

THE ROLE OF IMPROVISED TEACHING MATERIALS IN THE TEACHING OF HUMAN REPRODUCTION IN GRADE 12 LIFE SCIENCES

Wiets Botes¹, Fokolentle Blennis²

^{1,2} Sol Plaatje University, Northern Cape Province, South Africa

Abstract. *The study explored the role of improvised teaching materials (ITMs) in enhancing the educational experience of the topic 'human reproduction' in a grade 12 life science classroom context. Set in a teaching resource-constrained school context in the Frances Baard district of the Northern Cape Province, South Africa, the study addresses life science educators' challenges in effectively presenting this complex topic. It is well-reported that ITMs, developed from low-cost and recyclable materials, offer an authentic and innovative solution for promoting learner engagement and understanding. Grounded in Kolb's Experiential Learning Theory, this qualitative case study describes how ITMs facilitate active, reflective and experiential learning through concrete activities, such as constructing models and conducting hands-on experiments. Empirical data collected through a focus group discussion with a sample of four life science educators yielded five key themes. Findings indicated that the use of ITMs 1) actively engages learners 2) accommodates diverse learning styles, 3) promotes learner understanding of abstract topics, 4) sparks learner motivation and interest. Despite these benefits, a fifth theme centred around constraints to the use of ITMs such as 5) time constraints, resource shortage and financial limitations to the use of ITMs. This study contributes to the scholarship of innovative pedagogies in the context of life science teaching, particularly in the context of rural education. Findings from the study offer insightful insights for educators, policymakers and curriculum developers.*

Keywords: *Improvised Teaching Materials; Life Science Education, Innovative Pedagogies; Experiential Learning.*

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Introduction

The teaching of the topic 'human reproduction' in the subject life sciences¹ at a secondary school level presents distinct challenges, particularly in presenting the topic to learners in a manner that is both engaging and accessible. Apart from the complex nature of the topic, some resource-constrained schools in the Frances Baard district in the Northern Cape Province are not equipped with traditional teaching materials such as charts, anatomical models and digital tools which are essential in capturing learners' attention and easing their learning process. It is for this reason that improvised teaching materials (ITMs) that are created from low-cost and recycled materials offer a promising alternative to promoting learners' understanding and engagement in a classroom context. Adewale and Osalusi (2018) are similarly of the view that ITMs serve as practical and cost-effective teaching tools that enable Life Science educators to present abstract topics in a relatable and interactive manner.

With the teaching of the topic 'human reproduction' in mind, ITMs come in handy in enabling teachers to simplify complex concepts related to the topic through the use of tangible representations using low-cost and recyclable materials. Scholars such as Maduabum and Odili (2014) add that such teaching innovation not only results in interactive learning but also aligns with eco-friendly teaching practices. Furthermore, the use of ITMs also encourages learner-

¹ The life sciences are made up of the sciences that study living things. Biology, zoology, botany, and ecology are all life sciences, for example.

centred learning since learners in the classroom participate in the development of the ITMs, thus prompting cooperative learning and design thinking and practical inquiry.

However, given these benefits towards the use of ITMs in the teaching of complex topics, several studies highlighted that teachers often lack the required training, knowledge and motivation to incorporate ITMs in their teaching in an effective manner (Omosewo, 2010). While some research has been conducted on the benefits of ITMs, little is known regarding the use of ITMs in the context of life science education at a secondary school level, particularly in the teaching of human reproduction. This research gap is particularly relevant in rural and under-resourced secondary schools in the Frances Baard District in the Northern Cape Province of South Africa. Mtshali and Lemmer (2016) remind us that rural and under-resourced secondary schools are faced with significant challenges, including poor classroom infrastructure and a lack of sufficient teaching resources and equipment. Others reported that limited opportunities for professional development for teachers to upskill their teaching methodology often result in teachers' over-reliance on traditional teaching methods that may not adequately cater for the diverse learning needs of learners (Maduabum & Odili, 2014).

The absence of research specific to the rural context of the Frances Baard district, specific to the Northern Cape, raises questions about how the use of ITMs might be beneficial in addressing the challenges raised. This lack of district-specific research highlights the need to explore the intersection between the use of ITMs and the learning process of the learner in the life science classroom. This qualitative case study will address this gap by exploring the role of ITMs in the teaching of the topic 'human reproduction' at a secondary school level at a particular school in the Frances Baard district. This research seeks to provide valuable insights into how life science educators can overcome resource-constraints challenges by making use of ITMs. Ultimately, the study contributes to the scholarship of innovative and inclusive life science teaching, particularly in the context of rural education.

Literature Review: Contextualising Improvised Teaching Materials in Life Science Teaching

Improvised Teaching Materials (ITMs) refer to creative, context-driven alternatives made from locally available resources to address the absence, inadequacy, or poor condition of standard instructional materials. These materials are designed to serve the same instructional purpose as conventional tools while fostering innovation and resourcefulness. ITMs encourage collaboration among teachers, learners, and local artisans, ensuring they align with lesson objectives and enhance teaching and learning (Ajayi, 2008 & Ibe, et al., 2021).

In Life Sciences education, ITMs are transformative solutions that enable active, inquiry-based learning despite resource constraints. They shift the classroom dynamic from teacher-centred to learner-centred approaches by engaging learners in creating, exploring, and applying materials. For instance, learners actively participate in constructing improvised Bunsen burners or lung models using balloons and plastic bottles. These activities promote critical thinking, problem-solving, and collaboration while sparking learner interest and motivation. ITMs are significant for diverse learning styles, providing visual, tactile, and experiential learning opportunities that deepen understanding of scientific concepts. They address learning barriers, making abstract processes—like cellular respiration or osmosis—tangible and relatable. Ultimately, ITMs align with constructivist pedagogical principles, helping learners connect theoretical knowledge with real-world applications, which is fundamental to Life Sciences education.

International research, particularly in Sub-Saharan Africa and South Asia, underscores the effectiveness of ITMs in resource-limited settings. Research by Bogador et al. (2024) and Daniela et al. (2015) shows that ITMs facilitate hands-on learning and inquiry-based strategies,

enhancing creativity, critical thinking, and deeper engagement among learners. While ITMs cannot completely replace conventional materials, they offer functional and contextually relevant alternatives, enabling teachers to deliver meaningful practical lessons despite resource shortages.

Nationally, studies in countries like Uganda (Altinyelken, 2010), Kenya (Githui, 2021), and Rwanda (Mushimiyimana et al., 2020) have demonstrated the value of ITMs in enhancing science education. These studies reveal that ITMs stimulate learner interest, improve retention of scientific concepts, and foster innovation and collaboration. For example, teachers noted that ITMs help alleviate the abstract nature of science subjects by promoting hands-on experiments and 3D visualization. Additionally, learner involvement in ITM creation develops critical life skills such as problem-solving and adaptability. However, the studies also highlight challenges such as misconceptions, time constraints, and the need for teacher expertise to ensure ITMs meet instructional goals.

Teachers play a central role in the successful use of ITMs in Life Sciences education (Kadir et al., 2023). They must exhibit creativity and resourcefulness in identifying suitable local materials and designing alternatives that meet learning objectives. Teachers act as facilitators, guiding learners in sourcing, developing, and using ITMs, ensuring that they align with curricular goals and promote meaningful learning. For instance, a teacher might collaborate with learners to construct plant models using locally available materials or guide them in creating improvised laboratory equipment for experiments. Learners are expected to take an active role in the development and application of ITMs. In Life Sciences, this involves contributing to the design, exploration, and use of improvised materials. For example, learners can participate in assembling an improvised Bunsen burner or constructing a model of the human heart using clay and recycled materials. Such engagement reinforces scientific concepts, enhances problem-solving skills, and fosters a sense of ownership and inquiry. Learners are encouraged to experiment, hypothesize, and evaluate the effectiveness of ITMs, aligning with inquiry-based learning and the scientific method.

The use of ITMs in Life Sciences offers several benefits (Narathon et al., 2024). They address resource shortages by providing cost-effective alternatives while promoting active participation, critical thinking, and creativity. ITMs make abstract concepts more concrete, catering to diverse learning styles and fostering hands-on experiences that enhance retention and understanding. For example, constructing plant models from banana stems or using balloons to simulate lung function brings Life Sciences content to life. However, ITMs also present limitations. Their development can be time-consuming and may delay curriculum coverage. Teachers must possess the necessary skills and creativity, as poorly designed ITMs can lead to misconceptions.

Additionally, improvised materials, such as homemade microscopes or lung models, may lack the precision and durability of standard equipment, potentially impacting the quality of learning. Financial constraints and the unavailability of suitable resources further challenge the production of effective ITMs. Despite these challenges, ITMs remain an invaluable tool for promoting inquiry-based, learner-centred learning in Life Sciences. By transforming resource constraints into opportunities, ITMs equip learners with essential scientific knowledge and skills while fostering innovation, adaptability, and lifelong learning.

Experiential Learning Theory as Theoretical Lens

The use of traditional teaching methods such as direct teaching often fails to fully engage learners with complex topics related to biological science such as ‘human reproduction’ (Roberts, 2019). Experiential Learning Theory, in this regard, provides a robust framework to provide a hands-on and interactive learning experience for learners to engage with challenging

topics in the classroom setting (Azeez & Aboobaker, 2024). One such example is through the use of improvised teaching models, which provide learners with the opportunity to engage with concrete teaching materials that facilitate the learners' concrete experiences to enhance educational engagement. Early work done by Kolb (1984) suggests that Experiential Learning Theory is underpinned by several learning experiences which are briefly unpacked next.

The first learning experience that feeds into the ELT is referred to as the 'concrete experience'. The concrete experience deals with learners engaging directly with the concrete models such as 'posters and three-dimensional models' in a physical and emotional manner (Morris, 2020). For example, the concrete learning experience can be stimulated when learners create models representing the physiological processes involved in human reproduction using materials such as clay, cardboard and fabric to craft models that represent organs such as ovaries, testes, uterus, and so forth. This hands-on activity helps learners visualize and understand the anatomy and spatial relationships between different reproductive organs. Recent studies, such as those by Aina (2013), explain that through practically engaging with ITMs, learners are able to gain a deeper understanding of the complex biological processes tied to human reproduction. This allows for the learning process to be made more tangible.

Secondly, Experiential Learning Theory also makes provision for what Kolb (1984) refers to as 'reflective practices'. Brookfield (2017) reminds us that reflective practices are essential for consolidating learning by drawing on their own experiences, considering what they engaged with and learnt during the concrete learning experience. In other words, reflective practices enable learners to integrate their experiences with ITMs into a broader understanding of the intricate biological and anatomical processes underpinning human reproduction. For example, after engaging with the ITMs, learners can be tasked to draft a reflective journal to document their learning experiences. One other way could be for the learners to engage in a classroom discussion after working with the ITMs. This approach allows them to obtain a deeper understanding of the concepts covered during the lesson (Azeez & Aboobaker, 2024).

In the third instance, Kolb's Experiential Learning Theory also advocates for 'abstract conceptualization' (Kolb, 1984), where the observations and engagements that the learners had with the ITMs are now linked to learners' better understanding and conceptualisation of the anatomical processes related to human reproduction (Brookfield, 2017). During the abstract conceptualisation experience, learners would typically use their hands-on and practical experiences to form a structured understanding of the anatomical processes related to human reproduction (Huang et al., 2020). This process in itself results in them being problem solvers and critical thinkers. For example, learners can actively engage in a concept mapping exercise after engaging with the ITMs. This will allow them to make concept maps of the various aspects of human anatomy and the physiological processes involved in human reproduction. For instance, the learners might connect diagrams of the reproductive system with processes like gametogenesis, fertilization, and gestation, highlighting the stages and interactions at a cellular level. This approach allows them to have a more concrete understanding of the topics at hand.

Finally, Kolb's Experiential Learning Theory makes provision for 'active experimentation'. In the context of life science education, active experimentation will typically be encountered where the learners are tested on whether they can respond to case studies and structured questions that challenge their understanding of anatomical processes related to human reproduction. For example, learners can be tasked to simulate an experiment to demonstrate how hormones are released during the process of human reproduction by explaining how chemical reactions stimulate hormonal changes during reproduction. Another example underpinned by active experimentation entails learners engaging in a simulated experience where they participate in a doctor-patient role-playing scenario discussing reproductive health. During this scenario, the doctor should make use of the ITMs to diagnose, discuss and advise health issues based on their understanding of human reproduction. This

approach promotes empathy and communication skills among learners since they apply their knowledge of processes related to human anatomy in a social space (Morris, 2020).

Experiential Learning Theory assists with learners' deeper understanding and retention of complex biological concepts. Looking back at all four learning experiences, it is safe to say that the Experiential Learning Theory is essential in deepening learners' understanding of complex topics, such as anatomical processes related to human reproduction, through concrete observations, reflective practices, abstract meaning-making and active experimentation. This approach in itself enables teachers to teach topics in a more transformative manner by boosting learner engagement in the classroom, prompting inclusive and accessible learning.

Methodology, Data Collection and Procedures

The study adopted a qualitative research approach. The sample of participants included that of 4 teachers with more than 10 years' experience in life science teaching at a purposively selected school in the Frances Baard District of the Northern Cape Province. These teachers were selected based on their vast experience and close proximity to the researcher. Given this purposive sample, the study also adopted an intrinsic case study research design that centred around their reflective accounts on the use of ITMs in the teaching of the topic 'human reproduction' at a secondary school level. Aspects related to data collection and procedures are briefly described below. The aspects of the research methodology and approach are briefly described below.

For this study, a focus group discussion was used to capture the reflective accounts of the four Life Science teachers on the role of ITMs in the teaching of human reproduction at a secondary school level. The focus group discussion took place after the teachers' teaching experience with ITMs. A characteristic feature of a focus group discussion is that it allows for the sharing of rich verbal data through open dialogue between the researcher and the participants (Bruggeman et al., 2021). The use of a focus group discussion allowed the 4 teachers to provide a reflective account on how they perceived the role of ITMs in their teaching. It should be noted that the focus group discussion was informed by several open-ended questions that aligned to the focus of the study. These questions were designed to elicit detailed responses on various aspects of ITMs, including the teachers' understanding of these materials, their views on their use in Life Sciences (LS) education, and the roles both teachers and learners play in utilizing them. The teachers were also asked to provide examples of how they have used improvised materials in their lessons and to reflect on the potential constraints and shortcomings of these materials in LS teaching. By posing these questions to the focus group, the four teachers were able to share rich verbal data that were thematically grouped.

Methodological rigor in the study was ensured by drawing on measures such as "confirmability", "credibility" and "neutrality" (Hirose & Creswell, 2023). The aspect of confirmability was assured through the element of open dialogue that was reflected between the 4 Life Science teachers and the researchers during the focus group discussion. The measures of "credibility" and "neutrality" were ensured through the prolonged interactive engagement with the four Life Science teachers in the afternoons after school. Finally, all findings were shared with the participants to ensure that the empirical data was an accurate representation of their reflective accounts.

Findings

This study examined the role of ITMs in the teaching of human reproduction to Grade 12 learners at the secondary school level. The focus group discussion yielded five key themes that respond to the role of ITMs in the teaching of human reproduction, highlighting their

influence on pedagogical effectiveness, learner engagement, and knowledge retention. These five themes included four that highlighted the *advantages* of using ITMs in the instruction of human reproduction: (1) the use of ITMs as a teaching method to actively engage learners in the learning process, (2) ITMs as a teaching approach materials to accommodate learners learning styles, (3) the enhancement of conceptual understanding of life sciences through the use of such materials, and (4) the strategic role of teachers in cultivating motivation and sparking interest by integrating ITMs into their lessons. The fifth and final theme focused on the (5) constraints of using improvised teaching materials in teaching human reproduction. These themes are described next.

Theme 1: ITMs as a method to elicit active engagement

The first primary advantage identified by teachers during the focus-group discussion regarding the use of improvised teaching materials, particularly in the context of human reproduction instruction, is its influence on promoting *active learning* in the classroom. This can be found in the following verbal responses below:

These materials allow me to engage my learners in a variety of ways. The method not only makes the learning of the subject more engaging but also encourages curiosity and innovative thinking.

Participant 1

Improvised materials discourage cramming and bring theory into practicality. They can also be made to be relevant to the learner's cognitive level. In life science, these materials encourage kinaesthetic learning.

Participant 3

My general opinion on improvised teaching materials is positive, because...they are helpful tools that provide learners with a more active and interesting context. These resources help to provide a more advanced understanding of the living sciences as a subject.

Participant 4

All three participants' responses confirm a shared understanding that improvised teaching materials foster an active learning environment. Phrases such as “...*the method not only makes the learning of the subject more engaging but also encourages curiosity and innovative thinking...*” and “...*they are helpful tools that provide learners with a more active and interesting context...*” highlight the teachers' perception that improvised materials serve as effective teaching aids. These materials not only enhance learner engagement but also stimulate curiosity and promote innovative thinking, thus creating a dynamic and interactive learning environment.

Theme 2: ITMs as a method to accommodate learners' diverse learning needs

The second key advantage identified by teachers regarding the use of improvised teaching materials is their inherent ability to address and support a variety of learning styles. The responses within the focused group discussion confirmed that indeed ITMs serve as a teaching aid used to break down complex concepts into smaller, manageable parts, tailored to suit each learner's unique learning style. This can be confirmed by Participant 3 who mentioned that “...*these materials encourage kinaesthetic learning...*”

In addition, both Participant 1 and Participant 2 expressed how these teaching aids promoted inclusivity by catering to the varied learning styles and needs of learners, regardless of their preferred learning approach, when they mentioned that:

“...these resources make the content of life sciences to be broken down easily to the learners by making it more accessible and relevant to the learners.

Participant 1

“.....improvisation makes the subject matter to be much easier and understandable.

Participant 2

Phrases such as “*broken down easily,*”, “*much easier,*” and “*encourage kinaesthetic learning*” provide evidence that improvised teaching materials effectively accommodate learners' diverse learning styles. Additionally, the term “*understandable*” further supports the

idea that learners acquire information in different ways. Participant 1's response "...*the method not only makes the learning of the subject more engaging, but also encourages curiosity and innovative thinking...*", highlights that, through "innovative thinking", learners can independently acquire new knowledge by utilizing these materials, without relying solely on direct instruction from the teacher. This suggests that improvised materials serve as valuable teaching aids, enabling learners to explore and discover the best methods for acquiring information. The unanimous responses from participants underscore how these materials facilitate the process of making information more accessible and comprehensible for learners

Theme 3: ITMs as a method to enhance learners' conceptual understanding of complex topics

The third key advantage highlighted by teachers in using improvised teaching materials, particularly for teaching human reproduction within the Life Sciences, is their remarkable ability to enhance learners' conceptual understanding, aligning with the principle of stimulation. During the focus group discussion, it became evident that ITMs provide dynamic, context-specific resources that not only promote active learner engagement but also deepen comprehension of complex biological concepts. By fostering a more interactive and experiential learning environment, these materials encourage critical thinking and contribute to the sustained retention and application of essential scientific principles. This can be witnessed in the following response:

These resources help to provide a more advanced understanding of the living sciences as a subject.

Participant 4

The aspect of conceptual understanding was also evident from the responses provided by Participant 1:

I realised that when I make use of this teaching approach, where learners learn through doing, it enhances their understanding of Life Sciences content by promoting practical skills, creativity, and active learning.

Participant 1

An analysis of the responses provided by participants 1 and 4 serves as evidence that improvised teaching materials enable learners to achieve a deeper and more nuanced understanding of the subject matter by enhancing both the clarity and depth of their comprehension, thereby facilitating a more thorough grasp of the underlying concepts. In addition, participant 5 provided a detailed description of how improvised materials enhance learners' level of understanding by "*promoting practical skills, creativity, and active learning*".

Theme 4: ITMs as a method to motivate and spark learner interest

The fourth theme addressed the principle of curiosity, emphasizing how these materials enhance learner motivation and engagement. This in turn promotes active participation, aligned with the principle of active learning and cultivates sustained interest in the subject matter. From the focus group discussion, it became apparent that teachers use these materials not only to guide learners as facilitators in the learning process but also to stimulate higher-order thinking skills by motivating learners and fostering their interest in the subject content. Evidence of how ITMs are used by teachers to motivate, and spark interest is reflected in the following response:

"...my role is to be aware of my learners' needs, relate resources with curricular goals, and encourage fresh ideas during teaching and learning. Involve learners in the design of materials, use effective assessments, and be adaptable. This has to do with instead of developing the improvised teaching materials I should also involve the learners in creating them"

Participant 2

A closer examination of Participant 2's response reveals the pivotal role of ITMs in stimulating curiosity through active learner involvement. The emphasis on phrases such as "*Involve learners in the design of materials*" and "*encourage fresh ideas*" illustrates the significance of co-creation in education. This proof highlights the powerful ability of ITMs to

transform the education approach from passive reception to active, learner-centred exploration, confirming their importance in today's teaching methods.

Theme 5: Shortcomings associated with the use of ITMs

The fifth and final theme highlights the various constraints that restrict teachers from fully utilizing ITMs in life sciences education. Insights from the focus group discussion revealed several critical challenges associated with ITMs, including time constraints, misconceptions, resource shortages, financial limitations, curriculum delays, safety risks, lack of durability, and inadequate coverage of subject content. Evidence of these constraints is reflected in the following response:

Using improvised materials takes too much time because of the preparations and involvement of learners especially when learners are not cooperative.... a lack of funds to purchase some materials e.g. paper for making posters or making copies of learning documents.

Participant 1

The main and major constraints may be the danger of materials used, and it is also time-consuming to get some of the materials, maybe outside the premises or go and buy them yourself. Sometimes you are supposed to do that within a certain stipulated duration and by then you don't have money to do it. When you postpone then you'll also fall behind with curriculum coverage...

Participant 2

Jeez..., these materials are time-consuming, especially when you are not that creative. They take a lot of time when presenting a lesson since they lead to one not finishing the lesson of the day, especially when learners work in groups to create posters. They sometimes lead to misconceptions and display partial information, like... uhm... not presenting everything that needs to be covered on the ATP, resulting in one having to go back and teach certain concepts and falling behind with ATP as a result.

Participant 3

They also take a lot of time when preparing them and implementing them.

Participant 4

All participants consistently identified time constraints as a significant barrier to the development and use of Improvised Teaching Materials (ITMs). The process of sourcing, preparing, and implementing ITMs is notably time-intensive, often leaving teachers feeling overwhelmed and discouraged from incorporating them into their lesson plans. This challenge is exacerbated when faced with uncooperative learners or the pressure to meet curriculum coverage deadlines. Phrases such as “when learners are not cooperative,” “fall behind with curriculum coverage,” “Jeez..., they lead to one not finishing the lesson of the day,” and “they also take a lot of time when preparing them” illustrate the frustration experienced by teachers. The time required for the preparation of ITMs not only affects the completion of daily lessons but also contributes to delays in overall curriculum delivery.

The second constraint identified by all focus group participants regarding the use of improvised teaching materials during teaching and learning is that, if not developed properly, these materials can lead to misconceptions.

These materials can affect the validity of the results, especially when one uses improvised beakers, or measuring cylinders to conduct a certain investigation.... Lack of funds to purchase some materials...

Participant 1

They sometimes lead to misconceptions and display partial information, like... uhm... not presenting everything that needs to be covered on the ATP, resulting to one having to go back and teach certain concepts and falling behind with ATP as a result.

Participant 3

Shortcomings that might occur include limitations in representing science concepts. They are also expensive.... this results to one having to use your own pocket money to

create and develop another one with colour because in our school we do not have colour ink.

Participant 4

An analysis of the responses provided by all participants reveals that improvised teaching materials (ITMs) can contribute to a lack of subject content knowledge, often because of misconceptions. This claim can be supported with phrases such as “*these materials can affect the validity of the results*”, “*these materials can lead to lack of subject content information*”, “*they sometimes lead to misconceptions and display partial information*”, and “*limitations in representing science concepts*”. The aspect of lack of resources due to financial constraints was also one of the frequently mentioned shortcomings of using improvised teaching materials, as highlighted by the participants.

Sometimes you are supposed to do that within a certain stipulated duration and by then you don't have money to do it.

Participant 2

This claim is supported by Participants 1, 2 and 4, who expressed: “*lack of funds to purchase*” and “*you don't have money to do it.*” These statements illustrate the financial difficulties faced by schools. When a teacher mentions, “*one does not have money,*” and “*one having to use your own pocket money*” it suggests that they had sought assistance from the school, but the institution was unable to meet this need.

In addition, improvised teaching materials have been identified as hazardous due to their lack of durability, which can lead to safety risks in the classroom. The degradation or breakdown of materials over time makes them unreliable, potentially resulting in accidents or injuries during lessons. One of the primary constraints highlighted by Participant 2 is the danger posed by these materials. When not properly constructed or maintained, ITMs can introduce serious safety concerns for both teachers and learners. Participant 4 further elaborates on this issue, stating, “*Some materials might not be 100% safe to use, such as improvised beakers, especially when they are not heat-resistant*”. This indicates that, without appropriate specifications or safety measures, such materials could fail during practical activities, leading to hazardous situations, particularly when exposed to high temperatures in experiments involving heating elements or chemicals.

Discussion of Findings

Despite the expectation for Grade 12 learners to master complex Life Sciences topics, such as human reproduction, recent reports indicate poor national performance, particularly in the Northern Cape Province, as reflected in mid-year and final exam results (Department of Basic Education, 2022:6). This issue is further highlighted by the Frances Baard district's ranking of fourth out of five districts in Life Sciences performance (Department of Basic Education, 2022:10). The persistent underperformance in this topic underscores the need for innovative teaching approaches to address the challenges learners face. This study investigates the potential of improvised teaching materials in enhancing the teaching of human reproduction in Grade 12 Life Sciences.

With this argument in mind, this paper recognises the need to explore the role of improvised teaching materials in the delivery of human reproduction content. It aims to provide a comprehensive analysis, considering not only the advantages these materials offer in enhancing learner engagement and understanding but also the constraints that may hinder their effective implementation in the classroom. To achieve this aim, a qualitative case study was conducted with four purposively selected life science teachers from a local secondary school in the Frances Baard District, Northern Cape Province, South Africa. The participants were chosen based on their experience in teaching the subject of life sciences at a senior level.

To collect data, the study employed a focus group discussion to explore how life science teachers perceive the role of improvised teaching materials in their instruction of physiological

processes related to the human reproduction topic. The focus group discussion facilitated an open exchange of ideas, encouraging a rich dialogue on the teachers' use of ITMs in their teaching approach. From this discussion, verbal data was collected that centred around 5 themes such as “ITMs eliciting active engagement” “ITMs accommodating learners’ diverse learning needs” “ITMs enhancing learners’ conceptual understanding of complex topics”, “ITMs motivating and sparking learner interest” and “shortcomings associated with the use of ITMs”.

In the first instance, the teachers reported how their use of ITMs elicited active engagement amongst the learners during their teaching of physiological processes related to human reproduction. This is supported by responses such as *“the method not only makes the learning of the subject more engaging but also encourages curiosity and innovative thinking, “these materials encourage kinaesthetic learning” and “they provide learners with a more active and interesting context.... advanced understanding of the living sciences as a subject”*. These feelings expressed by experienced life sciences teachers resonate well with the outcomes of the use of ITMs in teaching human reproduction content. Mbotto et al. (2011) explained that ITMs foster active learner engagement, enabling teachers to implement interactive strategies that promote collaborative learning experiences. Okafor (2015) adds that improvised teaching materials are not only considered adequate but also highly relevant, as they equip learners with essential knowledge, skills, and character necessary for optimal academic performance.

In the second instance, it was also reported how the use of ITMs accommodated learners’ diverse learning needs during their teaching of physiological processes related to human reproduction. Phrases such as *“...these materials encourage kinaesthetic learning...” (participant 3); “these resources make the content of life sciences to be broken down easily to the learners by making it more accessible and relevant to the learners” (participant 1) and “...makes the subject matter to be much easier and understandable” (participant 2)*, resemble the accommodation of diverse learning style. Fujii (2019) highlights the importance of structuring the Life Sciences curriculum to address the diverse needs of learners effectively. In contrast, Pajo (2017) advocates for the use of manipulatives as a form of ITMs, emphasizing their ability to facilitate hands-on exploration that engages all five senses. This approach not only fosters active learning but also enhances cognitive engagement, making it a valuable strategy for improving learner outcomes.

In the third instance, it was reported how the use of ITMs enhanced learners’ conceptual understanding of complex topics during their teaching of physiological processes related to human reproduction through responses such as *“...it enhances their understanding of Life Sciences content by promoting practical skills, creativity, and active learning” (participant 1) and “these resources help to provide a more advanced understanding of the living sciences as a subject” (participant 4)*. These responses correspond with the view of Zondi and Ramaila (2020) who emphasize that this integration significantly enhances pedagogical content knowledge, particularly for the teacher. As a result, possessing a heightened level of pedagogical content knowledge allows teachers to make the subject matter more intellectually accessible to learners, facilitating deeper understanding and engagement. The underlying principle is that improvised teaching materials make learning more concrete, relevant, immediate, and lasting. Specifically, when applied in the teaching of life sciences, these materials provide meaningful platforms to demystify abstract scientific concepts, making them more tangible and easier to grasp.

In the fourth instance, it was reported how the use of ITMs motivates and sparks learner interest during their teaching of physiological processes related to human reproduction. Participant 2’s statements, such as *“Involve learners in the design of materials” and “encourage fresh ideas,”* serve as evidence of the principle of curiosity. These responses highlight how engaging learners in the creation and exploration of learning resources can

stimulate their intellectual curiosity, fostering a more evolving and participatory learning environment. Improvised teaching materials plays a key role in increasing learner engagement and interest in learning (Abdu- Abdu-Raheem & Oluwagbohunmi, 2015).

Finally, teachers could also report on some restricting factors associated with the use of improvised teaching materials (ITMs). One of the main factors identified was time constraints. This limitation emerged as a significant challenge, underscoring its role as a critical barrier to the effective implementation of ITMs. Phrases such as “*when learners are not cooperative*” (participant 1), “*fall behind with curriculum coverage*” (participant 2), “*jeez..., they lead to one not finishing the lesson of the day*” (participant 3), and “*they also take a lot of time when preparing them*” (participant 4), serves as evidence that indeed the utilizing of improvised teaching materials takes a lot of time when one makes use of them during teaching and learning. These responses are consistent with Stephen's (2015) assertion that time constraints may arise from a lack of creativity in instructional material development, which is often a consequence of insufficient professional training (Achimugu & Onojah, 2017).

The unavailability of teaching resources due to financial constraints faced by the school was also identified as a limiting factor that prevents teachers from utilizing improvised teaching materials in the teaching of Life Sciences (LS). Responses such as “*lack of funds to purchase some materials...*” (participant 1), “*by then you don't have money to do it*” (participant 2) and “*...one having to use your own pocket money...*” (participant 4) reflect this challenge. Folorunso (2019), examines the issue of insufficient funds, linking it to the constraints imposed by inadequate school budgets. The underlying concern is that if the financial crisis persists and remains unaddressed, school leaders may struggle to fully support teachers in acquiring the necessary materials for improvisational teaching methods. As a result, learner performance may continue to decline, as teachers appear to be losing interest in developing these materials. This is evidenced by statements such as, “*they are expensive... this results in one having to use your own pocket money.*” (participant 4).

In addition, curriculum delays and inadequate coverage of subject content are critical barriers hindering the effective use of ITMs in life sciences teaching. Participants emphasized that the time required to plan, create, and implement ITMs often disrupts the Annual Teaching Plan (ATP) pacing, resulting in content being postponed or omitted. For example, Participant 2 noted that delays cause teachers to “*fall behind with curriculum coverage,*” while Participant 3 expressed concerns about “*not presenting everything that needs to be covered,*” which necessitates revisiting concepts and exacerbates time constraints.

Moreover, concerns were raised regarding the accuracy and comprehensiveness of ITMs. Improvised materials, while resourceful, may lack the precision required to fully represent scientific concepts. Participant 3 highlighted the risk of “*lack of subject content information,*” while Participant 4 pointed to their “*limitations in representing science concepts.*” These reflections underscore the critical role of subject content knowledge in life sciences teaching. Comprehensive content mastery equips teachers to effectively integrate ITMs without compromising the integrity of scientific knowledge. It ensures that learners receive accurate and meaningful instruction while fostering deeper conceptual understanding and engagement with the subject matter. Ultimately, while ITMs have the potential to enhance life sciences education by encouraging creativity and active learning, their successful use requires careful consideration. Teachers must balance innovation with curriculum demands and ensure that improvised materials uphold the rigour and accuracy necessary for effective science teaching.

Conclusion

This study examined the reflective accounts of four life science teachers on the role of ITMs in the teaching of human reproduction at a secondary school level. Grounded in Kolb's experiential learning theory, the findings emphasized the significance of active, reflective and hands-on learning encounters. The integration of ITMs provided learners with opportunities for concrete experiences, reflective observation, abstract conceptualization, and active experimentation, which collectively deepened their understanding of complex scientific concepts. Through hands-on activities such as constructing models and conducting experiments, learners actively engaged with the content, fostering critical thinking, problem-solving skills, and the ability to apply knowledge in practical contexts. These active learning encounters enabled learners to synthesize practical and theoretical knowledge, promoting deeper conceptual understanding and cognitive engagement.

Teachers highlighted how ITMs served as catalysts for sparking learner interest and curiosity, transforming traditional, teacher-centred instruction into interactive, learner-centred experiences. Learners became co-creators of knowledge, actively participating in collaborative learning environments where they explored, experimented, and reflected on scientific principles. This process not only supported content mastery but also encouraged the development of essential skills such as creativity, teamwork, and metacognition, which are fundamental for lifelong learning. Additionally, the experiential nature of ITMs enabled learners to connect abstract concepts to real-world contexts, making learning more meaningful and accessible.

However, the study also revealed challenges that teachers faced when integrating ITMs into their instructional practices. Reported limitations included time constraints, resource shortages, financial limitations, and curriculum delays, which often hindered the effective implementation of ITMs. Teachers also expressed concerns about potential misconceptions, safety risks, and the lack of durability of improvised materials. Despite these shortcomings, the findings underscore the pedagogical value of ITMs in overcoming resource barriers and promoting active, experiential learning.

This study contributes to the growing body of knowledge on the use of ITMs in life sciences education, demonstrating their potential to enhance the teaching and learning of complex physiological processes. By critically analyzing both the benefits and constraints, the study offers practical insights for teachers, policymakers, and curriculum developers. The findings highlight the need for targeted professional development to equip teachers with the skills to effectively design and implement ITMs, as well as the importance of addressing systemic challenges, such as resource limitations, to maximize the impact of ITMs on learner outcomes. Ultimately, the integration of ITMs aligns with innovative, learner-centred pedagogies that foster deeper conceptual understanding, critical thinking, and scientific inquiry—skills that are essential for success in the study of Life Sciences and beyond.

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