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LIFE SCIENCES TEACHERS' NEEDS AND CHALLENGES WHEN INTEGRATING INDIGENOUS KNOWLEDGE USING INTERACTIVE WHITEBOARDS

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Abstract

The South African Curriculum and Assessment Policy Statement (CAPS) document for Life Sciences mandates the integration of Indigenous Knowledge (IK) in teaching to foster inclusivity and relevance of concepts taught. However, previous studies reveal that the meaningful and effective integration of IK remains challenging for Life Sciences teachers, particularly when using tools like Interactive Whiteboards (IWBs). The study reported herein sought to determine Life Sciences teachers' needs and challenges in using IWBs to integrate IK into teaching cellular respiration in Grade 11 classrooms. The study was underpinned by the Cognitive Justice framework, which advocates for equal recognition of diverse knowledge systems, and the Cognitive Theory of Multimedia Learning (CTML), which emphasizes the role of multimedia in enhancing learners' understanding. Using qualitative case study research design, 10 Grade 11 Life Sciences teachers were purposefully selected as participants from Johannesburg and Ekurhuleni Districts. Each teacher was interviewed once using a semi-structured interview schedule to establish their perceived needs and challenges using interactive whiteboards to integrate IK. Thereafter, each teacher was observed twice when teaching cellular respiration whilst integrating IK using an interactive whiteboard to examine their practices. Data was analyzed thematically, and two themes emerged: 1. Life Sciences teachers encounter challenges when using IWBs to integrate IK; and 2. Life Sciences teachers' needs in using IWBs to integrate IK. The findings revealed many challenges teachers encountered, which included a lack of appropriate infrastructure, persistent electricity cuts, unreliable internet connectivity, and insufficient institutional and policy support. Some teachers also acknowledged and demonstrated the affordances of IWBs when integrating IK. Based on the findings, it is recommended that: 1. There be an alignment between the Life Sciences curriculum stipulations and infrastructural development in schools and resource provisions for effective implementation; 2. There should be collaborative initiatives like Professional Learning Communities (PLCs) to facilitate the sharing of best practices and foster peer learning among teachers; and 3. Both pre-service and in-service teacher professional development programs should incorporate Information and Communication Technology (ICT) tools and IK integration as core components to provide practical, hands-on training to teachers.

Keywords: *Indigenous knowledge, interactive whiteboards, Life Sciences teachers, teachers' needs and challenges.*

1. Introduction

South Africa, often referred to as the "rainbow nation," is renowned for its rich diversity in racial, ethnic, linguistic, socio-economic, and cultural backgrounds. This diversity is mirrored in Life Sciences classrooms, which comprise learners from varied cultural, ethnic, and socio-economic contexts. Consequently, Life Sciences teachers face the critical task of cultivating a learning environment that reflects and responds to this diversity through both content knowledge and pedagogical approaches. The current South African curriculum, articulated in the Curriculum and Assessment Policy Statement (CAPS) for Life Sciences, emphasizes the integration of Indigenous Knowledge (IK) into teaching (Department of Basic Education [DBE], 2011). Steenkamp et al. (2019) define IK as a body of knowledge and practices developed within and passed down through local communities over generations. The call for IK integration is intended to foster culturally responsive and relatable learning environments, particularly benefiting learners from underprivileged and indigenous communities (Cronje et al., 2015; Mavuru, 2022). According to Sitsha (2023), indigenous learners often struggle to comprehend Life Sciences content due to its misalignment

with their cultural contexts. Mkhwebane (2024) similarly observed that many African learners struggle to connect scientific knowledge with their lived experiences and local contexts. de Beer and Whitlock (2009) attribute this challenge to the abstract and complex nature of Life Sciences concepts, which can obscure understanding and complicate learning. Additionally, Edson and Govender (2021) noted that Life Sciences content is predominantly rooted in European languages (e.g., Latin), practices, worldviews, and beliefs, thereby imposing additional cognitive demands on non-European learners. These learners often exert significant effort to decode and internalize scientific concepts and processes, further exacerbating educational inequities.

According to Slay et al. (2008), the current generation of learners exhibit a strong preference for interactive multimedia information and communication technologies (ICTs), such as IWBs). For this reason, this study strongly argues that by leveraging IWBs to support the integration of IK, Life Sciences teachers, and learners can benefit from a range of pedagogical affordances. Moreover, using IWBs facilitates the meaningful integration of IK and equips learners with essential 21st-century competencies, including digital literacy (Mokoena et al., 2021). Selepe et al. (2022) emphasize that IK is inherently characterized by familiar vocabulary and language accessible to learners. As such, its integration into Western science enables learners to comprehend scientific concepts more readily, rendering the subject more meaningful and relevant to their lived experiences and local contexts (Edson & Govender, 2021). This relevance is crucial, as indigenous learners lack motivation and interest in Science, Technology, Engineering, and Mathematics (STEM) disciplines, as da Silva et al. (2023) reported. In response, Nwokocha and Jegg-Lack (2024) advocate strongly for the integration of IK into STEM education, suggesting that it has the potential to rekindle learners' interest and motivation by bridging scientific content with their home environments.

Despite these benefits, existing research highlights that integrating IK in Life Sciences classrooms remains inadequate or poorly implemented by Life Sciences teachers (Mkhwebane, 2024; Cronje et al., 2015). Many teachers rely on traditional teaching methods, which often fail to sustain learner engagement and interest (Cronje et al., 2015). Moreover, the potential of ICT tools, such as IWBs, for facilitating IK integration is yet to be fully explored in Life Sciences teaching. Furthermore, Sitsha (2023) noted a persistent gap in the use of IWBs to support culturally responsive teaching, underscoring the need for further research and professional development initiatives aimed at equipping teachers to effectively integrate both ICTs and IK in Life Sciences education. Hence, the current study sought to determine Life Sciences teachers' needs and challenges in using IWBs to integrate IK. The following questions guided the study:

1. what are Life Sciences teachers' perceived needs and challenges in using interactive whiteboards to integrate indigenous knowledge?

2. How do Life Sciences teachers use interactive whiteboards to integrate indigenous knowledge?

2. Theoretical frameworks

This study is grounded in two theoretical frameworks: cognitive justice as pioneered by Visvanathan (1997) and the Cognitive Theory of Multimedia Learning (CTML) developed by Mayer (2024). Cognitive justice emphasizes the need for recognizing, respecting, and equally valuing diverse knowledge systems within society (Odora-Hoppers, 2015). Aligning with this principle, this study advocates for Life Sciences teachers to acknowledge and integrate marginalized knowledge systems, particularly Indigenous Knowledge Systems (IKS), into their teaching practices.

CTML, on the other hand, explains how learners construct meaning from multiple modes of representation, guided by three cognitive principles: dual-channel assumption, active processing, and limited capacity (Mayer, 2024). The theory emphasizes the importance of using multimedia learning tools, such as Interactive Whiteboards (IWBs), enabling learners to engage with content through visual and auditory modalities (de Silva et al., 2016). IWBs allow educators to present content using diverse media, including diagrams, text, sound, videos, and films, facilitating deeper comprehension through multimodal interaction.

3. Methodology

The current study followed a qualitative case study design (Creswell & Creswell, 2018). This design is more appropriate for studies exploring social or human phenomena. The current study explores Life Sciences teachers' needs and challenges in using IWBs for IK integration. Using purposive sampling (Cohen et al., 2017), 10 Grade 11 Life Sciences teachers from Johannesburg and Ekurhuleni from schools furnished with functional IWBs and more than two years of teaching experience were selected for this study. Semi-structured interviews followed by two lesson observations for each teacher were conducted for data collection. This data collection process enabled the researchers to gain elaborate and deeper insights

into Life Sciences teachers' challenges and needs when using IWBs for IK integration (Creswell & Creswell, 2018). Focus on the Integration of Technology Classroom Observation Measurement (FIT: COM) was used as a lesson observation protocol in conjunction with field notes to document the episodes that transpired amid the observations, especially how teachers employed IWBs when integrating IK.

Following Braun and Clarke's (2006) six-step approach, thematic analysis was used to analyze teachers' interview transcripts and lesson observation field notes. This method facilitated the identification of codes, themes, and patterns, ensuring a rigorous and systematic interpretation of the data. Dependability, confirmability, transferability, and credibility were employed to improve the findings' rigor, trustworthiness, reliability, and validity.

Different measures were implemented to ensure the study's compliance with the universal research ethical standards. Before data collection, the faculty of education ethics committee obtained an ethical clearance certificate (Sem-1-2024-084/10 May 2024). All the participants were informed about the study and requested to partake voluntarily without undue influence. Lastly, pseudonyms are used to protect the participants' confidentiality.

4. Research findings

The analysis of the findings led to the emergence of three themes in line with the study's research questions: 1. Life Sciences teachers encounter challenges when using IWBs to integrate IK and 2. Life Sciences teachers need to use IWBs to integrate IK. Each theme is discussed in detail below.

4.1. Life Sciences teachers encounter challenges when using IWBs to integrate IK

Findings from the semi-structured interviews revealed that Life Sciences teachers encounter numerous challenges when using IWBs to integrate IK. Teachers have raised concerns about learners' negative attitudes toward IK, particularly in the context of Life Sciences teaching. Xolani highlighted that learners often perceive IK as "traditional" and "outdated," knowledge deeming it irrelevant for inclusion in modern school curricula. This perception is especially pronounced in Life Sciences, a subject commonly associated with content grounded in Western scientific paradigms. He further noted that learners frequently question the relevance of IK by asking, "How is this relevant in 2024?" and subsequently lose interest in the topic. This indicates that, although teachers may be willing to integrate IK into their teaching, learners' dismissive attitudes can be a significant deterrent, potentially discouraging teachers from integrating IK into their lessons.

Another challenge teachers encounter is a lack of adequate professional development and training on using IWBs for IK integration. Khansani and Rendani pointed out that while they have received basic training on operating IWB, they have not been trained to use them specifically for IK integration. Coupled with this issue is that some teachers could not attend the workshops that GDE facilitated in the past. Nokuzola, one of the teachers, mentioned that due to workload, they could not make time to attend the limited training workshops that GDE facilitated on using IWBs as a tool for teaching and learning. Furthermore, Khensani also pointed out that *"we do not have proper training"*. In addition to teachers lack sufficient training, Xolani lamented that:

"Most teachers have minimal time, so they do not have enough time to attend the training because they have classes from 8 a.m until 4 p.m at noon."

This indicates that even though the GDE provided some workshops for teachers, some teachers were not able to attend due to time constraints, and those who attended did not benefit much, as the training took place after teaching when teachers were fatigued. Still, on training, teachers indicated that they have never received training on integrating IK using IWBs; they have only been trained on using IWBs. This means that teachers are unprepared to meaningfully and effectively use IWBs for IK integration.

Rendani further voiced that frequent power outages and poor internet connectivity in her school disrupted her use of IWBs when teaching. She mentioned that *"when load shedding strikes, that is it for us"*. Teachers also lamented the lack of teaching and learning materials that have IK-related content. Devika and Layla highlighted the lack of pre-existing materials such as textbooks, artifacts, and teaching aids. Teachers also further raised the issue of time constraints owing to the workload and teach-to-test pressure. Teachers said the following:

Devika: We cannot integrate IK because we are getting through the heavily assessed syllabus in the tests.

Themba: Our SMT is more concerned about us finishing the syllabus and making sure learners pass the assessments.

From the responses, teachers are not supported on IK and IWB integration. However, they are under pressure to finish the syllabus and ensure learning performs well in the assessments. This results in

teachers not integrating IK, which is often not assessed in Life Sciences. In addition, the time factor also comes in, as teachers need to focus more on teaching than searching for IK and IK-related resources.

The observed lesson also laid bare the challenges teachers encounter when using IWBs for IK integration in Life Sciences classrooms. Most of them showed a lack of digital skills to use IWBs, which indicates lacking professional development and training. For example, Layla only showed an image of an African lady brewing traditional African beer, while other teachers only mentioned this example for learners. Learners were not further engaged, and other multimedia elements of the IWB, such as simulations, videos, and audio recordings from IK-holders, were not explored. In addition, all the teachers used one example when teaching the topic of cellular respiration: traditional beer. This indicated that teachers lack examples of IK that they can integrate when teaching Life Sciences. In addition, this further confirms that teachers do not have guidelines from CAPS documents and textbooks at their disposal. As a result, teachers tend to rely on traditional teaching methods when integrating IK using IWBs.

4.2. Life Sciences teachers' needs in using IWBs to integrate IK

From the challenges teachers mentioned and experienced, it is clear that teachers need support from stakeholders such as GDE, DBE, SMT, and IK-holders to be proficient in using IWBs to integrate IK meaningfully. When asked about the support they needed, these are the teachers' responses:

Nokuzola: Schools should invite IK-Holders to share examples of IK that can be integrated into different topics.

Hunter: DBE should make more examples of IK available for teachers through CAPS documents and textbooks.

Rendani: We require more reliable school infrastructure with stable electricity and internet connectivity.

Themba: We need more collaborative opportunities as teachers to share best practices and strategies for using IWBs for IK integration.

Xolani also raised a most pressing need in line with the challenges raised by teachers: professional development and training from DBE and GDE are crucial. This support will enable teachers to be competent and confident in using IWBs effectively for IK integration. To sum up, teachers need support from various stakeholders such as colleagues, IK-Holders, SMT, DBE, and GDE. As mentioned by Themba, teachers need to create Professional Learning Communities (PLCs) for teachers to share best practices and examples of IK amenable for integration in different Life Sciences topics.

5. Discussion

The study's findings showed that most teachers encounter numerous challenges when using IWBs for IK integration. As such, these teachers need support from various stakeholders to mitigate and encounter these challenges for meaningful and effective Life Sciences teaching and learning. Teachers revealed they cannot access the necessary resources to help them integrate IK, such as textbooks, artifacts, and examples of IK. This aligns with a sentiment shared by de Beer and Whitlock (2009) that DBE has failed to provide teachers with clear guidelines to integrate IK. Also, Sitsha (2023) reported that teachers lack professional training on using appropriate teaching strategies when using technology to integrate IK. As a result, teachers often use traditional methods, such as sharing only one or two examples of IK (Cronje et al., 2015). This was also witnessed in this study, as teachers only used one example, IK, brewing traditional beer, by mentioning it or showing a static image. This indicated that teachers lack the knowledge of pedagogical content to integrate IK meaningfully.

Different scholars (e.g., Mokoena et al., 2021) have reported that when IWBs were installed in schools, teachers did not receive sufficient training on how to use them for teaching effectively. This claim corroborates the findings of this study, as many teachers lamented the lack of proper training on using IWBs. In addition, teachers have not received holistic training on integrating both IK and IWB when teaching. The challenges raised indicate that an intervention is required through support from various stakeholders. Edson and Govender (2021) recommended that teachers collaborate with IK-Holders to gain access to different IK amenable for integration, owing to teachers' lack of awareness of IK (Mkhwebane, 2024).

6. Implications, recommendations, and conclusions

Important findings of this study indicate that teachers encounter numerous challenges when they attempt to harness IWBs for IK integration; thus, urgent support is needed. Without support such as professional development and training on using IWBs to integrate IK, Life Sciences learners will continue to have less interest in the subject and perform poorly. In addition, teachers will continue to avoid using

IWB for IK integration. In contrast, others integrate IK as an 'add-on' by mentioning a few examples and showing static images to learners. If left unaddressed, all these challenges will cause the decolonization of our education system project to fail, especially in the 4IR era, where technology takes center stage in the classrooms. This study's findings have implications for in-service and preservice teachers' training on using IWBs to integrate IK meaningfully. This study recommends that teachers take the initiative to learn from each other through PLCs, where they will share best practices for IK integrating using IWBs. IK-holders should also share IK examples amenable to integration in Life Sciences teaching. Lastly, DBE and GDE should make technical support personnel available to assist teachers with technical issues.

References

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. https://psycnet.apa.org/doi/10.1191/1478088706qp063oa

Cohen, L., Manion, L., & Morrison, K. (2017). *Research methods in education*. Routledge.

Creswell, J. W., & Creswell. J. D. (2018). *Research Design: Qualitative, quantitative and mixed methods approaches* (5th ed.). SAGE Publications.

Cronje, A., De Beer, J., & Ankiewicz, P. (2015). The effect of an intervention programme on how science teachers view the nature of indigenous knowledge. In *Proceedings of ISTE International conference on mathematics, science, and technology education* (pp. 588-596). UNISA.

da Silva, C., Amorim, J. P., & Pereira, F. (2023). The integration of indigenous knowledge in school: A systematic review, Compare. *A Journal of Comparative and International Education, 1*(0), 1-18.

de Beer, J. C., & Whitlock, E. (2009). Indigenous knowledge in the life sciences classroom: Put on your de Bono hats! *The American Biology Teachers, 71*(4), 209-216. https://doi.org/10.1662/005.071.0407

De Silva, C. R., Chigona, A., & Adendorff, S. A. (2016). Technology integration: Exploring interactive whiteboards as dialogical spaces in foundation phase classrooms. *The Turkish Online Journal of Educational Technology, 15*(3), 141-150.

Department of Basic Education. (2011). *Curriculum and Assessment Policy Statement: FET phase, Life sciences*. South African Government Gazette.

Edson, M., & Govender, N. (2021). Creating Indigenous Knowledge Spaces in Physics Learning Environments: Postcolonial views and insights from high school physics teachers. *Universal Journal of Educational Research, 9*(9), 1628-1640. http://dx.doi.org/10.13189/ujer.2021.090903

Mavuru, L. (2022). Reimagining indigenous knowledge in a multicultural science classroom. *International Journal of Inclusive Education*, 1-17. https://doi.org/10.1080/13603116.2022.2127498

Mayer, R. E. (2024). The past, present and future of the cognitive theory of multimedia learning. *Educational Psychology Reviews, 36*(8), 1-25. https://doi.org/10.1007/s10648-023-09842-1

Mkhwebane, L. N. (2024). Life sciences teachers' integration of indigenous knowledge: A vision for making science classrooms culturally responsive. *EURASIA Journal of Mathematics, Science and Technology Education, 20*(8), em2483. https://doi.org/10.29333/ejmste/14859

Mokoena, M. M., Simelane-Mnisi, S., & Mji, A. (2021). Challenges and solutions for teachers' use of interactive whiteboards in high schools. *Universal Journal of Education Research, 10*(1), 36-47.

Nwokocha, G., & Legg-Jack, D.W. (2024). Reimagining STEM education in South Africa: Leveraging indigenous knowledge systems through the M-Show model for curriculum enhancement. *Journal of Social Sciences Research and Review, 7*(2), 173-189.

Odora-Hoppers, C. A. (2015). Think Piece: cognitive justice and integration without duress. *International Journal of Development Education and Global Learning*, 7(2), 88-101.

Selepe, K., Ramsaroop, S., & Carolin, A. (2022). Incorporating indigenous knowledge in the teaching of weather and climate in primary schools in KwaZulu-Natal, South Africa. *Journal of Geography Education in Africa, 5*(1), 1-25. https://upjournals.up.ac.za/index.php/jogea/article/download/3953/3724

Sitsha, M. (2023). *Exploring the Integration of Indigenous Knowledge (IKS) into the teaching of Life sciences through Information and Communication Technologies* (Master's Dissertation, North-West University).

Slay, H., Sieborger, I., & Hodgkinson-Willians, C. (2008). The use of interactive whiteboards to support the creation, capturing, and sharing of knowledge in South Africa. *Learning to Live in Knowledge Society, 281*(1), 19-26. https://doi.org/10.1007/978-0-387-09729-9_3

Steenkamp, J., De Beer, J., & Petersen, N. (2019). The conundrum of integrating indigenous knowledge in science curriculum themes: A review of different viewpoints. In *Proceedings of the 10th ISTE conference on Mathematics, science and technology education* (pp. 21-25).

Visvanathan, S. (1997). *A carnival for science: Essays on science, technology, and development*. Oxford University Press.