Available online at: https://jurnal-fkip.ut.ac.id/index.php/ijrse/issue/archive
International Journal of Research in STEM Education (IJRSE)
ISSN 2721-2904 (online)
Volume 6 Number 2 (2024): 73 - 84

Incorporating Indigenous Knowledge into Chemistry Lessons on Acids and Bases: *Exploring Potential and Challenges*

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Abstract

This study delved into the potential and hurdles involved in integrating indigenous knowledge (IK) into Physical Science lessons among Namibian teachers. Rooted in an interpretive paradigm, it adopted a qualitative case study approach, gathering data through observations and stimulated recall interviews. Socio-cultural theory served as the overarching framework, with Pedagogical Content Knowledge (PCK) used as a lens for data analysis. Specifically, the study employed five knowledge components within the realm of topic-specific pedagogical content knowledge (TSPCK) to scrutinize the data. Two Grade 9 Physical Science teachers were observed teaching concepts on Acids and Bases, with each teacher's two lessons providing qualitative data. Teachers were purposively sampled for inclusion in the study. The findings indicated that teachers possessed local knowledge that could be effectively integrated into Physical Science topics. For example, the topic of acids and bases was identified as conducive to incorporating IK. Both observed teachers utilized local substances to enable learners to practically test them using litmus paper (blue or red). Substances such as Omutoko (wood ash), Oshikundu (a traditional drink made from Mahangu flour and sorghum), Oshimhumu (a shrub used for dental hygiene), and Onghalanyenye (subterranean soil) were tested for their acidic or alkaline properties during Physical Science lessons. Stimulated recall interviews further revealed teachers' awareness of homegrown substances suitable for teaching acids and bases in science lessons.

Keywords: *Indigenous Knowledge, Science Education, Pedagogical Content Knowledge, Curriculum Integration, Educational Policy*

INTRODUCTION

Indigenous knowledge (IK) has long been ignored in sub-Saharan Africa education system (Kibirige & Van Rooyen, 2006; Shizha, 2007). Amongst other things, lack of professional development was given as a reason for the neglecting IK in science curriculum. In recent years, however, there are research done on the inclusion of IK in science classroom (Òtúlàjà, Cameron & Msimanga, 2011; and Ogunniyi & Ogawa, 2008) but the possibilities and challenges are not illustrated.

This study unpacked the possibilities and challenges teachers are faced with and encourage them to integrate IK in their lessons. Acid and bases is one of the topics that requires learners to be aware on how to use the models and requires the better understanding from lower grade before they go to senior secondary grades. Learners find it difficult to use the model in secondary grades without a better understanding of the topic in lower grades. Drechsler and Schmidt (2005) illustrated that teachers Sweden cannot distinguishes acid and bases very well, they just depend on what is documented in the books. Furthermore, "they seemed to have difficulties in applying this view (model) with respect to acids and bases" (p.19). The examiner's report (2013 & 2015) reviewed that learners are not doing well during examination in grade 10 on the topic of acid and bases. Learners perform poorly on writing chemical

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DOI: https://doi.org/10.33830/ijrse.v6i2.1714

equation on the topic (Namibia, Ministry of education, 2015), thus there is a need to start from what the learners knows to abstract on the topic. Acid and bases are commonly used by indigenous people, when adding cattle dug to the soil to neutralize the acidic present in the soil for a good harvest. This knowledge still exists today in most indigenous people in Namibia (Mukwambo, 2017). But such knowledge is not optimally utilised in schools to contextualise science concepts on acid and bases. Yet, teachers need to connect indigenous knowledge and western science, to scientific concepts imbedded in cultural practices.

This paper intends to help to understand science teachers on how they teaches acid and bases using indigenous knowledge practices, and also to understand science teachers PCK on the topic. Cobern and Loving (1999) critiques the integration of IK and WS that they are strong in their domain and intersecting them it will weaken their domain. They further contextualize that western science could co-opt and dominate IK if it is integrated as science in the lessons. To challenges this, we have to look at the possibilities that are available for science teachers to integrate IK and what challenges do they face during the integration process.

Research Objectives

To get a further in-depth understanding of the possibilities and challenges, two science teachers were observed teaching the topics on acids and bases. Stimulated recall interviews were used on both teachers to clarify more on what was the possibilities and challenges they encountered during the lessons. This study is thus guided by the following research questions:

1. What are Grade 9 Physical Science teachers' experiences and views on mediating learning when integrating local knowledge in the topic of acids and bases?
2. How do Grade 9 Physical Science teachers mediate the learning of acids and bases using local knowledge in their classrooms?

LITERATURE REVIEW

The infusing of indigenous knowledge in science education has been researched globally and has yielded good results (Mukwambo, Ngcoza & Chikunda, 2017). A number of countries in sub-Saharan Africa, such as South Africa, Mozambique, Kenya, Ethiopia, Tanzania, inter alia, have embraced the ideas of integrating IK and western knowledge in science education (Mhakure & Otulaja, 2017). The scholars believe that the use of IK in science lessons brings learning environment of learners into science classroom. However, those that oppose the integration of IK and western science (WS) cite the absence of rules of evidence in the IK worldview (ibid). Despite this, not all indigenous knowledge was neglected and most of the existing societies still practice what they regard as their knowledge and cultural heritage (Cocks, Alexander & Dold, 2012).

Mhakure and Otulaja (2017) looked at the four categories where IK and WS could manifest each other in science education. Firstly, category 1: where indigenous knowledge system (IKS) can be explained in western science knowledge (WSK). Teaching the concepts of sound and waves using traditional drums (Liveve, 2022) is one example of how IK could be used to explain WS. Secondly, WKS practice is likely to be used to explain IKS but its usage cannot be verified. Thirdly, IKS and WSK can be linked but the interpretation is different and lastly, IKS and WSK are incompatible. For example, in WSK discharge of electricity between cloud causes lighting, whereas in IKS lighting is caused by witchcrafts as believed in some African cultures (Mhakure & Otulaja, 2017).

Thus, IK may be related to common indigenous knowledge practices seen in the communities that are indigenous to a specific area, or the emphasis might be on the long history of the practice, in this case it is often called traditional knowledge (Boven & Morohashi, 2002). Local, traditional and indigenous knowledge are interrelated and are characterized by the words such as locally bound which means

indigenous to specific area, culture and context, non-formal knowledge, orally transmitted and generally not documented, dynamic and adaptive, holistic in nature and closely related to survival and subsistence for many people worldwide (Boven & Morohashi, 2002). IK may have useful benefits in science lessons provided it is used properly to allow teachers to integrate IK with western science.

The curriculum that allows learners to integrate their indigenous knowledge with science knowledge is what Aikenhead and Jegede (1999) called cultural border crossing. Cultural border crossing can serve science teachers, the 'pedagogical culture workers' who make the culture of science accessible to all their learners (ibid). The knowledge from home (IK) and science knowledge need to agree and where it agrees, learners might master the subject content. This concurs with Aikenhead and Jegede (1999) who showed that in about 90% of learners, the movement between the micro-culture (IK) of their family and the micro-culture (science knowledge) of school science is not smooth and often limits their success in science. The cultural border crossing (Aikenhead & Jegede, 1999) will thus largely depend on how the teachers move the learners from IK into WS between the two worldviews (Mhakure & Otulaja, 2017). The curriculum should further help the teachers on how they can integrate IK into the science classroom without WS being dominant during the science lessons (Ogunniyi, 2007a). The science syllabus only tells teachers what they must do and should do but does not explain how to do it during the classroom situation (Mhakure & Otulaja, 2017). It only gives direction to the teachers on how to teach what is documented in the textbooks (western science), without guiding science teachers on how to include indigenous knowledge or train teachers on how best they could include IK in their lessons.

Teachers should therefore select learning content and methods on the basis of the learners' needs within their immediate environment and community (Namibia. MoE, 2010). Nyambe and Wilmot (2012) critique the implementation of learners' centred education that teachers were not ready to implement, and training was not that sufficient to equip them with needed knowledge. Even educators at colleges were not that aware on what to do (Nyambe &Wilmot, 2012). This might be the reason why IK was ignored in most countries in Sub-Sahara African on the inclusion of IK in the education and depended mostly on Western Science and Namibia is not exceptional.

Yet, the life experiences and learners' needs within their immediate environment and community may reveal the inclusion of IK. The Ministry of Education might have seen the importance of indigenous knowledge in the education system in Namibia by suggesting that the teacher must be able to identify the needs of the learners, the nature of the learning to be done, and the means to shape learning experiences accordingly (Namibia. MoE, 2010). However, for IK to be further implemented in the science classroom, teachers need to be trained on how to manage the two worldviews in their science classrooms and on the use of availability of teaching resources (Mhakure & Otulaja, 2017). The tension between the curriculum and implementation needs to be challenged. In the current study we report on the inclusion of IK in Physical Science classroom in two schools in Namibia, by looking at some possibilities and challenges. The theoretical framework for this research uses socio-cultural theory (Vygotsky, 1978) and the analytical tool used is PCK (Shulman, 1986a) as illustrated below.

Theoretical and Analytical Framework

This paper was guided by socio-cultural theory (Vygotsky, 1978) that looked at the cultural practices that might have some scientific process in it and on how social interaction helped teachers to guide the indigenous knowledge (IK) based on some cultural practices. The other theoretical framework is Pedagogical Content Knowledge (PCK) that looked at the knowledge the teachers has when teaching the topic on Acid and Bases. Each theory is explained in detail below by starting with socio-cultural theory and ending with PCK.

Socio-cultural theory

This study is informed by Vygotsky's (1978) socio-cultural theory that rests on the premise that learning is social. Vygotsky points out that social interaction plays a critical role in cognitive development in relation to what is learned and when and how learning occurs. Vygotsky believes that learners construct their own knowledge by interacting with other individuals (Blake & Pope, 2008). Allahyar and Nazari (2012) indicates that the socio-cultural view of learning shifts the teacher's focus from individual internalizing learning, an acquisition metaphor of learning, to a more participative perspective. That is, it is through social interactions with teachers and peers who are more knowledgeable that learners receive the assistance needed to learn (Teemant, 2005). Without social interactions with the other peers, learning could be difficult in the classroom setting and learners could not ably learn things that we do not know (Lutz & Huitt, 2004). This study afforded us opportunities to explore some possibilities and challenges on how science teachers integrate IK in science lessons, to see how language can be used in socio-cultural contexts. We looked at how teachers use the knowledge gained through social interactions within the local communities and the environment in teaching science concepts. To complement on vygotsky's (1978) socio-cultural theory, we used PCK as an analytical tool.

Pedagogical Content Knowledge (PCK)

Shulman (1986) PCK focuses on the knowledge teacher has that could be used in teaching specific topic in science classroom. This knowledge could western science knowledge or indigenous knowledge that might be useful when teaching science topics. The teacher chooses the topic on acid and base as one of the topics that has a lot of IK in it. This moved the analytical framework to Topic Specific Pedagogical Content Knowledge (TSPCK). TSPCK assists teachers to consider the specific information about the content knowledge of the topic in relation to indigenous knowledge that could be used in relation with WSK (Rollnick & Mavhunga, 2014).Topic specific pedagogical content knowledge (TSPCK) was defined in terms of five knowledge components namely: learner prior knowledge, curricular saliency, representations, what is difficult to teach and conceptual teaching strategies (Pitjeng-Mosabala & Rollnick, 2018). Mavhunga, Ibrahim, Qhobela and Rollnick (2016) outline the five knowledge components and were used as analytical tool when analyzing the data. Learners' prior knowledge, which includes common learner misconceptions known on the topic. IK of learners could be embedded in their prior everyday knowledge and this knowledge was gained during the social interaction with community people. Curricular saliency, which refers to the identification of the most important meaning of major of a topic, without which understanding of the topic would be difficult for learners and also includes the knowledge to logically sequence the learning and the knowledge of pre-concepts needed to teach a topic.

What is difficult to understand refers to gate keeping concepts which are difficult to understand often because they cause conflict with previously established understanding. Presentation which refers to a combination of presentation of macro, symbol and submicroscopic levels that may be employed to support explanation. Lastly, conceptual teaching strategies which refer to teaching strategies derived from the considerations made from the other four components and excludes general teaching methodologies.

TSPCK is relevant when exploring PCK in a given topic that is known to the science teachers that requires IK. Socio-cultural theory helped us to analyse the knowledge the teachers gained through the social interaction with the community, with enact of IK it that could be used in science lessons. PCK helped us to analyse data from the observation of the science lessons. With TSPCK as analytical tool we analysed the data looking at knowledge components teachers has when teaching the topic on acid and bases using five knowledge components.

RESEARCH METHODS AND DESIGN

This study is underpinned by interpretive research paradigm. The interpretive research paradigm is fundamentally concerned with meaning, and it seeks to understand social members' definitions and understanding of situations (Henning, Van Rensburg & Smit, 2007). This study sought to understand possibilities and challenges facing teachers when incorporating IK in science lessons. It employed a qualitative case study approach. A case study was appropriate in this study as we looked at a particular case in relation to the inclusion of IK in science lessons. Two teachers were purposively selected to be involved in this study and their profiles are provided in Table 1 below. The two teachers were requested to give themselves some pseudonyms to conceal the identity. For instance, Shekupe translated her real first name from English into Oshikwanyama which is her ethnic group, while on the other hand Kapashu used his nickname for soccer.

Table 1: Teachers' Profiles

Category	Shekupe (Female)	Kapashu (Male)
Age	52	34
Teaching experience in years	24	6
Qualification(s)	BETD and MASTEP	BETD
Ethnic Group	Kwanyama	Kwanyama
Religion	Catholic	Anglican Lutheran Church In Namibia (ELCIN)
School location	Rural	Rural
Average class size	18	27

Science teachers observed in this study are from the Oshikwanyama ethnic groupin Namibia and are from the area within the communities of the school where they teach. They grew up in the community and schooled at the school where they were currently teaching during this study.

Data gathering techniques

The following data gathering techniques were used to collect data in this study:

Observation

Observation requires the researcher to go to the site of the study and observe what is actually taking place there (Bertram & Christiansen, 2015). Observations thus afford a researcher an opportunity to get the first-hand information of the situation to be observed. This research allowed the first author to do observations in the science classrooms to be able to see and hear on how teachers mediate learning by includes indigenous knowledge in Physical science lessons. Cohen, Manion and Morrison (2011) indicates that observation is more than just looking, but it is looking and noting systematically, people, events, behaviours, setting, artefacts, and routine and so on. The first author observed two lessons per Physical Science teacher while teaching the topic on acids and bases in which they included indigenous knowledge. The lessons were videotaped and thereafter transcribed. Additionally, an observation schedule was used to supplement the data from the videos. To validate the data from observation, stimulated recall interviews (SRIs) were conducted while watching the videos with each teacher.

Stimulated recall interviews

Stimulated recall interview (SRI) was done when watching the videotaped lessons with teachers to clarify what they meant or wanted to do during the lesson. SRI has often been used to explore aspects of cognition that lie behind the participants' decisions and actions (Ryan &Gass, 2012). The use of SRI in the paper was intended to seek clarity on the lessons that the first author observed and to validate the data generated from the observations. This was done a week after the lessons were observed and it added value to our study. Each stimulated recall interview took about one hour because teachers were interested in clarifying more concepts that were not clear during the lesson. Research also indicates that stimulated recall interviews have also been found to enhance reflection of teachers (Muir, 2010). Powell (2005) found that stimulated recall interview as reflective dialogues enabled teachers to articulate their thinking and feelings by defining a focus and context for inquiry into their professional practice. This was observed during SRI when teachers were critically reflecting back on their teaching and clarifying some of the points made during the lessons.

Data analysis

Walker and Myrick (2006) assert that coding in qualitative research is one way of exploring bits of information in the data and looking for similarities and differences within these bits to categorize and label them. To code, data are broken down, compared, and then placed in a category. Similar data are placed in similar categories, and different data create new categories. Coding is an iterative, inductive, yet reductive process that organizes data, from which the researcher can then construct themes, essences, descriptions, and theories (ibid). Cohen, Manion and Morrison (2011) accentuate that qualitative data analysis involves organizing, accounting for and explaining the data. In short, making sense of data in terms of participants' definitions of the situation, noting patterns, themes, categories and regularities.

Findings and Discussions

The qualitative data presented here were generated from the lessons observed and stimulated recall interviews. The data are presented into two themes that emerged from the data.

Theme 1: Cultural pedagogical knowledge of teachers on Acids and Bases

It emerged from the study that the social interactions teachers have with the communities helped them to mediate learning by integrating indigenous knowledge of the local people into science lessons. The use of Oshikundu, lemon fruit, and orange fruit were used by Shekupe when teaching acids and bases as evidence on how IK and WS can be taught simultaneously. During the lessons the first author observed that these teachers seemed to be knowledgeable about examples of local materials or substances that taste sour or have bitter taste. For the teachers to include IK in their lesson they have to use local language as a tool to make learners have a better conceptual understand. Teachers scaffold learners' prior everyday knowledge using local/indigenous language.

Kapashu indicated that "It is good to build to what already learners know from home using local language when mentioning the substances". Teachers used local language when integrating indigenous knowledge into their science lessons. In view of the above, language has become part of the wider community, it must be used in the right way to enhance teaching and learning science concepts in the classroom. Vygotsky's socio-cultural theory promotes gradual changes using social contact and language which gradually changes with development. He believed that learners construct their own knowledge by interacting with other individuals (Blake & Pope, 2008). Language is an essential tool when teacher scaffold learners in small group, cooperative learning, group problem solving and in assisted learning to be able to do the tasks successfully without any delay.

Through arguments learners understood the substances that test sour and bitter from home. The teachers used local language when talking about the indigenous knowledge which was used during the science lessons. One of the challenges is "I used more local language and learners will not able to translate it into English, lack of terminologies in the local language prevented me to fully include IK in the science lessons, like the names of trees, I don't know them but I know that they are sour (acidic) or bitter (bases)" (Kapashu).Furthermore, when my learners written Oshimhumu and acid during the examination they will be penalized because it is not reflected in science books. The use of local language helped teachers to integrate IK on acids and Bases successfully in their lessons and learners notably were pro-active.

This resonates with Vygotsky's socio-cultural theory that we learn first through person-person interaction and then as individuals through an internalization process that leads to deep understanding (Blake & Pope, 2008). Through this interaction of person-person, language is embedded in it, and it is only through language we can learn and interact with each other. Mukwambo, et al., (2014) illustrated that to develop social language into the language science teachers need to pose questions, create arguments and design purposeful experiments. Science concepts are not always explicit in most indigenous practices, but the Africanisation of school science curricula calls upon the teachers and learners to attach scientific explanation to IK (ibid). Kapashu asserted that "the use of local substances makes learners to like the subjects and enjoy it, when you bring these things (local substances) look at how learners are participating during the lessons. Look at these learners what they are doing here (pointing at the video)". He continue "I used learners prior knowledge to elicited the concepts I was about to teach". This is one of the knowledge components the teachers used to teach the learners. The teachers provoke the learners' prior everyday knowledge and engaged learners during the lessons.

During the stimulated recall interviews (SRIs), Shekupe responded that:

> *"I used local knowledge to make the learners understand what I was trying to explain to them, they are quite many because when we are talking of Physical science this has to do with almost anything things around us, so when we are looking at their homes what substances could be used to teach acids, they have a lot of fruit grown at home that taste sour. I used Oshikundu because they know it and they drink it every day, even before they come to school today". She continued "one thing I will not forget is the result we got after testing Oshimumhu roots and leaves that proved our indigenous knowledge otherwise, I thought this plant was a bases but my belief about it were shuttered after the test result"(table 3).The curricular saliency the teachers used to teach acids and bases when integrating IK was the roots of Oshimumhu that was thought to be bases but it was found to be acidic."*

This illustrates that teachers are knowledgeable on the substances that could be used in science lessons as Shekupe explained during the SRI, that "the curriculum for basic education does not explain on how teachers should include IK of learners". She further indicated that "we can teach science concepts by integrating IK but the books and other resources does not include them, so it might be the waste of time". This limits the effort the teachers could go when integrating IK in science lessons.

Learners were asked to test seven substances that were brought by the teacher using litmus paper (both red and blue) to identify which substances were acidic or basic. The teacher brought the substances to the classroom for the learners to test them. The show the PCK of teachers they have on Acid and bases using local substances available in the community. Shekupe used both litmus (red and blue) to taste different substances for their acidic and alkalinity as tabulated below.

Table 2: Shows substances classified as being acidic and not acidic

Name of substances	*No of learners indicated the substances to be acidic*	*No of learners indicated the substances to be not acidic*
Oshikundu	*16*	*2*
Tea	*3*	*15*
Lemon Juice	*17*	*1*
Soap Solution	*1*	*17*
Salt Solution	*6*	*12*
Guava Juice	*18*	*0*
Vinegar	*15*	*3*

It was discovered during science lesson that Oshikundu was classified as acidic as indicated by 16 (89%) learners after testing it. Only two learners found Oshikundu to be bases. Most (15 learners) indicated tea was not acidic but the teacher indicated that tea to be acidic. This contradicted the finding of learners, and the teachers could not explicitly convince the learners. Out of seven substances given, the learners found that four were acidic and three were basic or alkaline. The next lessons were based on bases and the results are as follow.

Table 3: Shows substances tested for their alkalinity

Name of substances	*% learners indicated the substances to be alkaline*	*% learners indicated the substances to be not alkaline*
Toothpaste	*94%*	*4%*
Dish liquid	*71%*	*29%*
Handy Andy	*59%*	*41%*
Lime (Calcium oxide)	*82%*	*18%*
Orange juice	*35%*	*65%*
Omutoko (wood ash)	*88%*	*12%*
Onghalanyenye	*76%*	*24%*
Oshimhumu	*12%*	*88%*

During the lesson on substances that are bases or alkaline, two local substances were tested for their alkalinity. It was interesting to discover that wood ash (Omutoko) solution was bases of which 82% of the learners indicated that it was a bases, only 12% found the ash to acidic. The solution of the soil called Onghalanyenye (soil from underground brought on top by insects), learners found that the solution was a bases, represent 76% and about 24% found it not to be the bases. Science teachers used conceptual teaching strategies to align IK with WS science on the topic. Difference substances from indigenous perspective were used as gate keeping concepts that it worth to be integrated into the lesson. The used of Oshimumhu, Omutoko and Onghalanyanye as concepts that lead to the understanding of acid and bases, allow teachers to avoid conflict in the mind of learners by testing them in the classroom. To prove them teachers used learners to test the substances in real life situation. Teachers were aware on the danger of integrating IK in science lessons.

Theme 2: Indigenous knowledge help science teachers to scaffold learners' IK into western science concepts

Both Shekupe and Kapashu employed the teaching strategies that allowed learners to test the substances to find whether they were acidic or not. During the stimulated recall interview (SRI)

participants showed that indigenous knowledge is useful during hands-on practical activities in science lessons. Kapashu agreed by explaining that:

> *"Is the knowledge that they have from home, when they come to school or maybe doing this practical allow them to link that knowledge that sample, that topic to the things they have seen at the home".*

Learners carried out the experiments and thereafter were required to givethe feedback to the entire class. In support of this Woodley (2009) puts forth that most practitioners would agree that well-planned hands-on practical activities can engage learners, help them to develop important skills, help them to understand the process of scientific investigation, and develop their understanding of concepts. In her study, Kota (2006) found that learners were able to relate what they observed at home with science in the classroom. "I know how to make fire, I just watched how it was done, then that's how I learn, there was no book" (Kota, 2006).

During the SRI with Kapashu, he revealed that "I used available substances to teach this topic (acid and bases) because our school does not have the substances in the laboratory; local substances can be tested to show the learners that in our homes we have acid and bases substances". The teacher used the life experience that he gained at home that could be more applicable in teaching science. Before the practical work Shekupe explained to the learners the instructions to follow "substance labelled A the you put a blue litmus paper in each of the container then you only say change colour or no colour change then if it's any acids you make a tick and if is not any acids you make across".

In this lesson the teacher used both local substances and western to teach bases to the learners. Kapashu indicated that "learners were actively involved, and it was wonderful to see every learners try to think and come up with the results during experiment". While Shekupe illustrates that "practical work allow them (learners) to do the activities or experiment in this way they will use their minds to think and, we do experiment to help our learners see the theories into reality". Maselwa and Ngcoza (2003) support the use of hands-on, minds-on and words-on during practical work in science classroom. This was observed during the science lessons as illustrated by Shekupe and Kapashu. Akbar (2012), who explained that the added value of practical is that it enhances motivation and stimulates participation by providing unusual objects and events, a contrast with the usual learning experience of sitting still and listening or doing exercise. "It is the first time for me to include some of the local substances when teaching these topics (acids and bases), I thought maybe it was not going to work out during practical work, but it worked" (Kapashu). Shekupe indicated that learners were engaged during the lessons when they were doing practical work, and they could find things on themselves by testing.

> *"I enjoyed the lessons seeing my learners so interested to test different substances, I observed that most learners wanted to test Oshikundu which I could not see during the lesson that day but watching this video I could see what learners were doing" (Shekupe).*

Some of the challenges illustrated by Shekupe and Kapashu are that:

"When we look at the time allocated 40 minutes is less for one to carry out practical, sometimes it is not enough unless the person (teacher) has to decide maybe either to do it in the afternoon" (Shekupe).

"Lack of terminologies in the local language prevented the teachers from integrating IK fully in the science lessons" (Shekupe);

"Learners will not be able to translate local language it into English during the test or examination" (Kapashu);

"Lack of IK in some of the teachers" (Kapashu);

"Learners will be penalized during examination when they write Omutoko and Ongalanyenye as examples of bases and Oshikundu as an acid" (Shekupe);

Misconception of IK, for example, Oshimhumu was thought to be a bases but after testing the roots and leaves both yielded acidic results; and finally, "In a multicultural classroom it difficult to use IK because leaner's have different IK on the some concepts" (Shekupe).

A proper integration of IK in science classroom may help an indigenous science teacher to become capable of developing learners' understanding beyond rote learning and memorization of concepts (Abah, Mashebe & Denuga, 2015). In support of this Mhakure and Otulaja (2017) argue that the integration of IK into the school science curriculum can only serve as a motivation factor for learners in non-western classroom, since they can easily identify it. This was observed during the science lessons when local substances were used in teaching acid and bases. Learners were inquisitiveness to learn and discover whether the substances were acid or bases.

CONCLUSION AND RECOMMENDATIONS

It emerged from this study that teachers are conversant with indigenous knowledge, and they are well-informed on how it can be incorporated into science. The lessons observed showed teachers using local substances to teach acids and bases. The use of wood ash (Omutoko) and Onghalanyenye that were tested during the science lessons and found that they were bases and Oshimhumu and Oshikundu were found to be acidic. The use of local substances allowed learners to use their prior everyday knowledge from home by allowing the teacher to do culturally border cross (Aikenhead & Jegede, 1999) and for the teachers to evaluate the four categories that manifest IK and WS in their science classroom (Mhakure & Otulaja, 2017).

The curriculum designers should give guidelines to the teachers (implementers) on how they should include IK in their science lessons. The curriculum has been quite silent on this and it times that curriculum designers need to be trained on the inclusion of IK for them to be able to see the usefulness of IK in science lessons. The research is needed to find out how science teachers further teach acids and bases with the use of models the in Namibia context.

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