

TEACHERS' PEDAGOGICAL PRACTICES WHEN USING INTERACTIVE WHITEBOARDS FOR INTEGRATING INDIGENOUS KNOWLEDGE IN LIFE SCIENCES TEACHING

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Abstract

This study investigated Life Sciences teachers' pedagogical practices when using interactive whiteboards (IWBs) to integrate indigenous knowledge (IK) in Grade 11 teaching and learning. Guided by Cognitive Justice and the Cognitive Theory of Multimedia Learning (CTML), the study adopted a qualitative research design. 10 Life Sciences teachers were purposively selected from schools implementing IWBs in Johannesburg and Ekurhuleni metropolitan municipalities in Gauteng province of South Africa. Data were collected through classroom observations guided by the Reformed Teaching Observation Protocol (RTOP). The study addressed the research question: What pedagogical practices are employed by Life Sciences teachers when integrating IK using IWBs? Data were analysed thematically, allowing themes to emerge from the dataset. Findings revealed that although teachers valued the integration of IK using IWBs, their pedagogical practices were largely limited to displaying static images and videos rather than utilising interactive features to support meaningful engagement with IK. Additionally, teachers experienced challenges including limited IK-aligned digital resources, technical and infrastructural constraints and this showed lack of insufficient professional development. These challenges restricted the effective pedagogical use of IWBs for culturally responsive teaching. As such, this study recommends ongoing professional development focused on pedagogical integration of IK using IWBs, the development of IK-specific digital resources compatible with IWBs, and improved school infrastructure. Notably, the study was limited to a small qualitative sample within one province, which restricts generalisability. Therefore, future research should include multiple provinces and examine the influence of IK integration using IWBs on learner engagement and academic performance.

Keywords: *Life Sciences, qualitative research, cognitive justice, interactive whiteboards, indigenous knowledge.*

1. Introduction

The transformation of education in South Africa has renewed debates about what knowledge should be taught, whose knowledge should be recognised, and how such knowledge should be taught in classrooms. During the era of colonialism and apartheid, the education system largely privileged Eurocentric knowledge systems while marginalising African indigenous ways of knowing (Ndlovu-Gatsheni, 2013). In the democratic era, curriculum reforms were introduced that sought to address these injustices by promoting inclusive and contextually relevant education. Consequently, teachers were mandated through Curriculum and Assessment Policy Statement (CAPS) document to integrate Indigenous Knowledge (IK) into teaching and learning for curriculum decolonisation, particularly in Life Sciences (Department of Basic Education [DBE], 2011; Mavuru, 2025).

Life Sciences is a key subject through which learners engage with critical topics such as biodiversity, heredity, health and environmental sustainability. However, the subject is often taught through abstract and textbook-centred approaches that appear distant from learners' everyday experiences (Mkhwebane, 2024). Such approaches may reduce learner participation and make scientific concepts difficult to understand (de Beer & Whitlock, 2009). Therefore, integrating IK can address this challenge by linking scientific concepts to local practices, community experiences and culturally familiar examples (Mkhwebane et al., 2025 & Patel et al., 2026). Studies indicate that IK integration can improve relevance, motivation and conceptual understanding while also preserving valuable community knowledge systems (Kalolo, 2015; de Beer, 2019; Selepe et al., 2022). Despite these benefits, the classroom integration of IK remains inconsistent and frequently superficial (Cronje et al., 2015). Teachers often refer to IK through isolated examples rather than embedding it meaningfully into pedagogical practices such as inquiry, discussion, comparison of knowledge systems and learner-centred activities (Cronje et al., 2015; Sitsha, 2023). This suggests that the challenge is not merely the inclusion of IK in policy, but how teachers pedagogically implement it in practice.

Alongside curriculum transformation, South African schools have increasingly adopted digital technologies such as Interactive Whiteboards (IWBs) to improve teaching and learning. IWBs enable the use of text, images, video, annotation and interactive tasks, thereby creating opportunities for multimodal and learner-centred pedagogy (Mihai, 2020). In science education, these affordances are significant because they can assist teachers to explain complex or abstract biological processes and enhance learner engagement (Mokoena et al., 2021; Onder & Halil, 2016). Although IK integration and IWB use are often discussed separately, their intersection offers important pedagogical possibilities. Teachers can use IWBs to display indigenous plants, compare indigenous and scientific explanations, annotate cultural case studies, and facilitate learner presentations based on community knowledge.

In this way, IWBs may serve as a bridge between local knowledge and formal science learning while supporting culturally responsive pedagogy. However, the availability of IWBs does not automatically lead to effective teaching. Evidence suggests that teachers often use IWBs for projecting static notes, images or videos rather than using their interactive functions to deepen learning (Mihai, 2020). At the same time, limited research has examined how Life Sciences teachers use IWBs specifically to integrate IK in classroom practice. Consequently, little is known about the pedagogical practices teachers employ to promote meaningful engagement, and the challenges teachers experience when combining technology with IK integration. The problem addressed in this study, therefore, is the limited understanding of Life Sciences teachers' pedagogical practices when using IWBs to integrate IK in teaching and learning. As such this study investigated pedagogical practices employed by Life Sciences when using IWBs to integrate IK in teaching and learning.

2. Theoretical frameworks

This study was guided by Cognitive Justice and the Cognitive Theory of Multimedia Learning (CTML) developed by Visvanathan (1997) and Mayer (1997), respectively. On one hand, according to Visvanathan (1997) Cognitive Justice promotes the recognition and coexistence of multiple knowledge systems rather than privileging Western knowledge alone. In the South African context, Life Sciences has historically marginalised indigenous ways of knowing in favour of Eurocentric perspectives, thereby limiting epistemic inclusion and disadvantaging learners whose cultural knowledge is excluded (Odora-Hoppers, 2021; Lebowitz, 2017). Applied to this study, Cognitive Justice provides a lens for understanding the importance of integrating IK into Life Sciences teaching and learning as a means of promoting socially just, inclusive and contextually relevant pedagogy.

On the other hand, CTML explains that learners understand more effectively when information or content knowledge is presented through coordinated verbal and visual channels (Mayer, 2024). CTML is based on the principles of dual channels, limited cognitive capacity and active processing. This means learners learn better when they actively engage with well-designed multimedia resources that reduce overload and support meaning-making (Mihai, 2020). In this study, IWBs are relevant because they allow teachers to combine text, images, videos, sound and diagrams when teaching complex Life Sciences concepts and integrating IK.

The two frameworks complement each other in the current study. Cognitive Justice advocates that IK should be integrated by valuing marginalised knowledge systems, while CTML asserts that ICT tools such as IWBs can be pedagogically used to support meaningful integration of IK through interactive and multimodal teaching. Together, these frameworks enabled the study to investigate how teachers use IWBs not only as technological devices, but as pedagogical tools for meaningful, inclusive and engaging integration of IK in Life Sciences teaching.

3. Research methodology

The current study adopted a phenomenological qualitative case study design (Creswell & Creswell, 2018) to investigate the pedagogical practices employed by Life Sciences when using IWBs to integrate IK in teaching and learning. This design was deemed suitable for exploring classroom pedagogical practices within real-life teaching contexts and as experienced by teachers. Through purposive sampling (Cohen et al., 2017), ten Grade 11 Life Sciences teachers were selected from schools in the Johannesburg and Ekurhuleni metropolitan municipalities in Gauteng Province that were equipped with functional IWBs. Participants were required to have a minimum of two years' teaching experience and active use of IWBs in Life Sciences classrooms.

Data were collected and generated primarily through classroom observations, with two lessons observed for each participating teacher. All teachers taught cellular respiration, a complex and abstract topic in Life Sciences. Observations were guided by the Reformed Teaching Observation Protocol (RTOP) as developed and validated by Sawada et al. (2000), which enabled the researchers to examine learner-centred teaching practices, classroom interactions, instructional strategies and the pedagogical use of IWBs during IK integration. Field notes were also used to capture contextual details and critical incidents that occurred during lessons.

Data were analysed thematically using Braun and Clarke's (2006) six-step approach. This process involved familiarisation with the data, generation of initial codes, searching for themes, reviewing themes, defining themes and producing the report. Thematic analysis enabled the identification of recurring patterns related to teachers' pedagogical practices, opportunities and constraints in using IWBs for IK integration.

To ensure trustworthiness, the study considered credibility, dependability, confirmability and transferability. Ethical principles were strictly observed. Ethical clearance (Sem-1-2024-084/10 May 2024) was obtained from the relevant university ethics committee prior to data collection. Participation was voluntary, informed consent was secured from all participants, and anonymity was upheld to protect the selected teachers' identities and confidentiality.

4. Research findings

Lesson observations were analysed using the RTOP to investigate teachers' pedagogical practices when using IWBs to integrate IK in Life Sciences teaching and learning. Findings are presented according to key RTOP dimensions: lesson design and implementation, content knowledge, classroom culture, and technology-mediated learning.

4.1. Lesson design and implementation

Observed lessons showed that teachers attempted to align IWB use with curriculum objectives by incorporating the CAPS-recommended example of traditional beer fermentation when teaching cellular respiration. Most teachers used PowerPoint slides, images and short videos to illustrate fermentation processes. This suggests that teachers recognised the curriculum value of integrating IK and attempted to connect scientific concepts with learners' socio-cultural experiences.

However, lesson design remained largely teacher-directed and transmissive. IWBs were mainly used for presentation rather than for inquiry, collaborative tasks or problem-solving. Learners were seldom invited to analyse, question or extend the indigenous examples presented. For instance, although images of traditional beer production were displayed, teachers rarely asked learners to compare traditional fermentation methods with scientific explanations or to share community-based knowledge. These findings confirm concerns raised in the literature that IK is often included superficially as an "add-on" rather than embedded meaningfully into pedagogy (Cronje et al., 2015; Sitsha, 2023). From a Cognitive Justice perspective, IK was acknowledged but not sufficiently positioned as a legitimate source of classroom knowledge. From a CTML perspective, multimedia tools were used, but mostly for passive viewing rather than active processing of information.

4.2. Content knowledge and conceptual understanding

Teachers generally demonstrated sound subject knowledge of cellular respiration and correctly linked fermentation to anaerobic respiration. Lessons covered core CAPS concepts, indicating adequate disciplinary understanding. The integration of traditional beer brewing enabled some learners to relate abstract biochemical processes to familiar cultural practices. One learner's reference to family brewing practices illustrated how IK can support contextualised meaning-making. This finding aligns with previous studies showing that IK can make science concepts more accessible and relevant to learners lived realities (Kalolo, 2015; de Beer, 2019). It also supports the study's background argument that Life Sciences concepts are often perceived as abstract unless linked to local contexts. Nevertheless, teachers relied heavily on a

single IK example—traditional beer fermentation. Broader indigenous examples related to food preservation, medicinal processes or ecological knowledge were absent. This narrow use of IK limited opportunities for deeper conceptual comparisons and broader epistemic engagement.

4.3. Classroom culture and learner participation

RTOP observations also revealed limited learner agency during lessons. Classroom interactions were dominated by teacher explanations, while learners mostly listened, responded briefly, or copied notes. Learners were rarely given opportunities to operate the IWB, present ideas, or co-construct knowledge using technology. Although some teachers asked factual questions, few tasks promoted higher-order thinking, debate or learner-led inquiry. This indicates that the classroom culture remained predominantly teacher-centred despite the presence of interactive technology. Such findings echo literature arguing that access to technology alone does not transform pedagogy unless accompanied by learner-centred instructional practices (Mihai, 2020; Mokoena et al., 2021).

4.4. Technology-mediated learning

The IWB was primarily used as a display tool for slides, static images and videos. Its interactive functions—annotation, manipulation of objects, collaborative writing, simulations or learner-led presentations—were rarely utilised. Learners did not use technology for inquiry, data gathering, problem-solving or creative production. This suggests that while teachers valued IWBs, they lacked pedagogical strategies for meaningful technology integration. In terms of CTML, the presence of multimedia alone was insufficient. Effective multimedia learning requires active engagement, integration of visual and verbal information, and reduced cognitive overload (Mayer, 2024). Since lessons remained presentation-based, the pedagogical affordances of IWBs were not fully realised.

5. Implications, recommendations and conclusions

The study showed that although teachers value integrating IK using IWBs, their practices remain largely limited to displaying static images and videos rather than using interactive features for meaningful engagement. Teachers face challenges such as limited IK-aligned resources, inadequate training, and technical constraints, which result in superficial integration of IK and continued teacher-centred approaches in Life Sciences. This hinders learner engagement, weakens conceptual understanding in Life Sciences, and limits the potential of IWBs to support culturally responsive pedagogy.

The findings imply that meaning IK integration requires targeted professional development focused on pedagogical use of IWBs, development of IK-specific digital resources, and stronger technical and infrastructural support in schools. It also highlights a need for Professional Learning Communities (PLCs) and collaboration with IK holders to strengthen authentic integration.

In conclusion, the study reveals that without adequate support, IK integration using IWBs will remain superficial and underutilised, limiting both curriculum transformation and learner engagement in Life Sciences. Strengthening teacher capacity and institutional support is essential for achieving meaningful, technology-enhanced, and culturally responsive science education.

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