiste, 2018). It is seen as odd and limited in the eyes of Western science. This view downgrades IK importance in societies as cultural values and local wisdom are marginalised (Handayani, Wilujeng & Prasetyo, 2018). Additionally, Cronje (2015) argues that majority of learners in Southern Africa come from indigenous background, but the science they are taught in schools is informed by Western culture, using Western teaching strategies. Similarly, most of Namibian learners hail from indigenous background but their teachers were trained through a western science curriculum. 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 rural Namibia. Teachers who participated used the same syllabus, resources and circuit-based tests and examinations. Therefore, all schools represent one phenomenon and only one unit of analysis is used. The 5 grades 8 and 9 Physical Science teachers were purposively selected 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, et al. (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 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) developed to provide a standardized means for detecting the degree to which classroom instruction in mathematics or science is reformed, was adopted for data collection (Sawada et. al., 2002). For this study, the 25 aspects of this instrument were grouped into five categories namely, lesson design and implementation, content- propositional pedagogic knowledge, content- procedural pedagogic, classroom culture - communicative interaction and learners-teacher relationship, which helped to evaluate classroom instruction and teaching approach. It provided insight into whether the five (5) teachers observed and created an atmosphere conducive for SDL, and elicitation of indigenous knowledge to enhance learning of Chemistry concepts. Like the questionnaires, this instrument together with interview protocols were also administered pre and post intervention.

4.2. Data collection procedure

The 5 teachers completed the questionnaire of the two instruments before intervention in a common location but individually. No one influenced the other, everyone answered and expressed themselves from their own knowledge and experience.

4.3. Presentation of the results

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) operational definitions of Indigenous Knowledge (IK) and (ii) Generation and validation of IK deemed suitable to address the views of teachers.

Theme (i): Operational definitions of Indigenous Knowledge

This theme relates to the definition of IK as such this study operationalised IK as defined by the 5 participants. Different definitions emerged from different teachers, for example: Pre-intervention from VNOIK, teacher 1 defined IK as: "*the knowledge that is based on people's understanding and beliefs."* Similarly, pre-intervention interview, she mentioned that indigenous knowledge looked familiar, but she did not know how to define it. However, post intervention, this teacher's response was surprisingly impressive, including her examples. Her definition was as follows; *"IK is knowledge possessed by indigenous people and communities, which is originally culturally oriented, and it is essential to the cultural identity of the society in which it is regulated and secured. For example, the process of making Ombike as a traditional drink from different foods such as eembe and palm fruit can be used in the teaching of distillation which is an example of separation of mixture or sieving as a method of separating mixture of mahangu grains and flours when pounding."* Unlike pre-intervention lesson on compounds and Bohr structure, her post-intervention lesson on physical and chemical change, to a certain extent, incorporated certain aspects of IK as she brought in class local materials (ice blocks, bean seeds, small stones, wood, etc.) for learners to explored in groups of 3. Interestingly, she focused only on what she brought to class. She appeared hesitant to ask the learners about their knowledge and experiences on IK.

Pre-intervention, Teacher 2's response to IK definition on VNOIK, was so brief; *"…skills that are practised by elders traditionally."* Despite teacher 2 attending the whole intervention, his definition remained almost the same. *"… a diverse knowledge and its efficacious in particular contexts in which it is used."* He added; *"…it's different from any other types of knowledge because it is not universal but relates to a particular group of people."* Like his textbook driven lesson on ionic bonding, post-intervention he taught the topic "writing formulas for ionic compounds" and still did not involve learners. Though he could explain in detail how Ombike is made traditionally during intervention, it appeared he was confined to his old ways of teaching, his exclusion of IK in teaching Chemistry did not change.

Teacher 3's definition pre-intervention (VNOIK) saw IK as knowledge with no origin but emerged from a long history of people and their natural surroundings. Post intervention when asked about the difference between IK and western knowledge, she replied, *"…[IK] does not strive for a universal set of explanations but is particularistic in orientation and often contextual."* Generally, she does not consider IK as concrete knowledge, she believes more in western science and does not associate IK with science. Post intervention, her definition still did not show any consideration to IK. Her pre-intervention lesson was on chemical and physical change, characterized by lack of learner active participation or real-life examples from the learners' environment except the textbook examples. She was the sole knowledgeable person, portraying learners as 'tabula rasa.'

Pre-intervention, Teacher 4's response on VNOIK indicated that he had an idea about IK. He responded "*…[IK] is traditional knowledge based on many aspects that a specific community depends on their day-to-day preparation and survival."* Similarly, pre-intervention interview he responded *"…[IK] is not obtained from school but obtained from elders, families, communities and passed on from generation to the next through traditional methods."* His pre-intervention lesson was on physical and chemical change. It was interesting and learner engaging. He afforded learners an opportunity to engage in IK using (warm and frozen water, cooked food, burning of firewood and brewing of traditional home-made Oshikundu). Post-intervention, he used learners' home experience to contextualise the lesson. He taught "Acids and bases in everyday life", using home-based materials which included sour milk, vinegar, mouthwash, ondjove (marula oil), and wood ash. He also strove to create context for the learners.

Teacher 5's pre-intervention response on VNOIK, defined IK *as "…[IK is] knowledge that everyone is born with and inherited from our forefathers and mothers. For instance, a boy is groomed to do manly work (cut trees, herding livestock) while a girl is groomed to do household chores (cooking, cleaning, looking after the young siblings)."* Her view seemed aligned with traditional inheritance practices, not much of scientific connection. However, her post-intervention lesson on acids and bases

was interesting. Learners sat in small groups, testing the degree of acidity or alkalinity of home-based materials (marula fruits, lemon, salt, sugar) using scientific methods (universal indicator solution and litmus paper). The lesson was learner-centred and inquiry-based. She exhibited a comprehensive appreciation and understanding of IK.

Theme (ii): Generation and validation of IK deemed suitable to address the views of teachers.

In this theme participants were asked through VNOIK if elders, herbalists and traditional healers do experiments and test to verify and validate IK. Participants responded differently: pre-intervention, Teacher 3 indicated that IK is never tested, it is just a belief. This is the same teacher who saw IK to be just peoples' practice, and nothing scientific. However, other participants indicated that test and validation were done long ago by elders as some products made from certain IK practices have yielded similar to same products as the western science, for an example making Ombike using traditional means, the product is alcohol. Through observation this knowledge has been passed on from generation to generation (Teacher 2 and 4). Teacher 5 concurred with Teacher 2 and 4, adding that it was the San people, who carried the test on herbs and food, as they were first people to live in Namibia in their nomadic way of life. An interesting and stimulating discussion emerged when Teachers 2 and 4 gave explicit explanations on how 'Ombike' is produced and tested for quality traditionally. A flame of light is set on the surface of the liquid. When it burns with a blueish flame it indicates the magnitude of strength and if fit for consumption and market. When it burns with a whitish flame, it confirms the weaker strength of alcohol content and as such can be consumed by children at home or given to neighbours at no cost. Moreover, like western science, they also used their animals to test their herbs, though this was not documented, Teacher 5 mentioned in support of others. Post-intervention interview, it appeared that all 5 participants believed that IK is generated and tested through careful observation using trial and error method. Teacher 1 and 5 even provided some names of the plants which have been used to cure diseases such as Lagundi and Sambong which have been recently approved by the Department of Health in Namibia. These inputs indicated that intervention also created awareness of some sort to teachers about the importance of using learners' environments to teach science.

5. Discussion of findings

Pre-intervention there was limited knowledge in defining the term IK amongst all the teachers. This was also observed at the beginning of their professional development intervention. Post intervention there was knowledge build up and refinement on IK definitions, this showed positive attitude as teachers defined the term correctly using scientific terminology with practical examples to clarify their definition. Four (4) of the five (5) teachers demonstrated significant improvement in the definition of IK, except for Teacher 3 who still could not make sense of IK as science. VNOIK and interviews showed that some teachers believe that IK was generated and validated a long time ago through trial-and-error method. Other teachers (including Teacher 3) felt that IK can be validated using western knowledge to create a sense of respect. This view resonates with De Beer and Van Wyk's (2019) opinion that validation of IK by western scientists is empowering and creates respect for the rigor 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, traditional alcoholic drink Ombike's level of alcohol content could be tested traditionally.

6. Conclusion

Based on the findings, although Physical Science teachers had basic knowledge about indigenous knowledge pre-intervention, they could not fully integrate it into their teaching. All the 5 teachers picked up IK definition from their discussions during the intervention. Even though two of the 5 struggled to incorporate IK into their classroom post intervention, 3 teachers (1, 4, and 5) managed to fulfil the sociocultural aspects of NCBE (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 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 the community, this shows an urge for continuing professional development that may see effective implementation of revised curriculum (NCBE, 2015). Thus, this study recommends, ongoing professional developments trainings.

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