

Qualitative Exploration of Self-Assessment in Natural Science: Grade 6 Learners' Experiences in Rural Kwa-Zulu Natal Classrooms

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EDITORIAL DATES

Received: 16 July 2024
Revised: 23 September 2024
Accepted: 25 September 2024
Published: 17 October 2024

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DOI: [10.38140/ijrcs-2024.vol6.18](https://doi.org/10.38140/ijrcs-2024.vol6.18)

Abstract: Self-assessment, a crucial metacognitive skill for self-regulated learning, is vital for academic growth, especially in challenging subjects like Natural Science. However, its implementation and effectiveness in rural South African primary schools remain underexplored. This study investigates Grade 6 learners' experiences of self-assessment in Natural Science at two rural schools in KwaZulu-Natal, South Africa. Employing a qualitative multiple case study design, the research utilised semi-structured interviews and classroom observations with twelve purposively selected Grade 6 learners. The study reveals that while learners generally perceive self-assessment positively, they struggle with effective implementation due to a superficial understanding and difficulties in objective self-evaluation. The rural context presents significant challenges, particularly the lack of practical science equipment, which hinders learners' ability to engage in hands-on experiments and accurately assess their understanding. Furthermore, traditional knowledge and cultural values sometimes conflict with the scientific methods taught in schools, creating confusion in the self-assessment process. These findings indicate that effective self-assessment in rural Natural Science education is im-

peded by both institutional factors (resource limitations, inadequate teaching methods) and personal challenges (lack of confidence, cultural conflicts). Recommendations include developing context-specific, age-appropriate self-assessment tools, implementing strategies to bridge traditional and scientific knowledge, and creating innovative approaches to maximise limited resources in rural schools. This study contributes to the understanding of self-assessment practices in resource-constrained rural environments and offers insights for enhancing its effectiveness in similar contexts, addressing a gap in the existing literature on rural education and self-assessment in developing countries.

Keywords: Self-assessment, natural science, grade 6 learners, rural education, Kwa-Zulu Natal, qualitative research.

1. Introduction

Grade 6 Natural Science classrooms in rural South African schools present a unique educational environment where learners engage with scientific concepts while navigating the challenges and opportunities of their specific context. These classrooms serve as critical spaces for developing not only scientific knowledge but also essential metacognitive skills, such as self-assessment. The quality of learning that students receive is heavily dependent on the teaching methodologies employed and the learners' ability to gauge their own progress (Panadero et al., 2022).

Self-assessment, defined as the process by which students monitor and evaluate the quality of their thinking and behaviour during learning, while identifying strategies that improve their understanding and skills (McMillan & Hearn, 2008), is a crucial metacognitive skill in education. When effectively implemented, self-assessment empowers learners to take an active role in their learning process. However, students may struggle when educational systems fail to implement effective self-assessment strategies. Thus, investing in the development of these skills can yield positive results, such as enhanced student achievement and the fostering of self-regulated learners.

How to cite this article:

Pillay, P. (2024). Qualitative exploration of self-assessment in natural science: Grade 6 learners' experiences in rural Kwa-Zulu Natal classrooms. *Interdisciplinary Journal of Rural and Community Studies*, 6, 1-17. <https://doi.org/10.38140/ijrcs-2024.vol6.18>

According to Braund and DeLuca (2018), a learner's academic growth is stunted when they lack the ability to accurately assess their own understanding and performance. Andrade (2019) argues that some challenges in implementing self-assessment are associated with learners' metacognitive skills and teachers' guidance. Harris et al. (2018) stated that clear criteria, feedback, and practice are vital components in developing effective self-assessment skills among primary school learners.

Hence, fostering an environment conducive to the development of self-assessment abilities aligns with South Africa's Action Plan to 2024: Towards the Realisation of Schooling 2030, which emphasises improving the quality of teaching and learning in rural and underprivileged areas (Department of Basic Education, 2020). Enhancing self-assessment practices in Natural Science education directly supports Goal 5 of this plan, which aims to increase the number of learners achieving age-appropriate outcomes in Mathematics and Science (DBE, 2020). This approach not only boosts learner productivity but also contributes to addressing the historical inequalities in South African education, particularly in rural contexts (Spaull & Jansen, 2019; Msila, 2022).

To maintain and enhance productivity in line with national educational goals, the implementation of supportive strategies is paramount. These strategies should include explicit instruction in self-assessment techniques tailored to the South African rural context, fostering a growth mindset that acknowledges both scientific and indigenous knowledge systems, and developing age-appropriate assessment tools that align with the curriculum standards set by the Department of Basic Education. Such strategies directly support the Action Plan's emphasis on improving educational outcomes in underprivileged areas and contribute to the broader goal of creating a more equitable and effective education system across South Africa.

Yan and Brown (2021) confirm that factors such as learners' understanding of assessment criteria, their ability to reflect on their work, teacher support, and classroom culture are crucial contributors to the effectiveness of self-assessment in primary schools. When these factors are inadequate, learners experience difficulties in accurately evaluating their progress and may develop negative attitudes towards self-assessment (Baas et al., 2020). On the one hand, teachers are responsible for guiding the process; on the other, learners face various challenges, including stages of cognitive development and personal factors that can hinder effective self-assessment.

According to Peel (2020), imbalances between learners' perceived and actual performance—exemplified by overconfidence or underconfidence—result in inaccurate self-assessments, leading to misguided learning strategies and potential academic setbacks. However, these imbalances are sometimes the result of insufficient practice and feedback from the educational system. Additionally, the complexities of subjects like Natural Science, which involve abstract concepts and practical experiments, may contribute to the challenge of accurate self-assessment (Hawe & Dixon, 2017). In essence, inadequate support in developing self-assessment skills can lead to ineffective learning practices, and when learners struggle to evaluate their progress accurately, the educational system is perceived as falling short. Consequently, a lack of effective self-assessment poses numerous challenges to primary education, including reduced learner autonomy, decreased motivation, and a potential decline in overall academic performance (Dignath & Veenman, 2021).

Comparatively, the educational systems in various countries face similar challenges in implementing effective self-assessment practices. It has been reported that primary school learners in Finland, despite the country's reputation for educational excellence, still struggle with accurate self-assessment, particularly in subjects requiring higher-order thinking skills (Hirvonen, 2022). Schools in the United States still face the challenge of integrating self-assessment effectively across different subject areas, as the focus often remains on standardised testing rather than metacognitive skill development (DeLuca et al., 2020). Furthermore, many primary schools in developing countries have turned into environments where rote learning prevails over self-reflective practices (Maba, 2017). This has led to a recommendation that education departments provide teachers with extensive

professional development in facilitating self-assessment. This will assist educators in becoming aware of best practices and managing challenges to prevent future recurrence (Ndoye, 2017).

In Turkey, for example, more progressive schools are moving towards student-centred approaches that emphasise self-assessment, offering better opportunities for learner autonomy (Yastibas & Yastibas, 2015). Even in countries like Singapore, known for its high-achieving education system, there is a growing recognition of the need to develop self-assessment skills in primary learners to foster lifelong learning capabilities (Tan, 2019). Sub-Saharan African countries are also grappling with the challenge of implementing effective self-assessment practices in their primary schools. Limited resources and large class sizes often hinder the individualised attention needed to develop these skills effectively (Ololube, 2020).

In the South African context, the implementation of self-assessment practices faces unique challenges, particularly in rural areas. Setlhodi (2019) highlighted that some learners struggle with self-evaluation due to language barriers and diverse cultural backgrounds. However, the challenges extend beyond these factors. In rural South African schools, the implementation of self-assessment in Natural Science education is further complicated by resource constraints and pedagogical traditions. Masinire (2015) noted that rural schools often lack essential science equipment, limiting learners' ability to engage in practical experiments and subsequently assess their understanding of scientific concepts. This shortage of resources can lead to a disconnect between theoretical knowledge and practical application, potentially impacting the efficacy of self-assessment practices. Moreover, Msimanga and Lelliott (2014) found that in many South African science classrooms, particularly in rural areas, there is a tension between traditional teaching methods and learner-centred approaches that facilitate effective self-assessment. Teachers often struggle to shift from teacher-centred pedagogies to more participatory methods that encourage learner reflection and self-evaluation. The cultural context also plays a significant role. Ramnarain and Hlatswayo (2018) observed that in some rural communities, cultural norms emphasising respect for authority figures can conflict with the critical self-reflection required for effective self-assessment. Learners may be hesitant to evaluate their own work critically, viewing it as a challenge to the teacher's authority. Additionally, Ngibe et al. (2020) highlighted the impact of socio-economic factors on self-assessment practices in rural South African schools. Many learners face challenges such as a lack of access to additional learning resources at home, which can limit their ability to benchmark their performance and engage in meaningful self-assessment. These multifaceted challenges underscore the need for context-specific research and interventions to enhance self-assessment practices in rural South African Natural Science classrooms. By understanding these unique contextual factors, educators and policymakers can develop more effective strategies to support learners in developing crucial self-assessment skills.

While the importance of self-assessment in primary education is well acknowledged globally and has been the focal point of numerous studies (Panadero et al., 2022; Yan & Brown, 2021; Dignath & Veenman, 2021), there is a discernible gap in the scholarly literature specifically addressing the South African context, particularly regarding rural school environments and Natural Science education. This gap is especially pronounced when considering the unique challenges faced by learners in rural South African schools. Research on self-assessment practices in South African education has primarily focused on urban or well-resourced contexts (Msimanga & Lelliott, 2014; Ramnarain & Hlatswayo, 2018). However, the complex dynamics associated with self-assessment in rural South African schools, especially in Natural Science education, remain underexplored. The intersection of resource constraints, cultural factors, and pedagogical traditions in these settings creates a unique environment that warrants focused investigation.

Moreover, while international literature provides valuable insights into self-assessment practices, the applicability of these findings to the specific context of rural South African schools is limited. The distinctive socio-economic conditions, multilingual classrooms, and cultural diversity characteristic

of rural South Africa present challenges and opportunities that are not adequately addressed in the global literature on self-assessment. In the context of Natural Science education, rural schools in South Africa face distinctive challenges in implementing effective self-assessment practices. These challenges stem from a unique intersection of rurality and the specific demands of science education. The constraints inherent to rural locales, such as limited infrastructure and socio-economic factors (Ololube, 2020; Setlhodi, 2019), interact with the resource-intensive nature of science education to create a complex environment for the implementation of self-assessment.

For instance, the lack of well-equipped science laboratories and modern technology in rural schools (Masinire, 2015) significantly hinders learners' ability to engage in practical experiments, which are a crucial component of Natural Science education. This limitation directly impacts learners' capacity to self-assess their practical skills and understanding of scientific concepts. Moreover, the abstract nature of many scientific concepts, coupled with potential language barriers in multilingual rural classrooms, creates additional hurdles for learners in accurately evaluating their comprehension. The professional development of teachers in rural areas, particularly in implementing self-assessment techniques for Natural Science, is often constrained by geographical isolation and limited access to training resources (Ramnarain & Hlatswayo, 2018). This gap in teacher preparedness can lead to inconsistent or ineffective implementation of self-assessment strategies in Natural Science classrooms. Furthermore, the cultural context of rural communities may present unique challenges in Natural Science self-assessment. Traditional beliefs and local knowledge systems sometimes conflict with Western scientific concepts taught in schools (Msimanga & Lelliott, 2014). This cultural dissonance can complicate learners' self-assessment processes as they navigate different ways of understanding natural phenomena. Despite these heightened complexities, the adaptive strategies employed by rural schools to promote effective self-assessment in Natural Science remain significantly underexplored. The innovative approaches developed by educators and learners to overcome resource limitations and bridge cultural gaps in science education are seldom highlighted in the broader discourse on metacognitive skill development. This lack of focused scholarly exploration necessitates a more nuanced investigation into the unique circumstances of rural schools and their adaptive strategies in implementing self-assessment practices, particularly in the context of Natural Science education for Grade 6 learners.

1.2 Objectives of the study

This study explores the experiences of Grade 6 learners regarding self-assessment in Natural Science at two rural schools in Kwa-Zulu Natal, with the following specific objectives:

- To examine the learners' understanding and implementation of self-assessment practices in Natural Science.
- To investigate the challenges faced by learners in effectively using self-assessment in their Natural Science studies.
- To explore how the rural context influences learners' experiences with self-assessment in Natural Science.

2. Theoretical Framework

This study adopts Zimmerman's (2000) Self-Regulated Learning (SRL) theory as its theoretical foundation. Zimmerman's cyclical model of self-regulated learning, which comprises forethought, performance, and self-reflection phases, provides a comprehensive framework for understanding Grade 6 learners' self-assessment practices in Natural Science. According to Dignath and Büttner (2018, p. 130), "Zimmerman's self-regulated learning theory proposes that learners go through three cyclical phases: forethought, performance, and self-reflection, each involving various sub-processes that contribute to effective learning."; SRL theory posits that enhancing learners' self-regulatory skills, including self-assessment, can significantly improve their metacognitive abilities and academic performance (Panadero et al., 2022). In the context of this study, the theory helps to identify key

challenges in self-assessment implementation, such as poor understanding of assessment criteria, lack of reflective skills, and difficulty in setting realistic goals (Yan & Brown, 2021). Crucially, the flexibility of SRL theory allows for its adaptation to various contexts, including rural settings (Ololube, 2020). This adaptability is particularly relevant given the unique challenges faced by rural schools, such as limited resources and professional development opportunities (Masinire, 2015). The theory thus provides a valuable lens through which to examine the cognitive, motivational, and contextual factors influencing Grade 6 learners' self-assessment practices in rural KwaZulu-Natal Natural Science classrooms. By framing the study within SRL theory, we can better understand the interplay between self-assessment practices, the rural context, and Natural Science education, potentially uncovering strategies to enhance learners' self-assessment skills despite resource constraints.

3. Methodology

This study employed a qualitative multiple case study approach within an interpretivist paradigm to explore Grade 6 learners' experiences of self-assessment in Natural Science at two rural schools in the Nongoma area of KwaZulu-Natal, South Africa. The interpretivist paradigm allowed for an understanding and interpretation of the subjective meanings of learners' experiences (Thanh & Thanh, 2015), while the qualitative approach facilitated an in-depth exploration of how learners engage with self-assessment practices (Creswell & Poth, 2018). Two rural schools in KwaZulu-Natal were purposively selected as cases for this study. The selection criteria included: 1) rural location, 2) implementation of self-assessment practices in Grade 6 Natural Science classes, and 3) willingness to participate in the study. These criteria ensured that the selected schools could provide rich data relevant to the research questions. Twelve Grade 6 learners, six from each school, were selected through purposive sampling based on their engagement with self-assessment practices in Natural Science. The semi-structured interviews allowed for flexibility in exploring learners' experiences, while classroom observations provided contextual data on self-assessment practices in action. The multiple case study design (Yin, 2018) facilitated a comparison between the two schools, allowing for the exploration of similarities and differences in self-assessment practices within rural contexts. This approach provided a more robust understanding of the phenomenon across different settings. Data analysis was conducted using thematic analysis, following Braun and Clarke's (2006) six-step process. This method allowed for the identification of patterns and themes across the dataset, providing insights into learners' experiences and the challenges they face in self-assessment. Ethical considerations included obtaining approval from the university's ethics committee, gaining permission from school principals, and securing informed consent from parents and assent from learners. Participants' anonymity and confidentiality were maintained throughout the study. This methodology allowed for a comprehensive examination of self-assessment practices in Natural Science within the selected rural schools, providing insights into the unique experiences and challenges faced by Grade 6 learners in these contexts.

4. Presentation and Discussion of Findings

Data were presented to address the three objectives that aimed to examine learners' understanding and implementation of self-assessment practices in Natural Science, investigate both internal and external challenges faced by learners in effectively using self-assessment, and explore how the rural context influences learners' experiences with self-assessment in Natural Science. Each objective has two themes that directly respond to it.

4.1 Learners' understanding of self-assessment practices in Natural Science

These sections addressed objective number one, and two themes emerged from the data: Understanding of Self-Assessment Purpose and Application of Self-Assessment Techniques.

4.1.1 Objective 1, theme 1: Understanding of self-assessment purpose

Every learner in the study demonstrated some level of understanding of self-assessment, but the depth and accuracy of this understanding varied significantly. Self-assessment is intended to be a reflective process in which learners evaluate their own work and progress, identifying strengths and areas for improvement. According to Panadero et al. (2022), when learners have a clear understanding of the purpose of self-assessment, they are more likely to engage with it meaningfully and benefit from the process. Participants expressed their understanding of self-assessment as follows:

Learner 3 (School A): "Self-assessment is when I check my own work to see if I did it right. It helps me know if I understand the lesson and where I need to improve."

Learner 5 (School B): "I think it's about marking my own work and seeing where I made mistakes. But sometimes I'm not sure if I'm doing it correctly. It's confusing when I have to decide if my answer is good enough."

These responses indicate that while learners grasp the basic concept of self-assessment, there is uncertainty about the depth and breadth of what they should be evaluating. This uncertainty could stem from a lack of clear guidelines or limited exposure to diverse self-assessment practices.

Classroom observations revealed a spectrum of engagement with self-assessment:

Observation note (School A): "During the lesson on plant cells, most learners actively engaged in self-assessment activities, referring to the provided criteria. However, a few students appeared hesitant, frequently looking to their peers for guidance or validation. This suggests a lack of confidence in their own judgement, which could undermine the effectiveness of self-assessment."

The data suggest that while learners generally understand the basic concept of self-assessment, there is a significant range in their comprehension of its purpose and how to implement it effectively. This variation in understanding could impact the effectiveness of self-assessment practices and ultimately affect learners' academic growth.

Learner 2 (School A): "I like doing self-assessment because it helps me prepare for tests. I can see what I know and what I need to study more. But sometimes I don't know if I'm being too easy or too hard on myself. It's hard to know what's really good work."

Learner 6 (School B): "Self-assessment is confusing sometimes. I'm not always sure what the teacher wants us to do or how to judge my own work. Sometimes I think I did well, but then the teacher says it's not good enough. It makes me doubt myself."

These comments highlight the need for clearer guidance and instruction on the purpose and process of self-assessment. The uncertainty expressed by learners suggests that they may not be fully benefiting from the reflective and metacognitive aspects of self-assessment. This could be particularly problematic in Natural Science, where critical thinking and self-reflection are essential skills.

The rural context of these schools seems to contribute to this variation in understanding, as noted by one of the learners:

Learner 4 (School B): "In our school, we don't have many resources like the city schools. Sometimes it's hard to know if we're doing things the right way. We don't get to see many examples of good work, so it's difficult to know what to aim for in our own work."

This comment underscores how the rural setting, with its limited resources, can impact learners' ability to develop a comprehensive understanding of self-assessment. The lack of diverse learning materials and exposure to varied examples of quality work may hinder learners' ability to set appropriate standards for self-assessment.

The data suggest that while learners have a basic grasp of self-assessment, there is a need for more explicit instruction and guidance on its purpose and implementation. This aligns with Panadero et al.'s (2022) findings on the importance of explicit self-assessment instruction. The rural context exacerbates these challenges, a unique aspect our study highlights, extending Ololube's (2020) general observations on rural education to specifically address Natural Science self-assessment. The findings resonate with Zimmerman's (2000) Self-Regulated Learning theory, particularly emphasising gaps in the 'forethought' phase. The rural setting's impact on self-assessment practices underscores SRL theory's recognition of environmental influences on learning processes. These results suggest a need for targeted interventions that provide explicit self-assessment instruction while accounting for the unique challenges of rural educational environments, particularly in Natural Science contexts.

4.1.2 Objective 1, theme 2: Application of self-assessment techniques

The application of self-assessment techniques varied widely among learners, revealing a spectrum of proficiency and engagement. Some demonstrated a good grasp of different methods, while others struggled to apply them effectively. This disparity in application could have significant implications for the overall effectiveness of self-assessment in enhancing learning outcomes.

Classroom observations provided valuable insight into how learners implemented self-assessment in practice:

Observation note (School B): "During the lesson on the water cycle, learners used a self-assessment checklist. Some completed it thoughtfully, referring back to their work and the lesson materials. Others, however, rushed through without much reflection, ticking boxes seemingly at random. This stark contrast in approach suggests that not all learners have internalised the value of self-assessment or understand how to engage with it meaningfully."

This observation highlights the inconsistent application of self-assessment techniques, which could be attributed to varying levels of understanding, motivation, or comfort with the process.

Learners shared their experiences with applying self-assessment techniques:

Learner 1 (School A): "I like using the rubrics the teacher gives us. It helps me know what to look for in my work. But sometimes the words are hard to understand. I wish we had simpler explanations or examples to follow."

Learner 4 (School B): "We use different ways to check our work. Sometimes we use checklists, other times we write reflections. I find the checklists easier to use because they're clear about what we need to look for. The reflections are harder because I'm not always sure what to write about my work."

These comments reveal that, while various self-assessment tools are being used, their effectiveness is not consistent across all learners. The preference for more structured tools, such as checklists, over open-ended reflections, suggests that learners may require additional support in developing critical reflection skills.

The rural context of the schools appears to play a significant role in shaping the application of self-assessment techniques, as noted in an observation:

Observation notes (School A): "Limited access to technology in this rural school means that self-assessment is primarily conducted using paper-based tools. This sometimes makes it challenging for learners to track their progress over time or engage with more interactive forms of self-assessment. During today's lesson, learners struggled to compare their current work with past performances, as they did not have easy access to their previous assessments."

This observation underscores how the rural setting, with its limited technological resources, can impact the variety and sophistication of self-assessment techniques available to learners. This limitation could potentially narrow the scope of self-assessment practices and hinder learners' ability to develop a comprehensive set of self-evaluation skills.

Learner 3 (School B): "In our science class, we sometimes do experiments and then have to assess how well we followed the steps and understood the results. It's hard because we don't have all the proper equipment, so sometimes our results are different from what the book says. I'm not sure how to assess myself when that happens."

This comment highlights a unique challenge in applying self-assessment techniques in Natural Science within a resource-constrained rural context. The lack of proper equipment not only affects the learning experience but also complicates the self-assessment process, particularly when experimental outcomes do not align with textbook expectations.

The data suggest that while a range of self-assessment techniques is being employed, their application is inconsistent and sometimes superficial. This aligns with Yan and Brown's (2021) findings on the challenges of effectively implementing self-assessment practices across diverse educational contexts. The rural context, with its resource limitations, appears to constrain the diversity and depth of self-assessment practices, echoing Masinire's (2015) observations on the unique challenges faced by rural schools in implementing educational innovations. These findings can be understood through the lens of Zimmerman's (2000) Self-Regulated Learning theory, particularly the 'performance' phase, where learners should be applying self-assessment strategies. The inconsistent application suggests a gap between the 'forethought' and 'performance' phases in these rural contexts. This situation calls for innovative approaches to self-assessment that can work effectively within the constraints of a rural setting while still fostering meaningful reflection and learning. As Ololube (2020) suggests, context-specific adaptations of educational practices are crucial for rural schools. In line with SRL theory, such innovations should aim to strengthen the connection between learners' understanding of self-assessment (forethought) and their ability to apply it effectively (performance) in resource-constrained environments.

4.2 Investigate both internal and external challenges faced by learners in effectively using self-assessment

These sections addressed objective number two, and two themes emerged from the data: personal barriers to self-assessment and environmental constraints.

4.2.1 Objective 2, theme 1: Personal barriers to self-assessment

Learners faced various personal challenges in effectively using self-assessment, including cognitive difficulties and emotional barriers. These internal obstacles significantly impacted their ability to engage meaningfully with self-assessment practices, potentially limiting the effectiveness of this important metacognitive tool.

Participants expressed their struggles as follows:

Learner 2 (School B): "Sometimes I'm not sure if I'm being honest with myself when I check my work. I want to do well, so I might say I did better than I actually did. It's hard to admit when I don't understand something, especially when my friends seem to get it."

This comment reveals a common struggle with objectivity in self-assessment. The desire to view oneself positively can lead to inflated self-evaluations, a phenomenon noted by researchers such as Dunning et al. (2004) in their work on the "above-average effect."; This tendency can be particularly problematic in Natural Science, where accurate self-assessment is crucial for identifying areas that need improvement.

Learner 6 (School A): "I get nervous when I have to judge my own work. What if I think I did well but the teacher disagrees? Sometimes I feel like it's better to wait for the teacher to tell me how I did instead of trying to figure it out myself."

This response highlights the anxiety and lack of confidence many learners experience when engaging in self-assessment. The fear of misjudging their own performance can lead to a reluctance to fully engage in the self-assessment process, potentially undermining its benefits.

Classroom observations also revealed some of these personal barriers:

Observation note (School B): "During the ecosystem project self-assessment, several learners appeared hesitant and sought reassurance from the teacher before committing to their self-evaluations. Some students spent an inordinate amount of time on single criteria, seemingly paralysed by indecision. This behaviour suggests a lack of confidence in their ability to make judgments about their own work."

This observation underscores the challenges learners face in developing the confidence and skills necessary for effective self-assessment. The hesitation and need for external validation indicate that these learners have not yet internalised the criteria for good performance or developed trust in their own judgement.

Learner 1 (School A): "In our culture, we're taught to be humble and not to boast. Sometimes when I do self-assessment, I feel like I'm bragging if I say I did well. It's confusing because the teacher wants us to recognize our strengths, but it feels wrong somehow."

This comment reveals how cultural factors can create personal barriers to effective self-assessment. The conflict between cultural values of humility and the self-evaluative nature of assessment creates an internal struggle for some learners, potentially leading them to underestimate their abilities.

Learner 4 (School B): "I find it hard to concentrate on self-assessment sometimes. There's so much going on in my head, and I'm often thinking about other things I need to do at home. It's difficult to focus on judging my own work when I'm worried about other stuff."

This response highlights how external pressures and responsibilities can create personal barriers to effective self-assessment. The cognitive load of balancing academic and home responsibilities may leave limited mental resources for the metacognitive processes required in self-assessment.

These personal barriers align with findings from Yan and Brown (2021), who noted that learners often struggle with objectivity, confidence, and emotional responses in self-assessment. This study extends this understanding by highlighting how the rural context adds layers of complexity to these challenges. This resonates with Masinire's (2015) observations on the unique sociocultural dynamics in rural education settings. From the perspective of Zimmerman's (2000) Self-Regulated Learning theory, these barriers primarily affect the 'self-reflection' phase, where learners evaluate their performance. The influence of the rural context on this phase supports Panadero et al.'s (2022) argument that environmental factors significantly impact self-assessment processes. The multifaceted nature of these barriers echoes Setlhodi's (2019) findings on the complex interplay of factors affecting learning in rural South African schools. Addressing these challenges requires a holistic approach that aligns with SRL theory's emphasis on the interdependence of personal, behavioural, and environmental factors in learning processes (Dignath & Büttner, 2018).

4.2.2 Objective 2, theme 2: Internal and external challenges faced by learners: Environmental constraints

The rural context of the schools presented unique environmental challenges to effective self-assessment. These external factors significantly impacted learners' ability to engage in

comprehensive and accurate self-evaluation, particularly within the domain of Natural Science education.

Learners and observations highlighted several issues:

Learner 3 (School A): "We don't have a library in our village, so it's hard to find information to check if our work is correct. We mostly rely on our textbooks. Sometimes I feel like I'm missing out on important information that could help me judge my work better."

This comment underscores the limited access to resources in rural areas and its impact on self-assessment. The lack of diverse information sources not only affects learning but also hinders learners' ability to develop comprehensive criteria for self-assessment. In Natural Science, where current information is crucial, this limitation can significantly affect the quality and relevance of self-assessment.

Observation note (School A): "The lack of consistent electricity affected today's lesson. The teacher had planned to use recorded videos for learners to compare their project presentations but had to resort to verbal feedback instead. This change visibly frustrated some students, who struggled to remember and apply the verbal criteria to their self-assessments."

This observation highlights how infrastructure challenges in rural areas can disrupt planned self-assessment activities. The reliance on technology for certain forms of self-assessment becomes problematic when basic utilities are unreliable. This situation can lead to inconsistent self-assessment experiences and potentially reduce their effectiveness.

Learner 5 (School B): "Sometimes it's hard to concentrate on self-assessment when our classroom is so hot and crowded. We don't have fans or air conditioning like city schools. When it's really hot, all I can think about is how uncomfortable I am, not about how well I did on my work."

This response reveals how physical discomfort caused by inadequate facilities can create significant barriers to effective self-assessment. The cognitive load of managing physical discomfort can leave limited mental resources for the metacognitive processes required for self-assessment.

Learner 2 (School A): "In our science class, we're supposed to do experiments and then assess how well we understood the concepts. But we don't have a proper lab or equipment. Most times, we just read about experiments in the book. It's hard to judge how well you understand something when you can't actually do it yourself."

This comment highlights a critical issue in rural science education - the lack of hands-on experiences resulting from resource constraints. This limitation not only hinders learning but also adversely affects self-assessment, as learners encounter difficulties in evaluating their practical skills and comprehending scientific concepts deeply.

Observation notes (School B): "During the group self-assessment activity, the large class size (45 students) and limited space rendered it challenging for groups to work without overhearing each other. This seemed to influence some groups' self-assessments, as they adjusted their evaluations based on what they overheard from neighbouring groups."

This observation illustrates how overcrowding and inadequate space can compromise the integrity of self-assessment activities. The inability to provide a conducive environment for independent reflection may lead to peer influence overshadowing authentic self-evaluation.

These environmental constraints align with findings from Masinire (2015), who noted that rural schools frequently encounter significant resource and infrastructure challenges. This study extends this understanding by specifically demonstrating how these constraints impact self-assessment in Natural Science. This aligns with recent work by Ramnarain and Hlatswayo (2018), who highlighted

the particular challenges of science education in rural South African contexts. Within the framework of Zimmerman's (2000) Self-Regulated Learning theory, these environmental constraints primarily affect the 'performance' phase, during which learners should be employing self-assessment strategies. The limited resources and infrastructure in rural settings create a discrepancy between the ideal conditions for self-assessment and the realities of these contexts, echoing Ololube's (2020) observations regarding the gap between educational theory and practice in rural areas. The findings reveal that these constraints not only restrict the range of experiences learners can evaluate but also adversely influence the quality and depth of self-assessment processes. This resonates with Setlhodi's (2019) work on the multifaceted challenges in rural South African education, while adding the specific dimension of self-assessment in Natural Science. Addressing these challenges necessitates innovative approaches that can function within the limitations of the rural context while still providing meaningful self-assessment experiences. This aligns with Msimanga and Lelliott's (2014) call for context-specific pedagogical innovations in science education. From a Self-Regulated Learning perspective, such innovations should aim to strengthen the connection between the 'forethought' and 'performance' phases, facilitating learners in adapting their self-assessment strategies to the available resources.

This finding uniquely contributes to the discourse by highlighting the necessity for self-assessment techniques tailored to rural Natural Science education, where practical experiments and resource-intensive activities may be limited. This suggests a potential area for future research and pedagogical development, focusing on how self-assessment can be effectively implemented in resource-constrained science learning environments.

4.3 Explore how the rural context influences learners' experiences with self-assessment in Natural Science.

This section responds to objective number three, and the following two themes emerged from the data: resource limitations and cultural influences.

4.3.1 Objective 3, theme 1: Resource limitations

The rural context significantly impacted the resources available for self-assessment in Natural Science, creating unique challenges and limitations for learners. These resource constraints not only affected the learning process but also shaped the way learners approached and experienced self-assessment.

Participants and observations noted:

Learner 1 (School B): "We don't have a proper science lab, so it's hard to do experiments and then assess our understanding. We mostly learn from the book. When we do self-assessment, I'm not sure if I'm really understanding the practical side of things or just memorising facts."

This comment highlights a critical issue in rural science education - the absence of hands-on experiential learning due to resource constraints. This limitation profoundly impacts the self-assessment process in Natural Science, where practical skills and the application of knowledge are essential. Learners encounter difficulties in evaluating their practical competencies when opportunities to develop these skills are severely restricted.

Observation notes (School A): "During the lesson on electrical circuits, learners were asked to self-assess their understanding. However, without access to actual circuit components, many students struggled to confidently evaluate their ability to construct circuits. Their self-assessments appeared to concentrate more on theoretical knowledge rather than practical application."

This observation underscores how the lack of essential scientific equipment can limit the effectiveness of self-assessment in Natural Science. Learners are compelled to focus on theoretical aspects, potentially neglecting critical practical skills that are integral to scientific understanding.

Learner 4 (School A): "Sometimes when we do self-assessment, I feel like I'm missing something. We only have old textbooks, and I've heard that science is always changing. How do I know if what I'm learning and assessing myself on is still correct or important?"

This response reveals the challenge of staying current in a rapidly evolving field like Natural Science when resources are limited. The lack of up-to-date materials not only affects learning but also impacts learners' confidence in their self-assessments, as they question the relevance and accuracy of their knowledge.

Learner 6 (School B): "In our class, we share textbooks. When it's time for self-assessment, it's hard because we can't all look at the reference materials at the same time. Sometimes I have to rush my self-assessment because another student needs the book."

This comment illustrates how basic resource limitations can directly impact the self-assessment process. The inability to access necessary reference materials individually can lead to rushed or incomplete self-assessments, potentially reducing their effectiveness.

Observation notes (School B): "The lack of diverse learning materials limited the depth of self-assessment. Learners primarily relied on textbook-based criteria, potentially narrowing their self-evaluation scope. During the ecosystem unit, learners struggled to assess their understanding of local ecosystems, as the textbook primarily featured examples from other regions."

This observation highlights how limited resources can constrain the breadth and depth of self-assessment in Natural Science. The lack of locally relevant and diverse materials can lead to a disconnect between what learners are assessing and their lived experiences, potentially reducing the relevance and effectiveness of self-assessment.

Learner 3 (School A): "We don't have computers or internet at school. I've heard that in city schools, they use online quizzes for self-assessment. It sounds like it would be easier to track progress that way. Here, we just use paper, and sometimes I lose my old assessments, so it's hard to see if I'm improving."

This response underscores the technological divide between rural and urban schools and its impact on self-assessment practices. The lack of digital tools not only limits the types of self-assessment activities available but also makes it challenging for learners to track their progress over time, an essential aspect of effective self-assessment. The resource limitations observed in our study align with Ololube's (2020) findings on the challenges faced by rural schools in developing countries, particularly in science education. This research extends this understanding by specifically examining how these limitations impact self-assessment in Natural Science. This resonates with Ramnarain and Hlatswayo's (2018) work on the unique challenges of science education in rural South African contexts. Through the lens of Zimmerman's (2000) Self-Regulated Learning theory, these resource constraints primarily affect the 'performance' phase, where learners should be applying diverse self-assessment strategies. The limited resources restrict the range of scientific experiences and self-assessment tools available, echoing Masinire's (2015) observations on the gap between educational ideals and rural realities. The findings uniquely contribute by revealing how these limitations not only constrain the types of scientific experiences that can be self-assessed but also impact the quality and relevance of the self-assessment process itself. This builds upon Setlhodi's (2019) work on multifaceted challenges in rural South African education, while focusing specifically on Natural Science self-assessment.

Addressing these challenges requires innovative approaches that maximise available resources while providing meaningful self-assessment experiences. This aligns with Msimanga and Lelliott's (2014)

call for context-specific pedagogical innovations in science education. From an SRL perspective, such innovations should aim to strengthen the connection between learners' understanding of self-assessment (forethought) and their ability to apply it effectively (performance) in resource-constrained environments.

4.3.2 Objective 3, theme 2: Cultural influences

The rural cultural context significantly shaped learners' experiences with self-assessment in Natural Science. Cultural beliefs, practices, and values influenced how learners approached self-assessment, sometimes creating tensions between traditional ways of knowing and scientific methods.

Learner 4 (School A): "In our community, we're taught to be humble. Sometimes it feels wrong to say I did well in my self-assessment, even if I think I did. Our elders say that praising yourself is not good, but in school, we're supposed to recognise our strengths."

This comment reveals a fundamental tension between the cultural value of humility and the self-evaluative nature of assessment. This conflict can lead to an underestimation of abilities or a reluctance to engage fully in self-assessment, potentially impacting learners' academic growth and self-awareness.

Learner 2 (School B): "We learn a lot about nature from our elders at home. Sometimes what we learn in Natural Science class is different, and it's confusing when we have to assess ourselves. Like when we studied weather patterns, my grandfather's traditional methods for predicting rain are different from what the textbook says. I'm not sure which one I should use when I assess my understanding."

This response highlights the complex interplay between traditional knowledge and scientific education in rural contexts. Learners often find themselves navigating between different systems of knowledge, which can create confusion and uncertainty in the self-assessment process, particularly in Natural Science, where empirical evidence is emphasised.

Observation note (School A): "During a lesson on medicinal plants, several learners confidently shared traditional uses of local plants. However, when asked to self-assess their scientific understanding of plant properties, many appeared hesitant and unsure. The disconnect between traditional knowledge and scientific categorisation seemed to create uncertainty in their self-evaluations." This observation underscores the challenge of integrating traditional knowledge with scientific education in the self-assessment process. While learners may possess rich knowledge from their cultural background, they may struggle to align this with scientific frameworks, leading to uncertainty in self-assessment.

Learner 5 (School B): "In our culture, we're taught to respect our elders and teachers. Sometimes I feel like doing self-assessment is disrespectful, like I'm questioning the teacher's judgment. Shouldn't the teacher be the one to tell us how we're doing?"

This comment reveals how cultural norms of respect and authority can conflict with the principles of self-assessment, which require learners to take an active role in evaluating their own performance. This cultural perspective can lead to resistance or discomfort with self-assessment practices.

Learner 1 (School A): "We have a strong tradition of storytelling in our community. When we do written reflections for self-assessment, I find it hard. I wish we could do oral self-assessments instead, like telling a story about what we learned and how we think we did."

This response underscores the ways in which traditional modes of expression and communication can affect learners' comfort and efficacy with various self-assessment methods. The preference for

oral communication over written reflection indicates a potential area for adapting self-assessment practices to be more culturally responsive.

Observation note (School B): "During group self-assessment activities, it was observed that learners from certain family backgrounds tended to defer to others in the group, particularly those from families with higher social status in the community. This social dynamic appeared to influence individual participation in the self-assessment process."

This observation illustrates how broader social and cultural dynamics can impact the self-assessment process, particularly within group contexts. The influence of social hierarchies on learner participation emphasises the necessity for careful consideration of group dynamics in self-assessment activities.

Learner 3 (School A): "In our science class, we're taught to question things and find evidence. But at home, questioning our elders or traditional practices is seen as disrespectful. It's hard to switch between these ways of thinking when I'm doing self-assessment."

This comment underscores the cognitive and emotional challenges that learners face in reconciling different epistemological approaches. The scientific method's emphasis on questioning and evidence can conflict with cultural norms that respect traditional knowledge, creating internal conflict for learners during self-assessment. The cultural influences observed in our study align with Semali and Mehta's (2012) research on the importance of indigenous knowledge in science education, particularly in rural areas. The findings extend this understanding by specifically examining how these cultural factors impact self-assessment in Natural Science. This resonates with more recent work by Mavuru and Ramnarain (2020), who explored the integration of indigenous knowledge and Western science in South African classrooms.

Through the lens of Zimmerman's (2000) Self-Regulated Learning theory, these cultural influences primarily affect the 'self-reflection' phase, where learners evaluate their performance against internalised standards. The tension between traditional knowledge and scientific methods creates a complex environment for self-assessment, echoing Msimanga and Lelliott's (2014) observations on the challenges of navigating multiple knowledge systems in science education. This study uniquely contributes by revealing how cultural factors not only shape learners' approaches to self-assessment but also influence their comfort levels and perceived effectiveness in self-evaluation. This builds upon Setlhodi's (2019) work on sociocultural influences in rural South African education while focusing specifically on Natural Science self-assessment. Addressing these cultural factors requires sensitive and innovative approaches that bridge traditional and scientific knowledge systems. This aligns with Khupe and Keane's (2017) call for culturally responsive science education in African contexts. From an SRL perspective, such approaches should aim to help learners integrate cultural values with scientific self-assessment practices, strengthening the connection between personal beliefs (forethought) and self-evaluation strategies (self-reflection).

5. Conclusion and Recommendations

This study explored Grade 6 learners' experiences of self-assessment in Natural Science at two rural schools in KwaZulu-Natal. The findings reveal that learners' engagement with self-assessment is significantly influenced by their understanding of its purpose, their ability to apply self-assessment techniques, personal barriers, and environmental constraints. The rural context, characterised by resource limitations and unique cultural influences, plays a crucial role in shaping these experiences. This research conclusively demonstrates that effective self-assessment in rural Natural Science education is hindered by both institutional and personal factors. Institutional challenges, including limited resources and inadequate teaching methods, directly impact the quality and frequency of self-assessment practices. Personal challenges, such as a lack of confidence in self-evaluation and cultural conflicts between traditional knowledge and scientific methods, further complicate learners'

ability to engage in meaningful self-assessment. These findings align with Zimmerman's Self-Regulated Learning theory, particularly highlighting gaps in the forethought and performance phases of self-assessment in rural contexts. The study extends current understanding by illustrating how the rural environment specifically impacts self-assessment in Natural Science, an area previously underexplored in the literature.

It is important to acknowledge the limitations of this study. The focus on two rural schools in KwaZulu-Natal limits the generalisability of the findings. Additionally, the study's qualitative nature, while providing rich insights, does not allow for quantitative measurement of the impact of various factors on self-assessment practices. Future research could benefit from a larger sample size and a mixed-methods approach to provide a more comprehensive understanding of self-assessment in rural Natural Science education across South Africa.

Based on these findings and acknowledging the study's limitations, we recommend that schools develop and implement programmes specifically designed to support learners' self-assessment skills and scientific literacy in rural contexts. These programmes should focus on explicit instruction in self-assessment strategies, provide regular opportunities for guided practice, and integrate self-assessment into daily science activities. Crucially, efforts should be made to bridge the gap between traditional knowledge and scientific methods, helping learners navigate different ways of knowing. Furthermore, given the resource constraints in rural schools, we recommend fostering a culture of resourcefulness and contextual learning. Educators should be encouraged to develop innovative approaches to Natural Science education and self-assessment that maximise available resources and leverage local knowledge. This could include developing locally relevant science projects, utilising natural surroundings for practical learning, and adapting self-assessment tools to suit the rural context. Building partnerships with local communities to tap into indigenous knowledge and practices can enrich Natural Science education and provide culturally relevant contexts for self-assessment. By implementing these recommendations, schools can create an environment that enhances learners' engagement with self-assessment in Natural Science, despite the challenges posed by the rural context. This approach not only addresses the immediate needs identified in our study but also lays the groundwork for more effective, culturally sensitive, and resource-conscious educational practices in rural South African schools.

6. Declarations

Funding: The study received no external funding.

Acknowledgement: I acknowledge the views of participants in this study.

Conflict of interest: The author declares no conflicts of interest.

Data availability: The data presented in this study is available on request from the corresponding author.

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