



Assimilation: Indonesian Journal of Biology Education

ISSN 2621-7260 (Online)

Journal homepage: <https://ejournal.upi.edu/index.php/asimilasi>



Challenges experienced by grades 10-11 teachers when preparing and conducting biology practical work in Ondobe Circuit, Ohangwena Region, Namibia

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ARTICLE HISTORY

Received: 30 September 2025

First Revised: 23 November 2025

Accepted: 29 November 2025

First Available Online: 30 November 2025

Publication Date: 30 November 2025

KEYWORDS

Biology education

Science teachers' challenges

Social cognitive theory practical work

Resource constrained classroom

ABSTRACT

Practical work plays a vital role in science education by fostering inquiry, conceptual understanding, and learner engagement. However, in resource-limited contexts, teachers face persistent challenges in implementing effective hands-on learning. This study explored the barriers encountered by Grade 10–11 Biology teachers in the Ondobe Circuit, Ohangwena Region of Namibia, when preparing and conducting practical lessons. A qualitative case study design was employed. Four Biology teachers were purposively selected from nine schools offering the subject. Data were collected through classroom observations, semi-structured interviews, and document analysis, and analysed thematically using Bandura's Social Cognitive Theory, particularly the Triadic Reciprocal Causation model. Results revealed multiple constraints, including inadequately equipped laboratories, scarcity of consumable materials, limited time for lesson preparation, and inconsistent safety practices. Many teachers relied on demonstration-based approaches, which reduced learner participation and skill development. Additionally, teachers exhibited gaps in pedagogical content knowledge, particularly in aligning practical activities with syllabus objectives and assessment standards. These challenges hinder learners' mastery of practical competencies and contribute to weak examination performance. The study underscores the need for targeted professional development, improved laboratory resourcing, and sustained institutional support to enhance the quality of practical science instruction in schools.



INTRODUCTION

Practical work is widely recognised as a cornerstone of science education, providing learners with opportunities to engage directly with natural phenomena and scientific inquiry. Through hands-on investigations, students develop essential skills such as critical thinking, problem-solving, and data interpretation, which are fundamental to scientific literacy (Osuafor & Amaefuna, 2016; Wei & Liu, 2018). Recent studies further confirm this, demonstrating that shifting from traditional methods to guided inquiry-based laboratory activities significantly enhances students' science process skills compared to rote learning (Chengere et al., 2025). Meaningful engagement in laboratory and field activities not only enhances conceptual understanding but also promotes positive attitudes toward science learning (Akuma & Gaigher, 2021). For these reasons, many curricula globally emphasise practical instruction as an integral component of science teaching and assessment. In Namibia, the Namibia Senior Secondary Certificate Ordinary (NSSCO) Biology syllabus explicitly requires learners in Grades 10–12 to be assessed on experimental and investigative competencies through Paper 3, an Alternative to Practical examination (National Institute for Educational Development [NIED], 2018). This underscores the curricular expectation that learners should acquire authentic experiences in planning experiments, collecting and interpreting data, and applying scientific reasoning.

Internationally, the integration of practical work into science education has long been valued, dating back to the 18th century when experiential learning was first formalised as a pedagogical principle (Wei & Liu, 2018). Practical activities have been shown to foster higher-order cognitive abilities such as analysis, synthesis, and evaluation, which are essential for developing scientific literacy. However, recurring barriers to effective implementation persist worldwide. For instance, studies in Nepal have reported inadequate laboratory facilities, shortages of consumable materials, and limited teacher competence in practical instruction (Koirala, 2019). Rahman et al. (2025) reinforces this, finding that structural constraints such as inadequate facilities continue to force teachers into rigid, teacher-centred practices, which ultimately limits students' independent experimentation. These global findings suggest that despite widespread recognition of the value of practical work, its implementation remains constrained by structural and pedagogical challenges.

Across the African continent, the successful enactment of practical work continues to be hindered by systemic constraints, including limited laboratory infrastructure, teacher under-preparedness, and overcrowded classrooms. In Ethiopia, the absence of dedicated laboratory spaces and equipment has restricted the frequency and quality of practical activities (Daba et al., 2016). In Nigeria and South Africa, poor pedagogical content knowledge, low learner motivation, and inadequate resources have collectively undermined learner-centred approaches (Aveni, 2021; Onyedikachi & Onukwube, 2022; Kibirige & Maponya, 2021). These studies reveal a continental trend where practical work is valued in theory but inconsistently practised due to contextual limitations.

In Namibia, the implementation of practical work in Biology is mandated by national curriculum policy, yet learner outcomes indicate persistent underperformance. Examiners' reports from 2020 to 2023 show that many candidates score below 30 marks in Paper 3, revealing weak mastery of experimental and investigative skills (Ministry of Education, Arts and Culture [MoEAC], 2023). Empirical studies further confirm that while teachers acknowledge the importance of practical work, many rely on theoretical instruction due to shortages of apparatus, overcrowded classrooms, and limited institutional support (Nghipandulwa et al., 2020). Despite these insights, little is known about the specific challenges teachers face during the planning and execution of Biology practical lessons, especially in rural and under-resourced regions.

The Ohangwena Region provides a pertinent case study: in 2022, only 20.79% of candidates achieved A–C symbols in Biology, ranking the subject 11th out of 20 regional subjects. Yet, no research has systematically explored the concrete challenges encountered by teachers in circuits

such as Ondobe, where schools are characterised by limited resources and large class sizes. Addressing this gap is essential for strengthening the quality of science education and ensuring that curricular intentions translate into effective classroom practice. Although the Namibian curriculum emphasises practical competencies as central to Biology learning and assessment, many teachers struggle to prepare and conduct meaningful experiments due to contextual constraints. Prior studies have focused primarily on teachers' perceptions rather than on the actual processes and barriers they face during lesson implementation. This study therefore seeks to examine the challenges encountered by Grade 10–11 Biology teachers in preparing and executing practical work in the Ondobe Circuit of Ohangwena Region. By situating the Namibian case within broader international and African literature, this study contributes to understanding how contextual, behavioural, and cognitive factors interact to influence practical instruction, guided by Bandura's Social Cognitive Theory and Triadic Reciprocal Causation model. The main objectives for the study were to identify and describe the key challenges faced by Grade 10–11 Biology teachers in the Ondobe Circuit when preparing and conducting practical work. We also analysed how contextual factors, teacher beliefs, and available resources interact to influence the effective implementation of Biology practical lessons in Namibian secondary schools.

METHODS

Theoretical Framework

Various theories of learning pertinent to the learning and teaching of science were explored to establish a research framework for this study. Among these, Albert Bandura's Social Cognitive Theory (SCT), specifically the concept of Triadic Reciprocal Causation emerged as particularly relevant. Originally rooted in psychology, Social Cognitive Theory has since been extensively applied to research across various fields, including education. At its core, SCT posits that learning occurs in a social context and is influenced by the dynamic and reciprocal interaction of personal factors, environmental influences, and behaviour, a concept referred to as Triadic Reciprocal Causation (Bandura & Walters, 1977). The Triadic Reciprocal Causation provides a robust framework for understanding the dynamic interactions that shape human behaviour and learning (Bandura, 1986). A recent critical analysis by Widodo and Astuti (2024) supports this application, emphasizing that environmental adaptations are crucial for the theory's effective implementation in school settings to foster positive learning behaviours. According to Zhan & Widén (2019), Bandura's model of triadic reciprocal causation illustrates how three interconnected factors influence one another: (a) cognitive and personal elements such as beliefs, goals, and values; (b) environmental conditions; and (c) behaviours. For instance, personal factors influence how individuals interpret, imitate, and reinforce behaviours observed in others, ultimately shaping the way they behave in learning environments.

In this study, the Triadic Reciprocal Causation was used to provide valuable lens for examining how Biology teachers prepare for and conduct practical work in the secondary school context. Therefore, in the context of conducting Biology practical work to Grade 10 and 11 learners, this model offers insight into how teachers' internal dispositions, classroom practices, and external environments interact to influence the quality and effectiveness of practical instruction as illustrated in Figure 1 and the discussions thereof.

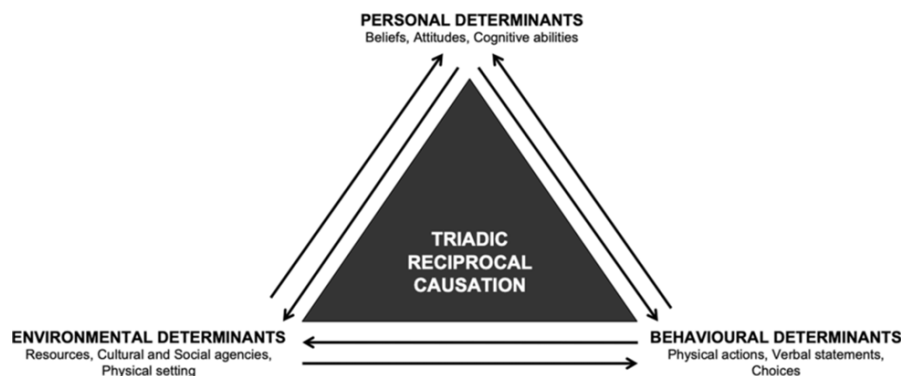


Figure 1. Bandura's Triadic Reciprocal Causation Model (Bandura, 1986)

Personal Factors – These include teachers' beliefs, attitudes, motivations, and professional confidence, particularly their Self-Efficacy in conducting practical work. A teacher who believes in their ability to manage a laboratory session and facilitate hands-on learning is more likely to implement engaging and effective practical works. Teachers' pedagogical content knowledge and skills also fall within this domain, shaping how teachers plan and deliver practical tasks.

Behavioural Factors – This encompasses the actual execution practices and actions that teachers carry out during practical sessions. It includes how teachers organize practical works, demonstrate procedures, interact with learners during hands-on activities, and assess learners' understanding and skills. These behaviours are influenced by both personal confidence and environmental affordances, and in turn, impact learners' engagement and learning outcomes.

Environmental Factors – These refer to the physical, institutional, and social environment in which practical works occurs. For Biology teachers, this includes the availability of laboratory space, equipment, and materials; class size; school policies; and support from school leadership and management. The socio-economic backgrounds of learners and the broader school context also shape how practical works are planned and executed.

Therefore, the Triadic Reciprocal Causation Model could be an instrumental in understanding how Biology teachers navigate the challenges and opportunities involved in preparing and conducting effective practical works. A well-equipped laboratory (environmental factor) may encourage a teacher to incorporate more interactive practical works (behavioural factor), thereby strengthening learners and teachers' confidence and motivation (personal factor). Conversely, a lack of resources may limit practical works engagement, which could negatively affect both learning and teaching practices and teachers' belief in their ability to deliver meaningful science instruction.

By applying this theoretical framework, the study explored how interactions among personal beliefs, teaching behaviours, and environmental conditions shape the ways in which Grade 10 and 11 Biology teachers prepare for and conduct practical work. This understanding may inform strategies to support teachers through professional development, resource provision, and contextualized instructional planning. Also, For Biology teachers working in the Ondobe Circuit of the Ohangwena Region, where resource limitations and large class sizes were noted to present challenges, SCT supports strategies that promote active engagement, peer learning, and observational modelling. Through demonstrations, group activities, and feedback, teachers can create an interactive learning environment that fosters understanding and scientific skill development among Grade 10 and 11 learners. These adaptive strategies align well with SCT's recognition of the role of the environment in shaping behaviour and learning outcomes (Zhan & Widén, 2019). All in all, by considering the interplay between personal beliefs, environmental conditions, and behaviours, teachers can effectively plan and conduct practical works that not only enhances academic performance but also equips learners with critical scientific skills and positive science learning attitudes.

Research Design

This study employed a qualitative case study design, which is well suited for exploring complex educational phenomena within their natural settings (Nota et al., 2016). The aim was to gain an in-depth understanding of the challenges experienced by Biology teachers in preparing and conducting practical work in secondary schools. A case study approach allowed the researchers to capture teachers' lived experiences through multiple data sources, thereby ensuring contextual richness and analytical depth.

Research Context and Participants

The study was conducted in the Ondobe Circuit of the Ohangwena Region, Namibia, an area characterised by predominantly rural schools with limited resources. Nine schools offered Grade 10–11 Biology in 2023, from which four schools were purposively selected. The selection criteria included the presence of Biology teachers with substantial teaching experience and willingness to participate in the study. Where schools had more than one Biology teacher, the teacher with the longest teaching experience was selected. A total of four teachers (all female) participated in the study. Their inclusion was guided by the principle of information power, which suggests that smaller samples are sufficient when participants are information-rich and the study employs multiple data collection strategies (Boddy, 2016).

Data Collection Methods and Instruments

Three data collection methods were used, semi structured interviews, non-participant observation and document analysis. As in line with the methods, three complementary instruments were designed and employed to enable triangulation and enhance the robustness of findings (Cohen et al., 2018).

a) Semi-structured interview guides

These explored teachers' experiences, challenges, and strategies for conducting Biology practical work. The open-ended format enabled participants to elaborate on their practices while allowing the researcher to probe emerging issues (Diviani et al., 2019).

b) Non-participant classroom observations sheets

Teachers were observed during eight practical lessons (two per teacher). An observation checklist focused on laboratory conditions, teacher–learner interactions, lesson organisation, safety measures, and learner participation. Observations provided “live” data that could be compared against self-reports (Allen et al., 2013; Braun et al., 2019).

c) Document analysis guide

Teachers' lesson plans, practical worksheets, assessment records, and relevant policy documents were reviewed. This offered insights into the extent to which practical work was planned, implemented, and aligned with curricular expectations (Mackieson et al., 2019). The combination of these methods ensured a multi-faceted perspective on the research questions.

Data Analysis

Data analysis followed the principles of thematic analysis, which is appropriate for identifying and interpreting patterns within qualitative data. Interview transcripts, observation notes, and documentary evidence were coded inductively and deductively, using the research questions as guiding categories. Themes were refined iteratively through constant comparison across cases. Pseudonyms were assigned to participants to maintain confidentiality.

To ensure rigor and trustworthiness in qualitative reporting, several strategies were adopted, including triangulation, member checking, and maintaining an audit trail (Johnson et al., 2020; Kakar, & Kaukab, 2023). Credibility was ensured through the triangulation of interviews,

observations, and documents validated findings across multiple sources (Stenfors et al., 2020; Ahmed, 2024). Member checking was conducted by sharing preliminary themes with participants for confirmation. Dependability was maintained by having a detailed audit trail of research procedures, coding decisions, and methodological choices.

RESULTS AND DISCUSSION

The findings are presented according to the main six themes emerging from interviews, classroom observations, and document analysis. These themes are, insufficient laboratory resources, poor laboratory infrastructures, gaps in lesson planning and preparations, teacher competence and confidence, safety concerns, and misalignment between reported and documented practices.

Insufficient Laboratory Resources

All four participants reported severe shortages of essential apparatus and consumables. Three schools relied on expired or broken materials, while one had only limited quantities, making hands-on engagement difficult. Observations confirmed that learners often shared scarce materials or observed teacher demonstrations rather than performing experiments themselves.

The results showed severe shortages of laboratory apparatus, reagents, and consumables across most schools, with many teachers reporting that they could not conduct the prescribed Biology practicals. From the perspective of Triadic Reciprocal Causation, these shortages demonstrate how environmental factors shape both teacher and learner outcomes. The absence of basic apparatus reduces teachers' opportunities to model scientific inquiry and, consequently, undermines their behavioural practices, leading to demonstrations only or theory-based lessons. This, in turn, affects personal factors, such as teachers' confidence and learners' self-efficacy in handling biological equipment.

Thus, the constrained environment initiates a reciprocal loop: *resource scarcity* → *limited teacher practical engagement* → *reduced learner exposure* → *declining confidence and achievement* → *further reinforcement of theory-dominant teaching*. This cyclical interaction mirrors Bandura's argument that environmental limitations can suppress behavioural capabilities, which then shape beliefs and expectations.

Although one school that participated in the study could actively involve all grade 12 learners in conducting practical work, the observation indicates that grades 10 and 11 learners were compromised by not carrying out practical work at all, due to insufficient practical laboratory materials, even though they were the focus of this study. Thus, it is worth noting that if schools are not equipped with adequate practical materials, it can negatively impact the achievement of assessment objective C (experimental and investigative) skills and abilities objectives for all science learners. Similar to findings by Ahmed et al., (2025) in Nigerian secondary schools, this study shows that inadequate availability and utilisation of laboratory apparatus constrain practical work and may undermine learners' performance in high-stakes examinations. Furthermore, Amrianto et al. (2025) identify that such resource limitations are a primary driver of student disengagement, often causing students to perceive biology as a rote-based and uninteresting subject. Additionally, this finding also aligns with Nghipandulwa et al., (2020), who reported similar shortages in Oshana region of Namibia, where many teachers acknowledged the lack of essential apparatus and materials, resulting in minimal or no practical activities being conducted. Onyedikachi and Onukwube (2022) also found that Nigerian Biology teachers avoided practical works due to a lack of resources, relying instead on theoretical instruction. Akuma and Gaigher (2021) also noted that many South African schools lacked the resources to conduct proper experiments. Hence, teachers often resorted to demonstrations, which limited learner engagement and conceptual understanding. However, addressing resources alone may not be sufficient; Prananda and Refariza (2025) argue that without continuous professional development focused on pedagogical

innovation, teachers may struggle to move beyond traditional methods even when facilities are improved.

Therefore, the insufficiency of laboratory materials and infrastructure is consistent with reports from Namibia and other African contexts (Nghipandulwa et al., 2020). Limited resources force teachers to rely on demonstrations, echoing South African and Nigerian studies where similar shortages reduced learner engagement (Akuma & Gaigher, 2021; Onyedikachi & Onukwube, 2022). This suggests that practical work in resource-constrained environments remains vulnerable to systemic neglect, undermining intended curriculum outcomes.

Poor Laboratory Infrastructures

The findings further revealed that laboratories were poorly structured, with missing benches, sinks, and safety equipment. In some cases, lessons were conducted in ordinary classrooms. These conditions hindered teachers' ability to organise safe and effective practical activities. The finding also further revealed that three of the four research participants show that have science laboratories where practical investigations are being carried out. However, the fourth participant does not have a science laboratory; hence, the teacher uses a classroom for practical investigations. It also emerged that of those that have laboratories, those laboratories were poorly equipped or not equipped at all, and this discouraged teachers to carry out practical work confidently. Rima et al. (2020) likewise reported that poorly functioning laboratories discouraged Indonesian teachers from implementing environmental-change practicums and demonstrated that carefully designed modelling activities can still meet curriculum demands despite resource constraints. Furthermore, it was also observed that two laboratories do not have working benches and chairs (stools). As a results two teachers use normal classroom chairs and tables when conducting practical work.

It was also observed that the tables were not enough for the learners. Hence, during practical investigations, learners were observed seated in groups as shown in figure 2. In addition, the water taps in the science laboratory were also not running due to damaged pipes. Therefore, the learners were observed collecting water from an outside tap to clean materials, apparatus and washing their hands after the practical. The laboratory also has gas taps, but they are disconnected and not functional. One participant had this to say, *"We have a laboratory, even though not well equipped. We use normal chairs. We don't have lab chairs, and we don't have lab tables. So, we use just normal school tables in that specific lab, which also doesn't have the proper door. We lock it just like this bangle door. The door itself does not work. Even though we have sinks and counters, the sinks are not in use currently because they are broken"*.

Another teacher also had this to say, *"We do not have a laboratory. You have to bring all what you have to do in the classroom."* This explanation confirms the learning setting presented in Figure 2.

The findings further showed that most schools implemented practical work irregularly, with lessons often reduced to teacher demonstrations or exam-driven activities rather than inquiry or experimentation. Using the TRC framework, this pattern emerges from the interplay between environmental factors (lack of time, resources, and administrative support), behavioural factors (teachers' instructional decisions), and personal factors (students' self-beliefs about learning Biology practically).

Bandura emphasises that behaviour is not simply a response to the environment; rather, individuals actively interpret environmental constraints. Teachers' choice to prioritise theory is a behavioural response shaped by environmental pressure (e.g., large classes, lack of resources) and personal factors (e.g., their comfort with theory-based instruction). Learners, in turn, internalise these experiences, leading to decreased practical confidence and lower perceived capability to perform laboratory tasks independently. This reciprocal pattern ultimately reinforces exam-centred teaching and limits authentic scientific inquiry.



Figure 2. Learners' sitting arrangement during a practical demonstration lesson observing a practical on food tests at a poorly resource lab, without proper benches, illustrating restricted access to laboratory apparatus and reduced experiential learning opportunities.

Gaps in Lesson Planning, Preparation, Teacher Competence and Confidence

Results indicated that teachers often lacked adequate preparation for practical lessons, with weak or incomplete lesson plans, absence of clear aims, and minimal alignment with the NSSCO Biology syllabus. In TRC terms, this reflects the interaction between personal factors (teachers' knowledge, skills, attitudes) and behavioural factors (their actual instructional practices). Teachers who feel underprepared or lack competence in practical pedagogy are less likely to adopt inquiry-based methods, and this behavioural pattern shapes the classroom environment by reducing opportunities for authentic practical engagement.

Conversely, the environmental constraints, such as limited training, large class sizes, and administrative workloads, negatively influence teachers' personal efficacy beliefs, which then impact their behaviour in practical instruction. This reciprocal-dynamic supports Bandura's claim that competence develops (or erodes) through ongoing interactions among beliefs, actions, and contextual affordances.

Apart from the availability of practical materials, interviews and observations revealed differences in teachers' pedagogical skills. Some teachers omitted experiments they felt unprepared to conduct. Weak integration of practical activities with syllabus objectives was evident, and demonstrations often replaced learner-centred investigations.

Therefore, results also showed that Biology teachers had challenges in the manner they conducted practical work in terms of competence, skills, and creativity. This emanates from their own abilities to prepare and conduct practical work. This resulted in some teachers leave out the practical work parts in which they are not knowledgeable, competent or skilful in carrying out the actual practical work. Kibirige and Maponya (2021) similarly found that South African teachers skipped practical work to complete the syllabus, undermining the development of investigative skills. Thus, from the practical work observed, the three out of four teachers did not indicate the aims of the practical work conducted. As a result, the learners were just carrying out the practical work without understanding what was expected of them at the end of the practical lesson.

In addition, only two out of four teachers could provide their practical work lesson plans. Therefore, practical planning can also be categorized as one of the challenges experienced by Biology teachers in conducting practical work. Consistent with Khoerunnisa, et al., (2025), the present findings reveal that many teachers' lesson plans lack clearly articulated aims, inquiry questions, and alignment with practical assessment objectives, suggesting the need for stronger preparation in planning and implementing inquiry-based practicums. A science teacher needs to

plan to be familiar with the materials to be used during the practical lesson and to make substitutions where necessary. Practical planning can also help the teacher gain confidence in carrying out practical work by seeking assistance where he or she may have difficulties and to be able to come up with clear procedures and objectives in carrying out practical work. This mirrors the findings of Agambar et al., (2019), who emphasized the importance of planning in ensuring successful outcomes. He echoed that proper planning enables alignment with curriculum objectives and ensures clear learning goals. Pedagogical content knowledge and teachers' confidence led to the lack of clear lesson objectives and weak alignment with syllabus goals reveal gaps in teachers' pedagogical content knowledge. For Namibia, this underscores the urgency of capacity-building initiatives that equip teachers to integrate practical work effectively.

Safety Concerns

Furthermore, learners were also observed breaking off some practical work materials and apparatus, some learners accidentally got burned by hot water, the usage of apparatus that are not cleaned since there is no running taps in the laboratories as reported to earlier. Only one of the four participant teachers incorporated explicit safety protocols into before the practical lesson begun. Therefore, this study emphasizes safety precautions as one of the challenges of conducting Biology practical work.

Observed safety lapses highlight an often-overlooked challenge in science education. Without adequate supervision and protocols, practical lessons expose learners to risks. Akuma (2017) made similar observations in South Africa, calling for systematic safety training and institutional support. Furthermore, the results revealed that many schools lacked proper laboratory rooms, water supply, functional sinks, gas outlets, and safety equipment. In some cases, practical lessons were conducted in ordinary classrooms, exposing learners to risks. Within the TRC framework, such environmental hazards directly influence behavioural choices, with teachers avoiding hands-on activities because they perceive them as unsafe or unmanageable. This avoidance behaviour affects learners' personal development, particularly their motivation to engage in practical work and their perception of Biology as a hands-on subject.

Bandura's (1986) model predicts that when the environment does not reinforce safe and structured learning opportunities, both teachers and learners develop lower expectations of successful practical engagement. The observed cycle: *poor infrastructure* → *avoidance of practicals* → *diminished learner competence*, demonstrates how unsafe environments suppress both action and confidence, reinforcing the very behavioural patterns that perpetuate poor practical performance.

Misalignment Between Reported and Documented Practices

Document analysis indicated inconsistencies between teachers' claims and their recorded evidence. For example, one teacher reported four practical lessons in a term, but only three incomplete plans were found. This discrepancy suggests that practical work is not consistently implemented as intended. The analysis of the NSSCO Biology syllabus reveals that learners are required to demonstrate experimental and investigative skills and abilities as part of their assessment (NIED, 2018).

In addition, the scheme of assessment for grades 10 and 11 specifies that all learners must complete Paper 3, an alternative to the Practical Work paper, which evaluates practical skills and abilities. Paper 3 consists of compulsory written questions aimed at assessing familiarity with practical laboratory procedures and skills primarily aligned with assessment objective C. This suggests that the number of practical works carried out by individual Biology teachers is way far less than the suggestions of the syllabus. This emphasis on theory poses a disadvantage to learners, particularly in Biology practical examinations, as they may lack familiarity with practical work. For example, learners were found to have limited exposure to essential biological techniques (dissecting, microscopy, food tests), leading to low confidence and poor performance

in Paper 3 practical examinations. Through the TRC lens, these performance outcomes reflect the cumulative interaction of *environmental factors*, inadequate resources, lack of structured practical lessons, poor lab conditions. *Behavioural factors*, limited practice opportunities, reduced experimentation, exam-driven demonstrations. *Personal factors*, low self-efficacy, anxiety, lack of skill mastery.

Bandura posits that mastery experiences are the strongest predictors of self-efficacy. Because learners rarely engaged in authentic practical tasks, they did not accumulate mastery experiences necessary to build confidence. Their low confidence then influenced their behaviour during practical exams (e.g., hesitating with equipment, difficulty following procedures), which resulted in low performance, thus reinforcing negative expectations in future tasks. This reciprocal loop explains why even when schools attempted practical sessions shortly before examinations, learners still struggle the personal, behavioural, and environmental conditions had already shaped their practical identities over time. All in all, document analysis revealed inconsistencies between what teachers claimed and what was documented. Hence, similar findings by Mackieson et al. (2019) advocate for triangulation to ensure accuracy in educational research.

Study Implication

Through the lens of Social Cognitive Theory (Bandura, 1986), the results illustrate the interplay between personal, behavioural, and environmental factors. Limited resources (environmental factor) constrained teachers' behaviours, leading to reliance on demonstrations. This in turn affected teachers' self-efficacy (personal factor), reducing their confidence to conduct practical works. Conversely, a well-prepared teacher with stronger self-belief was observed to integrate more interactive tasks despite limited resources. This reciprocal relationship highlights how teacher beliefs and practices are shaped by their contexts, confirming SCT's applicability to science education in resource-limited schools.

Therefore, the findings underscore that addressing structural constraints alone will not suffice. Teacher professional development, regular supervisory support, and the inclusion of safety protocols are essential. Moreover, the misalignment between reported and documented practices suggests a need for accountability mechanisms to ensure practical work is systematically planned and executed. Across all themes, the findings demonstrate that poor Biology practical performance is not a result of a single factor but rather a reciprocally reinforcing system of: Environmental constraints (infrastructure, resources, class size, safety). Behavioural adaptations (theory-dominant teaching, limited practicals, demonstrations). Personal consequences (teacher self-efficacy, learner skill levels, learner confidence). Bandura's TRC framework therefore provides a coherent explanation of how persistent environmental deficits shape teacher behaviour, how those behaviours influence learner attitudes and skills, and how learner outcomes in turn reinforce teaching practices and institutional expectations.

CONCLUSION

This study investigated the challenges encountered by Grade 10–11 Biology teachers in the Ondobe Circuit, Ohangwena Region, when preparing and conducting practical work. The results demonstrate that while teachers attempt to implement practical lessons, their efforts are constrained by systemic, pedagogical, and contextual barriers. These include inadequately resourced and poorly structured laboratories, insufficient consumable materials, weak lesson planning, inconsistent safety practices, and limited pedagogical confidence. Document analysis further revealed discrepancies between teachers' reported practices and recorded evidence, suggesting that practical work is not systematically embedded into daily instruction.

Through the lens of Social Cognitive Theory, the study shows how environmental constraints, teacher behaviours, and personal beliefs interact in ways that restrict the quality of

practical science education. These findings align with international evidence that highlights the fragility of practical work in resource-limited contexts, while also contributing context-specific insights from Namibia.

Considering these challenges, the study proposes several recommendations aimed at enhancing the effectiveness of Biology practical instruction:

- a) Directorate of education in the Ministry education, Innovation, Youth, Sport, Arts and Culture should strengthen resource provision to schools so that enough and timely supplies of basic laboratory equipment and consumables to enable authentic hands-on practical activities are carried on.
- b) The Ministry of education and other stakeholders, should ensure that regular in-service training should focus on planning, executing, and integrating practical work, with particular attention to safety and alignment with syllabus objectives to enhance teacher professional development.
- c) Biology advisory teachers and education authorities should conduct routine monitoring and provide constructive feedback on practical instruction as a way of institutional support and supervision.
- d) In contexts where resources remain scarce, simulation software, multimedia projectors, and low-cost local materials can supplement practical teaching to leverage alternative instructional tools.
- e) To Promote accountability mechanisms, Lesson planning and documentation should be strengthened to ensure consistency between policy expectations and classroom practice.

To build upon these findings, future research should broaden its scope by adopting comparative and longitudinal designs to examine how practical work evolves across different regions of Namibia. Additionally, exploring the effectiveness of targeted teacher training and the integration of digital simulations could offer viable solutions for resource-limited classrooms. Ultimately, by situating the Namibian context within the broader global discourse, this study underscores the critical need for systemic and pedagogical innovations to equip learners with the investigative skills essential for 21st-century scientific literacy.

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Acknowledgment

Researcher would like to thank the university which funded this research and the participants who were involved in this research.

Authors' Note

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

How to Cite this Article

Kambeyo, L., & Simon, L. (2025). Challenges experienced by grades 10-11 teachers when preparing and conducting biology practical work in Ondobe Circuit, Ohangwena Region, Namibia. *Assimilation: Indonesian Journal of Biology Education*, 8(3), 257-270. <https://doi.org/10.17509/aijbe.v8i3.90733>