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Factors Influencing Life Sciences Learners' Engagement in Classroom Questioning: A Case of Learners from Rural Contexts

Hlologelo Climant Khoza
University of Pretoria
climant.khoza@up.ac.za

Abstract

Learner engagement in Life Sciences classroom questioning has been seen as a driver of meaning-making. However, research suggests that this engagement is minimal in rural science teaching contexts. The purpose of this study was to investigate factors that influence rural school Life Sciences learners' engagement in classroom questioning. A conceptual framework consisting of several theoretical positions regarding science classroom questioning was developed to ground the study. Using a qualitative case study approach, data were collected through open-ended questionnaires. The 128 questionnaires were analysed using a qualitative content analysis. This analysis yielded six categories that characterise inhibiting and enabling factors to classroom questioning engagement. These categories include teacher orchestration of classroom questioning, teacher perception of questioning, learner preference and perceptions of questioning, learner anxiety and resilience, learner resonance with the topic, as well as language issues. I argue that it is important for Life Sciences teachers to realise these factors, especially issues of learner anxiety and language. A recommendation from this study is that teachers need to be trained in strategies that can be used to deal with the factors that inhibit Life Sciences learners' engagement in classroom questioning.

Keywords: *classroom questioning, engagement, Life Sciences learners, rural context*

Introduction

Classroom questioning is a core pedagogical practice that shapes learners' cognitive engagement, conceptual understanding, and the co-construction of science knowledge (Chin, 2007; Smart & Marshall, 2013). Through the strategic use of questioning, this pedagogy engages learners cognitively and promotes critical thinking and reflective learning (Chin & Brown, 2000). Hence, scholars in science education have always advocated for teacher and learner engagement in classroom questioning (see Chin, 2007; Khoza & Magadlela, 2025). Engagement in science classroom questioning encompasses the teacher asking questions and learners responding, as well as learners asking questions either to the teacher or to fellow learners. This study focuses on factors that influence Life Sciences learners' engagement in classroom questioning. In the South African context, Life Sciences is one of the subjects (amongst Physical Sciences and Natural Sciences) that involves complex biological concepts that require engagement in questioning to foster both conceptual understanding and application to real-life contexts (Siphukhanyo & Olawale, 2024). Furthermore, according to Zhang and Lamb (2025), questioning enables learners to articulate ideas, challenge misconceptions, and connect biological concepts. While learner engagement in science classroom questioning is considered significant for the construction of knowledge, it is not always a given that learners will engage. In the science teaching context, engagement is mediated by individual learner characteristics such as prior knowledge and

motivation, as well as other related issues like classroom dynamics and school-related factors (Harris & Williams, 2012; Reeve, 2012), hence the need to investigate these factors in specific science teaching contexts. In rural Life Sciences classrooms, these dynamics often take on distinct forms shaped by contextual realities perpetuated by linguistic challenges for both the teacher and learners (Seah et al., 2025). Therefore, the problem regarding classroom questioning in this study is seen from the perspective of teachers and learners in rural science classrooms. Rural classrooms in this study are defined as classrooms that are situated in schools in remote areas characterised by infrastructural limitations such as poor road access, under-resourced and overcrowded classrooms (Maphalala et al., 2023), and a lack of basic science resources and laboratories (Soyikwa & Boateng, 2024). In the South African context, rural classrooms differ from urban classrooms in the sense that rural classrooms are populated with learners from low socio-economic households (Hlalele, 2014) who exhibit language challenges and often face cultural practices and community expectations that shape their aspirations. Therefore, such learners come to science classrooms with limited exposure to formal scientific discourse and prior experiences that may not align with the science ways of explaining (Soyikwa & Boateng, 2024). Therefore, some learners from this context may struggle to engage in questioning and scientific discourse (Farrell & Tharpe, 2024). Against this background, in this study, I sought to investigate factors that influence learner engagement in Life Sciences classroom questioning. By foregrounding the voices and experiences of rural Life Sciences learners, I seek to illuminate both enabling and constraining factors by addressing the following research question: *What factors influence rural school Life Sciences learners' engagement in classroom questioning?*

Review of Related Literature

The purpose of this literature review is to provide an overview of research related to questioning practices in science classrooms generally. I begin by presenting literature on teacher questioning practices and then move to how learner engagement in classroom questioning may occur.

Within broader learner engagement pedagogy, teachers ask questions for different instructional purposes (Ainley, 2012). For example, teachers can ask questions to organise the classroom, give instructions, scaffold learners' thinking, as well as drive classroom discourse (Kawalkar & Vijapurkar, 2013). In science classrooms, questions can be asked by the teacher or the learner as per the Initiation-Response-Evaluation/Feedback interaction (IRE/F) pattern developed by Sinclair and Coulthard (1975). The teacher asks questions at the "I" level, thereby inviting learners' contributions or at the "E/F" level to follow up on the learner's contribution. Literature is replete in terms of the types of questions that the teacher can ask to facilitate engagement (see for example, Khoza & Msimanga, 2022; Tytler & Aranda, 2015). What can be gleaned from these studies (amongst others) is that teacher questions are categorised in terms of their purpose at different points during science lessons. Literature advocates for following up on learner response through extended and challenging questions (Khoza & Msimanga, 2022; Bansal, 2018). The authors argue that such questions can lead to heightened interaction. Effective questions asked in a psychologically safe learning environment support learning by probing for understanding, encouraging creativity, stimulating critical thinking, and enhancing confidence, thereby engaging learners in a dialogic discourse (Bansal, 2018). However, teachers can also ask poor questions that can inhibit learning by creating confusion as well as limiting creative thinking (Chin, 2007). Unfortunately, observations of classroom-based instructors have shown that lower-order questions are frequently used (see Khoza, 2023), usually due to teachers' attitudes and lack of knowledge of questioning (Eshach et al., 2014).

Although teachers may value questioning in science classrooms, learner contributions are necessary as they also drive the overall classroom interaction. Depending on lesson goals, teachers can allow learners to ask questions to seek clarity and extend their understanding of science content (Kaya & Temiz, 2018). According to Webb et al. (2019), when learners engage in

questioning by providing responses to teacher questions or asking questions themselves, they can monitor their own thinking and learning by offering ideas. Hardman (2020) categorised learner talk into brief learner contribution, extended learner contribution, learner closed question and learner open question. While learner responses to teacher questions can drive interaction and allow the teacher to detect misconceptions (Khoza, 2023), the significance of learner-generated questions in the learning process has been argued in previous literature (see for example, Almeida, 2012; Herranen & Aksela, 2019; Kaya & Temiz, 2018). Learner-generated questions can activate prior knowledge and promote deeper knowledge elaboration, enabling learners to concentrate on content and evaluate their understanding (Eshach et al., 2013). This practice allows them to articulate their current understanding, establish connections between concepts, and identify areas of confusion. However, the literature suggests that learners seldom ask questions during instruction (Eshach et al., 2013). For example, asking a question in class can evoke feelings of exposure and vulnerability. Cavanagh (2014) argued that when learners are exposed to vulnerability, they tend to reserve their views due to a lack of confidence. Sometimes language issues play a role where learners may lack proper scientific language to contribute to classroom questioning (Karlsson et al., 2019; Tagnin & Ní Ríordáin, 2021). In rural settings, this is often compounded by linguistic challenges, where learners speak a home language different from the language of instruction (Salloum & Boujaoude, 2020) while science content itself is a new language (Khoza, 2024). As a result, teachers need to provide learners with supportive guidance in a safe and encouraging environment, scaffolding their use of scientific language, clarifying concepts, and creating opportunities for all learners to engage in questioning. This approach is essential not only for conceptual understanding but also for fostering learner confidence and engagement in science learning, which can be a variable in rural contexts. Another reason reported in the literature for learners not to ask questions is the limited time available to develop and articulate questions (Chin & Brown, 2000). Thus, some researchers have recommended 'wait-time' as well as allowing learners to cognitively engage with the question before verbalisation (Khoza & Nyamupangedengu, 2018).

While the literature canvassed here contributes to our understanding of classroom questioning, there remains a distinct gap in research that investigates factors influencing learners' engagement in classroom questioning in science classroom settings, particularly in the Life Sciences classroom. Life Sciences bridges concrete observable phenomena with theoretical explanations, which may present unique pedagogical opportunities for questioning-based instruction. As argued above, rural Life Sciences classrooms often face unique challenges, such as under-resourced classrooms and socio-cultural dynamics that may interact with barriers to classroom questioning. Furthermore, the prevalence of terminology in the Life Sciences subject necessitates teachers to engage learners in discourse through questioning (Tagnin & Ní Ríordáin, 2021).

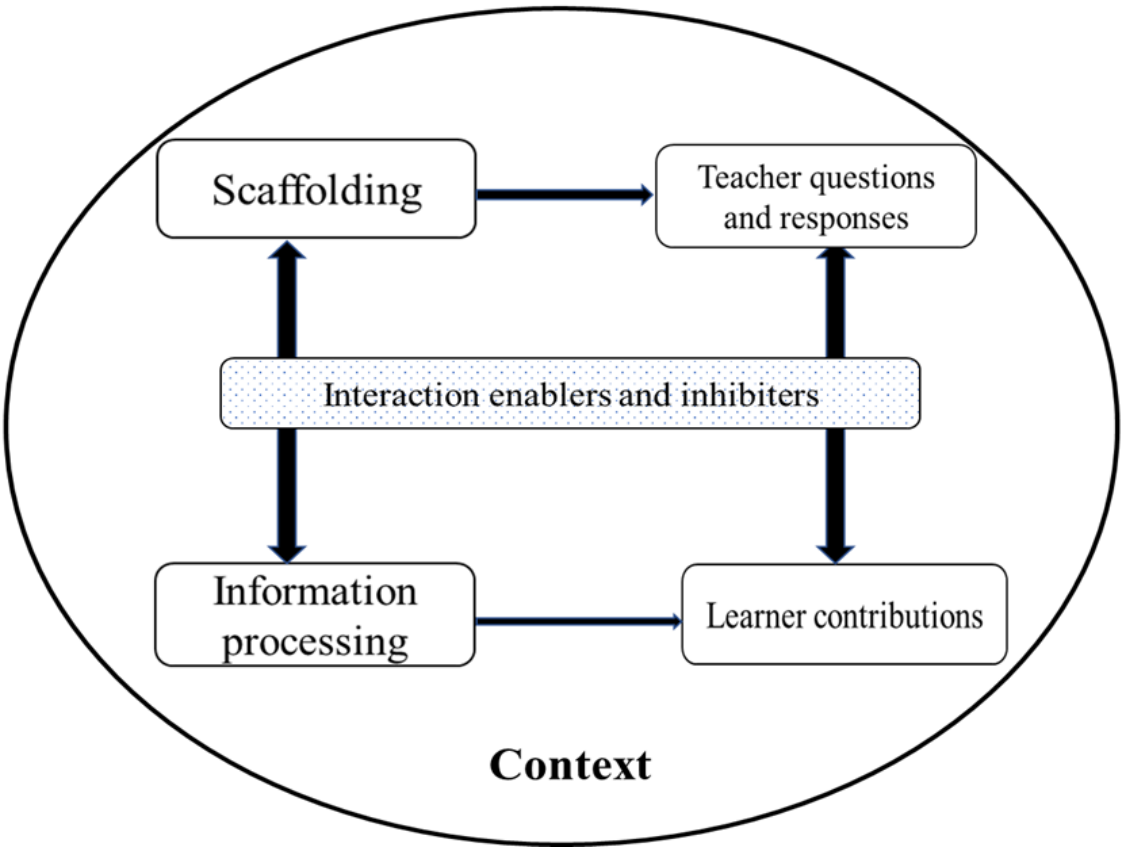
Theoretical Perspectives

In designing this research, I drew from various constructs to underpin factors that influence the engagement of Life Sciences learners from rural contexts in classroom questioning (see Figure 1).

In Figure 1, I begin by acknowledging the contextual nature of classroom questioning. In this study, the context is Life Sciences classrooms in rural schools. Investigating classroom questioning in this context highlights how learning can be supported through classroom questioning, such that learners can articulate scientific concepts. The theoretical framework for this study recognises that classroom questioning involves two or more players: the teacher and learners, who learn from the teacher and from each other. While the role of the learner is to contribute to classroom interaction through answering and asking the teacher questions, the role of the teacher is to ask questions and respond to learners' contributions. Learners' contributions can be both answering questions posed by the teacher as well as asking questions

either of the teacher or possibly other learners. Theoretically, teacher questions and responses to learners are underpinned by the notion of scaffolding from Vygotsky's (1978) socio-cultural theory. The emphasis in Vygotsky's theory is that individuals learn in a socially mediated context, and social interactions heavily shape their learning. Classroom questioning provides this social interaction where the teacher is a more knowledgeable other. From this theory, I also draw from Vygotsky's concept of the Zone of Proximal Development (ZPD), which views learner development as the gap between what they can achieve independently and what they can accomplish with guidance or collaboration. This guidance emerges when there are tools to provide the necessary scaffold (Wood et al., 1976) – in this case questions.

Figure 1: ***Theoretical Perspectives of the Study***



To theoretically ground learner contributions, through questions and responses to teacher questions, I draw from the information processing model developed by Atkinson & Shiffrin (1968). Using their model, I argue that learners internalise the question through their senses and then process it to make decisions regarding how they respond. Learners can select which questions to answer and what questions to ask during classroom interactions. Learners do this by identifying concepts, recalling their meanings, and forming a mental representation of the combined message (Anderson, 2004). Once the question is understood, learners generate their response by retrieving relevant information from memory or curriculum materials and manipulating this information to construct their answers (Jakobsson et al., 2024) and even ask further questions, thus actively engaging in classroom questioning. For the purposes of this study, I assume that in the science teaching context, classroom questioning is influenced by specific enabling and inhibiting factors which this study is seeking to reveal. I hypothesise that enablers and inhibitors may be situational, psychological and content-related.

Research Design and Methodology

This study addresses the research question: *What factors influence rural school Life Sciences learners' engagement in classroom questioning?* It uses a qualitative methodology, drawing from the interpretivist paradigm (Cresswell & Cresswell, 2018). This approach allowed me to delve deeper into learners' thinking regarding their perceptions of classroom questioning. I used an exploratory case-study strategy (Hamilton & Corbett-Whittier, 2013), where the case was defined in terms of context: Rural Life Sciences classrooms.

Participants

The participants were 128 learners from two public high schools located in the province of KwaZulu-Natal, South Africa. They were in Grades 10 and 11, and were selected using purposive and convenience sampling methods on the basis that they were studying Life Sciences in a rural context and were available to engage in the study. Both schools are located far from town and serve communities which are mostly dependent on government grants. This study was approved by the University of Pretoria, Faculty of Education, ethics committee under protocol number EDU096/23, and all ethical protocols, including learners' and parents' consents, were sought before collecting the data.

Data Collection

Data were collected through the distribution of an open-ended questionnaire (See Appendix A). The questions were specific to engagement in Life Sciences classrooms. An initial questionnaire was piloted with 5 learners whose data are not included in this study. The learners were then interviewed, asking them about the clarity of the questions. This led to the refinement of the questionnaire. For example, the first question was initially phrased as 'Between open-ended and closed-ended questions, which ones do you prefer?'. During the pilot phase, I realised that there was a need to first ask learners if they ask questions (items 3 and 6) to reveal their preference before asking for motivation. Many learners responded to the questionnaire. Although I asked closed-ended questions in items 3, 5 and 7, this does not qualify the study as quantitative. The purpose of these questions was to 'lead' the learners into the more open-ended questions.

Data Analysis

To analyse the questionnaires, a qualitative content analysis was employed, where the goal is to condense the raw data into categories that assist in addressing the research question (Hsieh & Shannon, 2005). Together with an independent researcher, we coded 10 questionnaires to establish initial codes by allocating the phrases that characterise some of the aspects that influence the learners' engagement in classroom questioning. Discrepancies were resolved through discussion, thereby increasing intercoder agreement and ensuring trustworthiness. Table 1 shows some of the codes used.

I then coded the rest of the questionnaires. The coding process was iterative, involving continuous comparison and memo-writing, as suggested by Braun and Clarke (2006), to ensure depth and consistency in category formulation. The codes were then reduced into meaningful categories. These codes and categories were then clustered into thematic categories reflecting enabling and inhibiting factors.

Table 1: ***An Example of the Coding Process***

Extract from questionnaire	Allocated code
The teacher does not give us a chance to ask questions… she asks questions.	Teacher as authority
I want to ask questions but sometimes I am afraid to ask because of my English… some learners will laugh at me	Role of language of communication
Even if I know the answer, I keep quiet until the Mrs X points at me because I am not sure of my answer	Learner confidence
Mr X asks difficult questions when he starts the lesson and most of us keep quiet…	Nature of teacher questions
I think the teacher should ask us challenging questions but not too challenging	Nature of teacher questions
I write down my answers and correct myself afterwards… I prefer not to answer because I might be wrong.	Learner confidence and anxiety
Sometimes I know the answer but I don't know how to put it.	Lack of scientific terms
I ask questions but Mrs X does not answer us. She says we must find out ourselves	Teacher approach to learner questions

Findings

Analysis of data revealed several factors that influence learners' engagement in classroom questioning. These factors are categorised into the six themes presented in Table 2 below. It is important to note that these themes are interrelated.

Category 1: Teacher Questions and Responses to Learner Contributions

The first category is about how Life Sciences teachers ask questions as well as how they respond to learner contributions. Here, learners allude to not being given enough time to process the questions; the complexity of the questions asked; the clarity in the questions asked; as well as teachers' response to their contributions. Extract 1A suggests that there is no clarity in the way in which teacher questions are structured. Therefore, the learners must "*read between the lines*". Another learner shared the same sentiments by stating, "*The teacher asks too many questions at once and I don't know which one to answer*" in support of clarity in questioning practices. Extract Extracts 1B and 1D show the lack of 'wait-time' during classroom questioning by arguing that while they are still trying to make sense of the question, the teachers become impatient and end up answering their own questions. In terms of ways in which teachers respond to learner contributions, Extract 1E reveals that there are usually no follow-ups on their responses. This was also supported by another learner who said, "*I get discouraged when the teacher says nothing after I have answered the question… she just continues teaching us*". 1C reveals that the learner does not like long questions because they are difficult. Another learner writes, "*I usually engage when I can see something and talk about it*", to suggest that where questions are accompanied by visuals, this acts as an enabling factor. Since questioning in science classrooms also involves learner-initiated questions, the learners shared practices related to their initiated questions in Life Sciences classrooms. While Extract 1H is about teachers 'parking' learners' questions that are deemed irrelevant and not asked at the right time, Extracts 1G and 1H are about the behaviour

and teachers' implicit and explicit messages when learners ask questions. These extracts reveal that learner questions may not be valued by some Life Sciences teachers and learners in the class.

Table 2: ***Categories of Factors Influencing Life Sciences Learners' Engagement in Classroom Questioning***

Category of factors	Examples of evidence from data
Teacher questions and responses to learner contributions	Extract 1A: I don't understand his [the teacher] questions and sometimes I have to read between the lines to get what he is asking
	Extract 1B: I engage when I am given enough time to think about the question. In many cases, the teacher does not give us time so that we understand the question well and it is frustrating.
	Extract 1C: The teacher likes long questions and I get confused because they are difficult. This is why I prefer to not answer questions and wait for the answers from my friends.
	Extract 1D: The teacher does not give us enough time to understand the questions… she answers them.
	Extract 1E: The teacher must correct you if you are wrong and tell you what is the correct answer and make you understand.
	Extract 1F: The teacher should say if I am wrong or right… sometimes she does not say.
	Extract 1G: If we ask, we are afraid that maybe he would shout at us that we not listening.
	Extract 1H: … whenever I ask a question, I am always told that this will be done next week and it is never answered.
	Extract 1I: I do engage but not always because I ask a lot and my teachers and other learners don't like it. They think I am wasting time.
Teacher perceptions of questioning	Extract 2A: The teacher thinks we are stupid because she does not ask us many questions. She gives us all the information even when I want to answer questions.
	Extract 2B: I don't think our teacher likes to ask us questions because she teaches and teachers without asking us anything
	Extract 2C: The only time I answer questions is during a test because in our class, we sit and listen.
	Extract 2D: We are asked questions when the lesson starts and after that, we just listen to the teacher telling us the information.
	Extract 2E: A lot of time, we are asked "what do you understand by…"
Learner anxiety and resilience	Extract 3A: Even if they laugh, I understand if I ask questions
	Extract 3B: Even if I don't know, I like to challenge myself with hard questions if the teacher asks
	Extract 3C: I always push myself to understand other learners when they argue on the question asked so that I can also answer and ask questions
	Extract 3D: Sometimes I'm afraid of learners that they would laugh at me then I have shy
	Extract 3E: Because sometimes I get scared to talk in front of other learners. I answer if I am sure of my answer.
	Extract 3F: I do not know how to ask… my questions are not put correctly.
	Extract 3G: I don't like it when the teacher just calls me if my hand is not up because I freeze and get scared to answer even if I know the answer.
Learner preference	Extract 4A: If there is someone that does not understand clearly, she/he could get help fast… I do that a lot because if I ask questions that relate to me, I can understand

Category of factors	Examples of evidence from data
and perceptions of question types	Extract 4B: I like short questions because they are easy to answer. Long questions become complicated for me and I get confused. Extract 4C: Long questions help you to learn the life sciences content well because they introduce you to more things that you did not know… Extract 4D: When you I have the knowledge, I can engage and ask questions… I like to share the knowledge I have especially with the question that says "Describe something", when the teacher says describe something, I think carefully and practice that in my mind. Extract 4E: I like hearing more of others' opinions as it helps me understand the topic. If others ask long questions, I get excited because I can also provide my view. Extract 4F: I like asking long questions because I gain information about the topic and challenging my knowledge. Extract 4G: Hard questions because it makes me to concentrate and work hard to find those answers. Extract 4H: I prefer short questions because I can easily get them correct but the teacher always asks hard questions. Extract 4I: The teacher has to ask questions that we can relate to and about things we can see and be able to explain because we need to talk about science even when are at home. But the teacher does not ask us these questions.\
Learners' resonation with the Life Sciences topics	Extract 5A: I do not engage when questions do not speak to me because I may not have an opinion about the topic because it doesn't interest me. Extract 5B… like with how life began on earth, I never engage or ask questions because I do not believe in it. Extract 5C: I ask questions with other topics and not others. For example, I prefer to keep quiet when we do how life began. I am a Christian and do not believe in that. Extract 5D: The reason is that some topics bore me and when I am bored, I don't ask questions or answer the teacher. Extract 5E: We were doing plants and I don't like plants. I lose interest whenever the teacher talks about plants because I am like "why should we do plants?"
Language	Extract 6A: Name of words become difficult and other words are hard to understand and say… Extract 6B: I am not sure how to ask questions because sometimes I don't understand the terms and I give up. Extract 6C: Some words are just difficult to pronounce and it gets challenging to say to the teacher that you don't understand because he will ask what is it that you don't understand and I will struggle to say it. Extract 6D: The teacher does not allow us to answer in Isizulu and some things make sense to me in this language. Sometimes I ask in my language and other learners correct me. Extract 6E: To be honest, when I think of the questions, I think in my language and then struggle to say that in English.

Category 2: Teacher Perceptions of Questioning

The second category reveals that teachers may have perceptions which inhibit learners' engagement in classroom questions. Although the extracts in Table 2 seem to be about how learners perceive their Life Sciences classrooms, what can be gleaned is that some seldom ask questions because the teacher does not seem to value classroom questioning. Extracts 2A and 2B reveal a learner's concern regarding how their teacher views them. Close to what these learners shared, another learner wrote, "*there are no questions to answer in our class… it is the teacher who tells us the information and we take notes*". This is corroborated by Extract 2C, where the learner shared that they are only allowed to answer written questions during a test or an exam. When questions are asked by the teachers, it is usually at the beginning of the lesson (see Extracts 2D and 2E). Therefore, where teachers do not ask questions throughout the lesson, this becomes a factor that inhibits learners from engaging in classroom questioning.

Category 3: Learner Anxiety and Resilience

The third category pertains to learner anxiety and resilience, characterising both inhibiting and enabling factors. In terms of inhibiting factors, Table 2 shows how some learners experience anxiety when they have to answer or ask questions due to other learners laughing at them; how to structure their initiated questions; and being unsure of their responses. Anxiety emerges as a clear inhibitor of learner engagement in classroom questioning. However, in terms of enabling factors, some learners reported that despite feeling anxious, they 'push' themselves to put their thinking across, thus revealing resilience as a contributing factor to their engagement. For example, one learner (see Extract 3C) shared that they ask and respond to questions even if they are unsure of their contributions. Another learner wrote, "*Some learners would laugh if I answer in the wrong way, but I don't care… I continue to ask questions*". Despite apparent risks, they persist in asking and responding to teacher questions in their Life Sciences classrooms.

Category 4: Learner Preference and Perceptions of Question Types

In this category, learners' preferences and perceptions of question types related to both the teacher questions as well as learner-initiated questions. While one learner's preference in Extract 4A is about the learner-initiated questions, another learner in Extract 4I relates to the questions asked by the teacher. These two extracts reveal the issue of contextualised questions that help learners link the science content to what they experience in their everyday lives. While some learners prefer short questions (see Extracts 4B and 4H), others prefer long questions and questions that request them to "*describe*" (see Extracts 4C, 4D and 4F). Another learner in Extract 4D noted that they prefer "*hard questions*" from the teacher. Their preferences seem to stem from their perceptions regarding various types of questions. For example, learners described that hard and long questions challenge and engage them in a science discussion, as seen in another learner's questionnaire who wrote, "*when I think deeply about the question [long questions] I know I am learning*". Others, like in Extract 4E, described that when they ask long questions, they can provide their view, thus participating in classroom questioning.

Category 5: Learners' resonation with the Life Sciences topics

Regarding the fifth category, the nature of the topics taught plays a role in whether learners engage in classroom questioning or not. Learners who engaged in this study mostly shared how some topics that do not resonate with them, based on several aspects like interest and religion, inhibit them from participating. As shown in the extracts (see Table 2), learners' engagement in questioning is impacted by whether they resonate with the topics or not. This resonance emerges from interest and being knowledgeable about the topic (see Extracts 5A, 5D and 5E). Specifically, Extract 5E reveals the learner's questions regarding why they should engage in certain topics like plants. Some learners' resonance with the topic emerges from religions and

cultures. For example, the learner in Extract 5C described how their religious beliefs prevent them to not engage during the teaching of topics like the history of life on earth.

Category 6: Language

The last category centres on issues of language. Data reveal language as an inhibitor to engagement in classroom questioning. Although not many learners alluded to this factor, the few who described the complexity of terminology and how it is difficult for them to pronounce the scientific terms (see Extracts 6A and 6C). One learner wrote, "*Some words you can't even say in your own language… it is just that English [scientific] term*" to describe the difficulty of technical terms in science. The learners further described a lack of opportunity for them to ask questions and respond to teacher questions. For some, meaning is lost as they think in their languages and then translate their thinking to English (see for example, Extract 6E). This struggle means they end up not participating in class questioning.

Discussion

This study reveals both enabling and inhibiting factors that can influence rural learners' engagement in classroom questioning in Life Sciences. How teachers ask questions at the Initiation level of the Initiation-Response-Evaluation/Feedback interaction pattern, depends on the instructional purpose, and determines how learners will respond (Kawalkar & Vijapurkar, 2013). Learners note a lack of clarity in questions as an inhibitor of their engagement in classroom questioning. Participants in this study described clarity as relating to the conciseness of the questions and whether questions are closed-ended or open-ended (Chin, 2007). They want to understand what the question requires them to do so that they can tailor their responses accordingly. Another point they raised relates to how the teachers seldom respond to their contributions. Data in this study suggests that teachers continue with the lesson without engaging with learner contributions. This is consistent with findings reported by Rop (2002), who highlights the paradoxical nature of classroom questioning, noting that it carries conflicting meanings due to the competing pressures present in daily classroom interactions: teachers often feel constrained by time and unable to accommodate extensive learner questioning. Like Rop (2002), Whittaker (2012) found that learners' questions are sometimes perceived as disruptions to the structured flow of lessons, potentially threatening classroom control and the ability to cover required content. This is a factor that inhibits learners from participating in questioning, potentially compromising their understanding and engagement in class, especially for those who value interaction and active learning. Literature describing questioning strategies in science classrooms emphasises the role of teacher follow-ups at the evaluation level of the Initiation-Response-Evaluation approach (Khoza & Msimanga, 2022; Bansal, 2018), even though some learners in this study seem to prefer being told if their answer is right or wrong. In other words, follow-up moves serve as critical junctures where classroom discourse can be expanded through prompting, revoicing, or juxtaposing student ideas. Where teachers use classroom questioning to follow the learners' responses and understand their thinking, deeper knowledge elaboration can be ignited, which also supports learner-initiated questions (Almeida, 2012). In this way, teachers can maximise learner engagement.

Although this study found that Life Sciences teachers do ask questions when teaching, it also became clear that they do not provide enough time for learners to process the questions, thereby inhibiting the learners from engaging. Providing learners with enough time to process information is explained by the notion of 'wait-time'. An & Childs (2023) found that 'wait-time' allows learners to join the classroom interaction and produce lengthy responses to teacher questions. By contrast, where teachers fail to 'wait' after asking a question, this makes learners lose interest in engaging in questioning, even if the learners know the answer. Rowe (1986) found that the average wait time in classroom interactions was one second or less. If a learner

did not respond within this brief period, teachers would often repeat or rephrase the question, pose a different question, or call on another learner. Even though rephrasing the question is desired in some cases, a lack of wait time may disturb learners' processing of the question, as some learners noted in this study. To explore the impact of extended wait time, Rowe (1986) trained teachers to pause for three to five seconds before responding. This adjustment led to significant improvements in both the quantity and quality of learner responses. Learners provided longer answers and engaged more with the content. Therefore, wait-time should be embraced to allow learners to answer teacher questions as well as ask questions since they would have had ample time to identify the necessary science concepts, recall their meanings, and form a mental representation of the combined message (Anderson, 2004).

Data in the current study further reveal that learners' preference and perceptions of questioning type may influence their engagement in classroom questioning. Some learners described preferring short and straightforward questions, while some expressed a preference for lengthy questions that challenge their thinking. Some preferred contextualised questions and questions that are accompanied by visuals. A factor which emerged as enabling learning and engagement was contextualising questions to assist learners to personally relate to some Life Sciences topics. This also helped learners cross the border from beliefs perpetuated by factors like religion and culture (as mentioned by some learners) to understanding science as a way of explaining natural phenomena. Although issues of religion versus science can also be found in urban schools (Billingsley, 2013), religion and cultural backgrounds are more prevalent in rural settings because such communities tend to maintain closer ties to traditional practices, belief systems, and collective identities compared to urban contexts. For example, Borgerding (2017) suggested that leveraging 'rural' funds of knowledge can help bridge the gap between learners' deeply rooted beliefs and science. Hence, contextualising science and leveraging learners' prior knowledge (including religious and cultural beliefs), especially in the introduction phase of lessons, can motivate learners and increase their interest in learning science (Davidsson & Granklint-Enochson, 2021). Thus, in a study by Zhang and Chen (2024), Life Sciences learners favoured contextualised and scenario-based questions and appreciated questioning approaches that minimised teacher dominance.

Although the learners in this study generally value questioning in Life Sciences classrooms, their confidence, anxiety, and resilience significantly influence their engagement. In rural settings, anxiety has been noted as an influence on learner confidence and engagement (Hlalele, 2014). Some learners reported lacking the confidence to ask or respond to teacher questions, while others experienced anxiety. This anxiety often stemmed from teachers' attitudes and questioning styles, as well as from learners' fear of providing incorrect or inadequate answers, which affected their morale (Özbuğutu, 2021). A study revealed that the primary factor contributing to this anxiety was the fear of negative evaluation—the apprehension of being judged unfavourably while speaking in front of the class, particularly when not volunteering (Cooper et al., 2018). Asking a question in class can evoke feelings of exposure and vulnerability, thus overshadowing learner curiosity and engagement in classroom questioning. Therefore, learners need an inclusive and motivating environment for them to engage with Life Sciences questions through motivation and cultivating resilience (Skinner & Pitzer, 2012). This is because rural learners often face low confidence levels. This inclusion can take the form of appreciating their contextual background and prior knowledge about various science topics during classroom questioning (Chen et al., 2017).

While language is seen as a tool for engagement in science classroom discourses (Semeon & Mutekwe, 2021), findings in this study suggest that it is an inhibitor for learners to engage in classroom questioning. Learners cited the inability to put their points across due to science terminology and difficulties expressing themselves in the language of teaching and learning. This is not surprising as rural learners often face linguistic challenges (Probyn, 2015). Learners for

whom language is a barrier to engagement require inclusive classrooms and, in this context, effective use of questions to support learning is a particularly powerful pedagogic tool. Therefore, teachers should be encouraged to ask open-ended questions as well. This finding builds on existing literature. For example, according to Tagnin and Ní Ríordáin (2021), teachers need to allow learners to use their own languages through code-switching and translanguaging. This may alleviate the problems of a lack of learner-initiated questions as reported in some studies (Watts & Pedrosa de Jesus, 2010). Furthermore, in this study (as seen in Table 2), it seems like teachers do not allow them to use their own vernacular, thus inhibiting them from participating in classroom questioning. Hence, English second-language speakers like those in rural schools may require more time to comprehend, process, and navigate scientific concepts than native English speakers during classroom questioning. Studies have also reported language as a factor that influences learner engagement in science activities, thus impacting their achievement (see for example, Prinsloo et al., 2018; Salloum & Boujaoude, 2020). Arguably, learning a subject like Life Sciences depends on the learner's ability to develop scientific language using English. In other words, learners should not only be competent and familiar with ordinary English registers but also be able to build substantial linguistic skills to engage in classroom questioning (Binothman et al., 2024).

Conclusion and Recommendations

This study aimed to investigate factors that influence Life Sciences learners' engagement in classroom questioning in a rural teaching context. Data reveal factors including how their Life Sciences teachers orchestrate questioning; teachers' perceptions of questioning; learners' preferences and perceptions of question types; anxiety and resilience of learners; as well as language issues. These factors interactively serve as both enablers and inhibitors of Life Sciences learners' engagement in classroom questioning. What is novel about this study is its rural context, where the voices of learners are often neglected. Orchestrating classroom questioning necessitates a need for awareness of such factors in rural science teaching contexts. These findings carry implications for science teaching in rural schools. For example, the learners' struggles with language, teacher responsiveness, and cultural resonance with topics signify how rurality is not just a geographic condition, but a pedagogical constraint. A recommendation from this study is that in rural Life Sciences teaching contexts, teachers must be cognisant of these factors to maximise learners' engagement in classroom questioning. Teachers should understand the anxiety as well as the language barriers that rural learners experience when engaging in classroom questioning. The findings in this study also suggest that teacher education programmes need to equip Life Sciences teachers with various tools and strategies on how to deal with learner anxiety and language barriers. Such strategies can involve how to build learners' resilience to overcome anxieties, language barriers and other contextual issues during classroom questioning.

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Appendix A: Questions Included in the Open-ended Questionnaire

1. What kind of questions do you think should be asked by your Life Sciences teacher during lessons?
2. What role do your teacher's questions play in your learning of Life Sciences content?
3. Do you usually answer questions from your teacher? State Yes or No.
4. If you wrote "yes" in question 3, explain why you answered questions from your Life Sciences teacher. If you wrote "no", in question 3, explain why you do not answer questions from your Life Sciences teacher.
5. Do you engage in discussions during your Life Sciences lessons? State Yes or No
6. If you wrote "yes" in item 4, how do you engage? If you wrote "no", why do you not engage?
7. Do you ask questions in your Life Sciences lessons? State Yes or No
8. If you wrote "yes", explain why you asked questions. If you wrote "no", explain why you do not ask questions.