



Unpacking Experienced and Novice Science Teachers' Understandings of Teacher Talk in Whole Class Discussions

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While there is a vast literature arguing that teacher talk in whole class discussions is a determinant of quality science teaching, teachers' understanding of enacting teacher talk is under-researched. Using teacher cognition as a theoretical lens, the purpose of this study was to explore how experienced and novice science teachers in South Africa understand teacher talk in whole class discussions. Multiple case-study design was adopted and data was collected from thirteen science teachers through interviews. Six of these teachers were considered novices and seven were considered experienced. A thematic analysis approach was used to make sense of the data. The teachers' nature of understanding was further categorised into authoritative, constructivist and transitional. A notable finding is that the majority of novice teachers displayed a constructivist profile while a majority of experienced teacher displayed an authoritative profile. Novice teachers seemed to understand a larger variety of ways to enact talk in whole class discussions regardless of their nature of understanding as compared with experienced teachers. However, the experienced teachers understanding revealed a distinct factor that influences talk, i.e. the sociolinguistic factor. In contrast, the novice science teachers emphasised their content knowledge as a contributing factor to teacher talk. We conclude that since the quality of science teaching is dependent on teacher talk, continued professional development to strengthen teacher talk is not only to be targeted at novice teachers but also at experienced teachers.

Keywords: *Teacher talk; whole-class discussion; teacher cognition; novice science teachers; experienced science teachers*

Introduction

Whole-class discussion is a common teaching approach in science classes as it allows learners to construct knowledge through dialogue with the help of teacher talk (Chen & Techawithayachinda, 2021). Teacher talk, defined as ways in which teachers ask questions and how they respond to learners' contributions, has been the focus of science education research since the 1970s (Mercer & Dawes, 2004). The influence of studies on teacher talk comes from the British linguists Sinclair and Coulthard (1975), who argued that the most common and basic type of talk is when the teacher asks learners a question and evaluates their contributions. This leads to the initiation-response-evaluation (IRE) interactive pattern that does not allow learners to express themselves (Khoza & Msimanga, 2022). Teachers' ability to move beyond the IRE approach in whole class discussions is influenced by how the initiating questions are asked at the 'I' level and by the teacher's response to learner contributions at the 'E' level. Therefore, productive talk that leads to heightened interactions in science classrooms where learners can reason and construct knowledge requires teachers to be cognisant of the discourse moves they use (Soysal, 2019). However, South African studies show that science teachers still struggle to facilitate whole-class discussions through talk (Khoza, 2023;

Mudau & Netshivhumbé, 2022). This raises some questions about the nature of science teachers' understanding and knowledge about teacher talk. In the South African context where many classrooms are multilingual, teacher talk is influenced by the language demands (Msimanga & Erduran, 2018) as well as teachers' ability to notice inherent messages in learners' responses (Khoza, 2023). What seems to be missing in the literature is how both novice and experienced science teachers understand enacting teacher talk in whole class discussions, especially in the South African context. Given that teacher practices are influenced by their perceptions and knowledge of pedagogical strategies (Tan & Caleon, 2023), it could be possible that teachers' ability to enact productive teacher talk in their classrooms is linked to their perceptions and knowledge of pedagogic strategies (or lack of these). Furthermore, there is literature suggesting that teachers' years of teaching experience influence how they construct their practice (Öztürk-Tavşan & İşler-Baykal, 2024). In this study, we want to unpack and compare experienced and novice teachers' understanding of teacher talk in whole class discussions by addressing the research question:

How do novice and experienced science teachers *understand enacting teacher talk in science classrooms?*

Literature Review

Enactment of Teacher Talk in Science Classrooms

We draw from a recent systematic review by Soysal (2019) who identified some indicators of what could be considered productive teacher talk in science classrooms. However, productive interaction is not confined to verbal talk as reflected in Soysal's (2019) study. For interaction to emerge in science classrooms, the teacher has to ask an initiating question that learners can respond to (Soysal, 2019). The initiating question can be accompanied by other modes of representation like a model or a diagram (Khoza & Makgata, 2024). Initiation of talk considers learners' prior knowledge and informal ways of explaining natural phenomena. According to Dong et al. (2020), students with more extensive prior knowledge display higher engagement because they tend to seek help and challenge their previously held conceptions.

Teacher talk has to be intelligible and involve critiques from participants—the teacher and learners. By this indicator, Soysal (2019) noted that the teacher has to cultivate a culture of seeking elaborated responses from learners. This can be done through asking extending questions and critiques (Khoza & Msimanga, 2022). In this way, talk can move beyond the IRE approach to a collective argumentation (Soysal, 2019). Teachers' ability to respond to learner contributions is dependent on what they notice in those contributions (Khoza, 2023). Another important indicator of productive teacher talk is about accountability, justification and authority-sharing. According to Soysal (2019), teachers need to cultivate an authority-sharing environment where learners are provided with opportunities to ask questions (Chin & Osborne, 2008) and account for their responses through reasoning. Again, the teacher can respond to learner contributions through the use of just verbal utterances and some other forms of representations like diagrams and concrete material (Khoza & Makgata, 2024). We envisaged that teachers' understanding of talk would reflect some of these indicators.

The Role of Experience in Teachers' Understanding of Science Teaching

There seems to be no consensus in terms of whether teachers' professional experience influences their practice (Graham et al., 2020). On one end, some authors argue that teaching skills and dispositions are gained over time as they put into practice what they have gained in their teacher training programmes and from earlier experience (see, for instance, Karlberg & Bezzina, 2020). According to Hargreaves (2005), although experienced teachers may show deep knowledge of teaching practice, they are usually reluctant to change. One possible reason for this is that these teachers get too comfortable as they gain experience and tend to recycle their pedagogical approaches without critical reflection. Although years of teaching experience may not lead to expertise, the study by Karlberg

and Bezzina (2020) suggests that the more teachers reflect on their practice in their years of teaching, the better their expertise. Mudau and Netshivhumbe (2022) found that less experienced teachers had problems in facilitating interactions. Another study by Qhobela and Moru (2020) found that although newly qualified teachers were able to implement classroom talk, they were not able to encourage learners to apply scientific meaning through talk. In another study by Chen and Rovegno (2000), it was found that expert teachers were more likely to foster social interaction than novice teachers. Thus, the expert teachers were deemed constructivists. From these studies, it is clear that experience may be a contributing factor, particularly given that teachers' understanding of pedagogical practices stems also from their perceptions and knowledge.

Theoretical Framework

This study is underpinned by teacher cognition theory. Teacher cognition is a theory developed by Borg (2003) to refer to cognitive constructs that teachers have regarding teaching. This theory is composed of three interrelated components; teacher beliefs, teacher thinking and teacher knowledge. Öztürk-Tavşan and İşler-Baykal (2024) called these components 'conceptual domains of teacher knowledge'.

Teacher Beliefs and Teacher Thinking

While teacher thinking is related to the reasoning that teachers have about their capabilities and conceptualisation of their profession (Borg, 2003), beliefs are described as a set of suppositions or understandings that teachers hold about their profession including instructional strategies either implicitly or explicitly (Hutner & Markman, 2016). Therefore, teachers' pedagogical decisions are derived mostly from beliefs about what is good and bad in the current state (Maseko & Khoza, 2021). Several terms are used as synonyms for beliefs. These terms include perceptions, ideologies and conceptual systems (Pajares, 2003). Usually, these beliefs originate from prior knowledge and how the teachers are prepared in initial teacher education, hence their deep-rooted nature. In science education, beliefs have been associated with orientations to science teaching (Magnusson et al., 1999). As teachers think of what they do, their belief system also changes over time, thus supporting the dynamic and contextual nature of perceptions. In this study, we posit that science teachers' beliefs/perceptions and thinking are part of their understanding of science classroom talk.

Teacher Knowledge

Teacher knowledge of classroom activity is traced from Shulman's (1986) pedagogical content knowledge (PCK) construct defined as the integration of the content and pedagogy. Pedagogical content knowledge has been conceptualised over the years and scholars agree that it is shaped by various forms of knowledge domains like content knowledge, pedagogical knowledge, knowledge of context and knowledge of students (Carlson et al., 2019). Knowledge of content in this perspective includes the concepts, facts and principles of science. Pedagogical knowledge is about understanding instructional strategies for teaching science. Teacher knowledge can be canonical (knowledge established by research and shared by many teachers) and personal (gained by teachers through reasoning and experience) (Carlson et al., 2019). Just like beliefs and thoughts, this knowledge is dynamic and continuously shaped by teachers' experiences. Furthermore, it is deemed necessary for the facilitation of whole-class discussions through talk (Auerbach et al., 2018; Khoza, 2023). In this study, we envisage that the science teachers' understanding of teacher talk would be influenced by their PCK.

Research Design and Methodology

This was a qualitative case study positioned within the interpretivist paradigm. A qualitative case study allows researchers to do an in-depth data analysis to understand a phenomenon (Thomas, 2011). The phenomenon was teachers' understanding of teacher talk in science classrooms. In this study,

we had two cases. The first case was a group of six novice science teachers and the second case was a group of seven experienced science teachers.

Context and Participants

This study was conducted in a South Africa where science teachers (the two cases) teach Physical Sciences and/or Life Sciences. Physical Sciences (comprising Physics and Chemistry) is a school subject offered from Grade 10 to 12. In many cases, a teacher teaching Physical or Life Sciences would also teach Natural Sciences offered in Grades 8 and 9. The participants in this study were 13 teachers who were teaching Physical Sciences and/or Life Sciences chosen purposively and conveniently. We adopted Graham et al.'s (2020) categorisation that 0–5 years of teaching is considered novice while 5 + years of teaching is considered experienced even though this categorisation may not be correlated with quality teaching or informed teacher understanding of teacher talk as in this study. Table 1 shows the participants' demographic information.

As can be seen in Table 1, both the Physical Sciences and Life Sciences were represented amongst the six novice teachers and seven experienced teachers, respectively.

Data Collection

Semi-structured interviews were used to collect data as this strategy allowed us to delve into the participants' thinking (Brown & Danaher, 2019). Some of the interview questions included: 'How would

Table 1. Participant information

Teacher (pseudonyms)	Subjects taught	Years of experience in teaching science	Highest qualifications
<i>Case 1: Novice teachers</i>			
Raven	Life Sciences	1	Bachelor of Education: Senior and Further Education Training (FET) phase teaching
Karin	Life Sciences	1	Bachelor of Science in Biochemistry and microbiology and a Post Graduate Certificate in Education
Shanice	Life Sciences	1	Bachelor of Education: Senior and FET phase teaching
Paul	Life Sciences	2	Bachelor of Science (General) and PGCE
Sam	Life Sciences	2	Bachelor of Education: Honours
Rose	Physical Sciences	1	Bachelor of Education: Senior and FET phase teaching
<i>Case 2: Experienced teachers</i>			
David	Physical Sciences	15	Bachelor of Education: Senior and FET phase teaching
Stanley	Physical Sciences	9	Bachelor of Education Honours: Science Education
Dan	Physical Sciences	20	Masters of Education: Physical Sciences Education
Melvin	Physical Sciences	8	Bachelor of Education Honours: Science Education
Desiree	Life Sciences	21	Bachelor of Education Honours: Life Sciences Education
Dorothy	Life Sciences	18	Bachelor of Education: Senior and FET phase teaching
Shaun	Life Sciences	8	Bachelor of Education Honours: Life Sciences Education

you maximise talk in your science classrooms?’ and ‘In your view, in what ways does your talk influence learner contributions?’ Such questions were important as they allowed us to understand teacher thinking, beliefs and knowledge related to teacher talk. Follow-up questions were also asked to gather rich data from the participants. The interview instrument was piloted with two science teachers whose data are not used in this study and the interview questions were improved. The shortest interview was 42 minutes and the longest was 1 hour and 12 minutes. The interviews were audio recorded and transcribed for analysis.

Ethical clearance was granted by the University of Pretoria Ethics Committee under protocol number EDU096/23. Furthermore, the Gauteng Department of Education permitted us to conduct the study. All the teachers were given information letters with consent forms to sign. Issues of anonymity and confidentiality were adhered to.

Data Analysis Procedures

The audio recordings of the interviews were transcribed verbatim by the researchers. The analysis approach we used was the inductive thematic analysis approach defined by Braun and Clarke (2006: 83) as ‘a method for identifying, analyzing, and reporting patterns (themes) within data’. However, the analysis was also deductive as we were informed by the literature review and theoretical perspectives presented above. Both authors started by coding the first transcript simultaneously, but separately. We then met to extract and compare our codes through a discussion. The extracted codes were applied to the second transcript separately by both authors. Meeting again to compare our application of the extracted codes from the first transcript led to the refinement of the codes and the inclusion of more codes. This allowed us to establish rigour in the data analysis process. Table 2 shows some of these codes.

Author 2 then coded the rest of the transcripts and reduced the codes into themes by looking for trends in the teachers’ utterances (see Table 3). A further analysis involved looking at the trends in the themes to categorise teachers’ understandings presented in Table 4.

Table 2. Examples of how we coded the transcripts

Teacher utterances	Codes assigned
I believe that learners should do most of the talking ... it would help them make mistakes	Role of learner contributions
As a teacher, I need to sometimes transmit the content because ...	Transmission of knowledge
As I have mentioned in the previous question, they bring their background knowledge for them to ...	Role of learner background knowledge
... then we use their background knowledge to scaffold after I am satisfied ...	Role of background knowledge
I would ask them what they know about whatever and then ...	Gathering learner prior knowledge
... we interact with what they know, and we try to integrate it in our teaching	Role of learner prior knowledge
When I see that they are not talking, I think I can ask questions in vernacular	Language as a barrier to learner contributions
I think asking many questions helps learners to understand	Role of asking questions

Table 3. Teacher quotes on understandings regarding teacher talk in whole class discussions for each theme

Teacher	Subject	Theme 1: role of teacher in whole class discussions	Theme 2: role of learners in whole class discussions	Theme 3: ways of facilitating talk in class discussions	Theme 4: factors influencing teacher talk in whole class discussions
<i>Case 1: Novice teachers</i>					
Raven	Life Sciences	Scaffolding is my duty if I want my learners to understand my content (teacher as a facilitator)	Learners should gain new knowledge and construct it. They should participate (learners as constructors of knowledge)	I usually ask many questions and let them express themselves (Facilitates through questioning)	I look at the type of learners I have then decide how far I can go with questioning (type of learners influences questioning).
Karin	Life Sciences	My role is to transmit the content, just to give them information, and ask them questions here and there (teacher as transmitter of content)	Lerner questions should be limited to allow the teacher to transmit the content (learners as passive recipients of content)	First they [learners] explain a real-life experience, so I can phrase my questions. They need to reason in the discussion. At some point you have to actually teach them (building on prior knowledge but still transmit content)	If I do not know my content very well, I can easily be trapped in just telling learners the information (lack of content knowledge leads to transmission)
Shanice	Life Sciences	I play the role of knowledge bringer and help them assimilate the knowledge (transmission of content)	Learners have to feed themselves with the content, they need to pass their exams (learners as passive recipients of content)	You help them make sense of those facts, and their personal lives. I ask questions that link with kids' responses (building on prior knowledge and asks questions)	I check if learners are getting the right answers. At the end of the day, they need to get the science correct (talk depends on learner responses)
Paul	Life Sciences	Not only I should talk, I have to give learners the opportunity to express themselves more (teacher as a facilitator)	Learners should be open to old and new ways of thinking, to discover more of Life Sciences by asking inquisitive questions (learners construct knowledge)	We use their background knowledge to scaffold. I question and ask why? Being persistent helps to identify areas requiring further exploration (building on prior knowledge and probing)	No evidence
Sam	Life Sciences	I have to guide learners to discovery by asking worthwhile questions (teacher as facilitator)	If learners are not involved, then the outcomes are mine, not that of the learners (learners construct knowledge)	Ground it in something they know even if it's an abstract concept. You have to use specific types of questions and prompts more (building on prior knowledge using specific questions)	No evidence

(Continued)

Table 3. Continued.

Teacher	Subject	Theme 1: role of teacher in whole class discussions	Theme 2: role of learners in whole class discussions	Theme 3: ways of facilitating talk in class discussions	Theme 4: factors influencing teacher talk in whole class discussions
Rose	Physical Sciences	I see myself as being there to help them and scaffold their learning (teacher as facilitator)	They (learners) need to engage with what I bring to class ... like be immersed (learners construct knowledge)	Even during class discussion, I can bring concrete things to support the interaction (representations supplement talk)	It is important to use diagrams to spark interaction. Even if you know how to ask questions, you need to have other methods to help learners to discuss (PCK influences talk)
<i>Case 2: Experienced teachers</i>					
David	Physical Sciences	Guide the learners so that they are able to get the answers as facilitator create learning environment (teacher as a facilitator)	If they talk about science (to each other), they get confident and ask questions. This is what is desired (learners construct knowledge)	Some questions cannot help them engage ... so, I plan my questions like open questions (use of open-ended questions)	No evidence
Stanley	Physical Sciences	I (and the textbooks) have the knowledge. I must ensure learners acquire it (teacher as transmitter of content)	After one learner reading the textbook, I explain the content. Learners can ask only straightforward questions (learners as passive recipients of content)	I ask questions but I limit them just to see if they are paying attention (asking minimal questions)	No evidence
Dan	Physical Sciences	I need to convey the content (teacher as transmitter of content)	Learners should listen to what I have to say (learners as passive recipients of content)	As much as they answer, I need to convey the right content (non-use of questions)	I taught Life Sciences. It was difficult to teach reproduction. How do I talk about penis and sex? I preferred not to ask too many questions (cultural context and topic)
Melvin	Physical Sciences	Asking questions is important. Then as a teacher, I have to tell learners if their answer is correct or not (teacher as transmitter of content)	In my classroom, they know that they have to focus and answer questions correctly (learners led to the correct content)	Asking questions is important. Then as a teacher, I have to tell learners if their answer is correct or not (asking questions for checking and getting the right response)	I think language would be a problem of learners and even for me. Most learners struggle to express themselves in English. Sometimes it is important to use vernacular (language)

(Continued)

Table 3. Continued.

Teacher	Subject	Theme 1: role of teacher in whole class discussions	Theme 2: role of learners in whole class discussions	Theme 3: ways of facilitating talk in class discussions	Theme 4: factors influencing teacher talk in whole class discussions
Desiree	Life Sciences	They should do the talking. I just should move them in the right direction (teacher as a director to the right content)	Usually, I ask questions and expect them to know answers especially if we did the topic before (learners recite content)	I can let them answer my questions and then tell them the correct answer (teacher asks questions for evaluating)	Most of my students are Nguni speaking so I ask questions in isiZulu (code switching)
Dorothy	Life Sciences	I need to facilitate learning: be there when they need help and ask questions (teacher as a facilitator)	Learners should not expect to be spoon-fed, but ask questions and be inquisitive (learners as constructors of content)	I allow for a lot of leading questions and content questions (guiding learner thinking through questions)	If I can use tangible things, learners may be able to see and participate (concrete items promote interaction)
Shaun	Life Sciences	I should make learners know the subject (teacher as a transmitter of content)	We teach towards exams ... so sometimes we do not have time for learners to explore (learners as passive recipients of content)	I use questions like typical exam questions to prepare them then we talk about that (use of exam questions)	No evidence

Findings

The findings are organised in terms of four interrelated themes. The themes and teacher utterances are presented in [Table 3](#) and later used as sub-headings in the discussion section. The teacher utterances and themes were further interpreted to profile the teachers. These profiles are shown in [Table 4](#).

Theme 1: The Role of the Teacher in Whole Class Discussions

In terms of the first theme, two novice teachers (Shanice and Karin) described their roles as transmitters of content while four (Raven, Paul, Sam and Rose) described their role as facilitators of information. For example, Shanice uses the phrase; 'knowledge bringer'. Karin had a similar understanding as she uttered; 'my role is just to give them information and of course ask them questions here and there'. Although asking questions can be part of facilitating learning, the last part of Karin's phrase denotes that the role of asking questions does not precede the transferring of information. On the other end, some novice teachers expressed their role as facilitators of learning through talk. For example, Raven used the term 'scaffolding' while Paul noted; 'I am not the only one who should talk ... I have to give learners opportunities to express themselves more'.

Similar to novice teachers, several experienced teachers described their role as transmitters of information (Stanley, Dan, Melvin and Shaun) while some as facilitators of knowledge (David and Dorothy). However, one experienced teacher, Desiree, described her role as a guide 'to the right content'. Stanley used the word 'acquire' to explain that his role is to help learners acquire knowledge. Furthermore, his phrase 'I have the knowledge' suggests that his role is to transfer the knowledge as it is from the textbooks. This is similar to Shaun's understanding that his role is to 'make the learners know the subject'. Thus, some of the teachers see themselves as individuals with authority having an obligation to transfer the science content. On the other hand, Dorothy sees herself as a facilitator of learning through asking questions. David sees his role as a facilitator to create an environment conducive for whole class discussion.

Theme 2: The Role of the Learners in Whole Class Discussions

The second theme pertains to the role of learners in whole class discussions. Some novice teachers perceive learners as passive recipients of information (Karin and Shanice). For example, Shanice, in line with how she sees her role as a teacher, is of the view that learners have to gather the content for exam purposes. Karin also stated that learners' questions should be limited to allow the teacher to 'transmit the content'. Other novice teachers (Raven, Paul, Sam and Rose) perceive learners as constructors of content during whole class discussions. Raven seems to have an understanding that learners have to be listeners. However, he further states that while listening to the information, learners still need to participate by responding to questions not only through talking but reactions. This leans towards understanding that learners are not only listeners but also participants in the co-construction of knowledge during discussions. When he was asked about the kind of reactions he is looking for in his learners, he uttered; 'they must nod, like if they agree or just show excitement over my questions'. This suggests that Raven does not only see the role of learners in discussions in terms of verbal utterances but also their reactions towards content. Sam and Paul on the other hand see learners' role in whole class discussion as an opportunity to discover knowledge by using their experiences. When Paul was asked how learners do this, he said; 'simply by asking inquisitive questions'.

Similar to novice teachers, some experienced teachers talked about the role of learners as passive recipients of information where they need to only answer questions correctly (Stanley, Dan, Melvin and Shaun). Dan sees his learners as receivers of information. A similar view is found in Stanley's utterances as he said, 'after one learner reading the textbook, I can explain the content'. When he was asked if he allows learners to ask questions his response was 'They can, but straightforward questions ... I do not ask a lot of questions because more time should be on getting the learners doing the calculations right'. The other two experienced teachers (David and Dorothy), have a different view. They believe that learners need be inquisitive and discover things for themselves by asking questions. This means they view learners as co-constructors of knowledge. David also explained; 'if

they talk about science things, they get confident and tend to ask questions ... I think this is what is desired ... I want them to lead discussions and talk to each other more'.

Theme 3: Ways of Facilitating Talk in Whole Class Discussions

The third theme revealed all the novice teachers have some knowledge on how whole class discussions can be facilitated through talk regardless of how they perceive their roles and learners' roles. Shanice identifies making links between science concepts as an aspect of class discussions and further notes that it is her role to help them think and make links by 'asking questions that link with kids' responses'. Paul, Sam and Karin note that whole class discussions are facilitated by first establishing learners' prior knowledge and linking their prior knowledge with the content. When Karin was asked how she uses this prior knowledge, she said 'You see, if they have misconceptions then I ask them further'. However, she cemented her role by saying 'but at some point, you have to actually teach the content'. Sam and Karin specifically noted that it is best to do this by asking specific questions and probing learners. Furthermore, Paul understands that discussions are facilitated by requesting learners to provide reasons for some of the responses they provide to his questions as well as probing other learners. Paul further stated, 'getting prior knowledge and being persistent can help me to identify areas that need further exploration' to argue how probing can help him notice things like misconceptions. Rose also stated 'even during discussions, I can bring concrete things to support the interaction' denoting that her understanding of teacher talk during whole class discussion is not only limited to verbal approaches.

As opposed to novice teachers, some experienced teachers seemed to believe that questions should be asked in minimal numbers (Stanley and Dan) or that asking questions only serves to evaluate learners instead of fostering heightened discussions (Shaun, Dorothy, Desiree and Melvin). However, Dorothy thinks concrete materials are the best way to get learners to not only talk to her as a teacher but also amongst themselves. Other than the concrete materials, Dorothy also noted the role of what she termed 'leading questions' and 'content questions'. Melvin was further prompted to share his knowledge of how he uses learners' responses to heighten classroom talk and he said 'I just look at whether the answer they give is correct ... if it is wrong, I ask other learners and the discussion continues'. This is similar to Dan's thinking when he observed, 'as much as they answer, I need to convey the right content' to show his lack of knowledge about different discourse moves that one can use in science classrooms. David believes that open-ended questions are a way of facilitating discussions.

Theme 4: Factors Influencing Teacher Talk in Whole Class Discussions

With regard to the last theme, an observable trend is that novice science teachers allude to their knowledge of teaching as the main factor. Karin and Rose's utterances above show that when they are thinking of teacher talk, issues of content and pedagogical knowledge come into play. Karin stresses that if a teacher does not have very strong content knowledge, they are likely to resort to the transmission mode of teaching. When she was asked to explain her statement, she said; 'I think learners can easily challenge you if they ask many questions ... so some teachers have a fear for that'. Similarly, Rose also talks about the role of a teacher's content knowledge as a factor. She further stated; 'even if you know how to ask questions, you need to have other methods of helping learners discuss' to denote the significance of not only the content knowledge but also the knowledge of instructional strategies for facilitating whole class discussions.

The experienced teachers' understanding of factors that affect teacher talk in whole-class discussions leaned towards socio-linguistic factors. For example, Desiree and Melvin talk about English as a factor that influences classroom talk. Dan draws from his previous teaching that 'learners would become shy' whenever he was teaching topics like reproduction. Desiree is multilingual so she tries to teach in isiZulu as her learners are Zulu-speaking. Using a language that learners understand better to teach in class has the potential to result in effective learning taking place. The issue of language in the classroom is a contentious one, but also a real one for those tasked with facilitating

Table 4. Teachers' profiles in terms of their understanding of teacher talk in whole class discussions

Profile	Description	Novice teachers	Experienced teachers
A. Authoritative orientated	The teacher's role is to transmit content while learners become passive recipients of knowledge. There is no indication of understanding how talk can be enacted in whole class discussions. These teachers shy away from asking questions and providing learners with an opportunity to ask questions and explore	None	Stanley, Dan, Melvin and Shaun
B. Transitional understanding	Although the teachers' role is to transmit knowledge while learners receive the knowledge, there is an indication of knowledge of various ways of facilitating whole class discussion and to some extent, learners participating in the process	Karin and Shanice	Desiree
C. Constructivist orientated	The teacher's role is to facilitate learning through questioning while learners should ask questions and construct knowledge. These teachers provide a clear indication of how whole class discussion can be facilitated through a variety of discourse strategies	Raven, Paul, Sam and Rose	David and Dorothy

learning in multilingual classrooms. The knowledge of how to deal with such challenges was not evident in the data.

Teacher Profiles

Further analysis across the themes suggests that both the novice and experienced teachers' nature of understanding can be categorised into three profiles described in Table 4. In general, authoritarian orientation to teaching science means teachers focus on transmitting the science content without involving learners. On the contrary, in constructivist teaching, the teacher involves learners in the process of meaning-making by encouraging exploration of scientific ideas through pedagogical tools like questioning (Soysal, 2019).

As can be seen in Table 4, none of the novice teachers resembled an authoritative nature of understanding of teacher talk in whole class discussions whereas the understanding of the majority (four) of the experienced teachers was authoritative orientated. The understanding of the majority of the novice teachers (i.e. Raven, Melvin, Shaun and Paul) and of some experienced teachers (Dorothy and David) resembled a constructivist approach to enacting talk in whole class discussion.

Discussion

The findings suggest that while the majority of experienced teachers display authoritative profiles, none of the novice teachers exhibit such an authoritative profile. This revelation is concerning, especially in the South African context. This is because, it has been found that when science teachers gain experience, their understanding and enactment of constructivist pedagogical practices like using discourse moves increases (Lehesvuori et al., 2019). Thus, there was an expectation that novice teachers would display an authoritative orientated understanding of classroom talk with the assumption that they would lack relevant classroom experience as their basis. However, this was not the case in this study. The teachers that have an authoritative orientation are those who do not value learner contributions (Lee & Kim, 2019), often pose closed questions aiming for recall responses or intending to check if learners pay attention, and usually provide a negative response evaluation instead of

probing during whole class discussions (Khoza & Msimanga, 2022). On the contrary, the findings also show that the majority of the novice teachers and some of the experienced teachers display a constructivist profile. Constructivist teachers create opportunities for learners to voice their ideas as well as asking questions at the 'R' level of the IRE pattern owing to the view that learners come to the classroom with pre-conceived ideas that need to be explored (Soysal, 2019). The teachers with a constructivist profile illustrate that, while teachers have authority, learners are equally given authority in the form of influencing how class discussions unfold as noted by Juuti et al. (2020). As such, teachers need to accept this role of shared authority for them to understand the kind of discourse strategies that they can use (Soysal, 2019). Using these findings, we argue that understanding how teachers perceive their role in enacting or facilitating class discussion through talk may be a starting point for teachers to move beyond the IRE approach of Sinclair and Coulthard (1975) as it has been found in the South African context that teachers struggle to facilitate heightened engagement (Khoza, 2023; Mudau & Netshivumbe, 2022).

The novice teachers with a transitional profile indicate that allowing learners to voice their prior knowledge may be the starting point for teachers to move on from their otherwise authoritative orientation and beyond the IRE approach of Sinclair and Coulthard (1975). This suggests that novice teachers understand the role of learner prior knowledge in enacting a productive whole class-discussion. Furthermore, all the novice teachers understand that various talk strategies of using teacher talk go beyond the IRE pattern regardless of their own perceived role in classroom talk and learners' contributions (see Table 3). The novice teachers' understanding of various ways to facilitate talk can be attributed to their understanding of the learners' role which spans between authoritative and constructivist. This finding is similar to Qhobela and Moru's (2020) finding that newly qualified teachers hold some knowledge about enacting productive classroom talk as seen through observations. However, the one experienced teacher (Desiree) with a transitional profile only seemed to understand how whole class discussions can be initiated at the 'I' level of the IRE pattern—through questioning. Unlike some novice teachers, she did not talk about the role of learner prior knowledge as a way of facilitating whole class discussion. What is reported in literature is a contradiction to this finding. For example, the relatively dated study by Meyer (2004) found that novice science teachers had insufficient understanding of learner prior knowledge while experienced teachers understood how to make use of this knowledge during instruction.

Both novice and experienced teachers talked about factors that influence teacher talk in whole class discussions. However, a key difference is that experienced teachers' understanding leans towards socio-linguistic factors whereas novice teachers lean towards content knowledge as a contributing factor. According to Ramma et al. (2024), the level of science teachers' understanding of content knowledge contributes to whether they enact authoritative or constructivist teaching. Therefore, the novice teachers' understanding of this aspect as a factor is an indication of their awareness that enacting talk relies on the strength of their content knowledge. Msimanga and Lelliott (2012) found that learners' home languages for engagement with difficult concepts may be a legitimate resource for science teachers to create opportunities for learner conceptual understanding. In this study, experienced science teachers like Desiree have this kind of understanding which according to Brown and Spang (2008), indicates that these teachers acknowledge that 'modelling vernacular discourse' (p. 731) can be a strategy to enact productive classroom talk. Science teachers need to understand that some learners are comfortable speaking their own languages rather than English. If possible, teachers should use a language that the learners understand when explaining abstract concepts and asking conceptual questions (Msimanga & Lelliott, 2012).

Conclusions and Recommendations

The focus of this study was to unpack and compare novice and experienced science teachers' understanding of teacher talk in whole class discussions. A notable finding is that the majority of novice teachers displayed a constructivist profile while a majority of experienced teacher displayed an authoritative profile. An interesting finding is that novice teachers seemed to understand how whole

class discussions can be facilitated through teacher talk as opposed to several experienced teachers who were able to articulate their understandings. Both the experienced and novice teachers alluded to factors that influence classroom talk. However, experienced teachers' understanding leans towards socio-linguistic factors whereas novice teachers lean towards teacher content knowledge. Understanding the socio-linguistic factors is important especially in the South African context where many science teachers teach in multi-cultural and multi-lingual classrooms. Since the quality of science teaching is dependent on teacher talk, support and continued professional development are to be given not only to novice teachers but also to experienced teachers, especially in the changing science education contexts. We suggest professional development initiatives geared towards this phenomenon. These initiatives should involve the novice teachers by using professional learning communities or through lesson study approaches, for example, to allow the sharing of knowledge from the novice teachers who in this study were found to hold some knowledge on how to enact productive classroom talk.

We acknowledge that the study only looked at teachers' understanding using interviews. The science teachers' understanding of teacher talk may not reflect how they enact classroom talk as this is dynamic. We therefore suggest that the findings of this study should be taken with caution. We recommend extended studies that look at teachers' understandings and their actual classroom practices to ascertain more succinct ways of supporting science teachers to enact productive classroom talk.

Disclosure Statement

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