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Research Article

Teacher noticing as a driver of interaction patterns in science classrooms

Hlologelo Climant Khoza

University of Pretoria, South Africa (ORCID: 0000-0003-0359-6586)

Teachers' responses to student contributions in science classroom influence the resulting classroom interaction. To establish a heightened interaction, teachers need to use specific discursive moves. Using the notion of noticing as a lens, in this qualitative case study, I report on how the notion of noticing and responding with a suitable discursive move is important for science teachers to drive interaction. I use data from two South African science teachers' lessons and video-stimulated recall interviews (VSRI) to show instances where they employed specific discursive moves as a result of noticing and the interaction unfolded in a dialogic manner and instances where they 'failed' to notice a pertinent feature of a student's contribution and the interaction did not move beyond the initiation-response-evaluation (IRE) triad. I discuss the significance of teacher noticing in science classrooms as it influences how the interaction unfolds. I also offer implications for pre-service science teacher education.

Keywords: Noticing; Interaction; Discursive moves; Authoritative discourse; Dialogic discourse

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1. Introduction

Scholars who research patterns of talk and interactions in science classrooms agree that the most important driver of talk is the teacher (Mercer & Dawes, 2014). The teacher drives the talk using discursive moves (Tytler & Aranda, 2015). In many cases and at a basic level, the teacher would initiate a whole-class discussion by asking a question (Correnti et al., 2015; Mercer & Littleton, 2017). When students respond, the teacher would evaluate whether the response is correct or not leading to the Initiation-Response-Evaluation (IRE) interaction pattern (Mehan, 1979). This pattern is normally associated with teacher-centred pedagogies where information is transferred from the authority (teacher) to the students (Mortimer & Scott, 2003). In recent times, through their talk, many science teachers are beginning to move beyond this IRE interaction pattern to creating spaces where learners can voice their ideas without restrictions. In such cases, the resulting interaction becomes dialogic where the teacher would elicit more responses and ask extended questions based on students' input (Bansal, 2018; Khoza & Msimanga, 2021). However, teachers must do this in the midst of everything that is happening in the classroom. Given this point and that teaching science is a complex process, teachers do not only require the necessary professional knowledge base to teach science but also the ability to reflect in action and act accordingly (Luna,

Address of Corresponding Author

Hlologelo Climant Khoza, PhD, University of Pretoria, Groenkloof Campus, Pretoria, 0027, South Africa.

climant.khoza@up.ac.za

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2018; Zwozdiak-Myers, 2018). According to Chan et al. (2020), the complexity of teaching lies in the fact that what the teacher does in the classroom is influenced by "spontaneous classroom events and can develop rapidly and unpredictably" (p. 2). The underlying assumption is that teachers, amongst their explanations, demonstrations, and other teaching methods they use, need to coordinate and facilitate talk (Michaels & O'Connor, 2012). Unfortunately, a teacher can never be prepared enough to anticipate all the situations that would take place in the classroom. Yet the teacher needs to continue coordinating the lesson despite these spontaneous and unpredicted events like the nature of students' responses to questions. In science classrooms, this coordination happens through the use of specific discursive moves (Bansal, 2018; Lehesvouri et al., 2018).

Previous research has attributed science teachers' use of discursive moves to the nature of student input (see Hardman, 2019; Tytler & Aranda, 2015). According to Hardman (2019), students can give short responses, ask a question, or provide extended responses requiring a teacher's feedback or probe. In a recent study by Haverly et al. (2020), it was argued that teacher moves are powerful in creating space for sense-making in science classrooms, thus, the need for teachers to be cognisant of the talk moves they use during classroom interaction. Given the fact that science teachers need to respond to student contribution as part of classroom situations (Güler et al., 2020), such that they establish certain discourses (Bansal, 2018; Mortimer & Scott, 2003), in this paper, I want to argue that despite student input that influences the patterns of interaction, the notion of noticing is important for science teachers to drive interaction. Noticing is described by van Es and Sherin (2008) as a set of skills that enable the teacher to take note of features of practice that are important at that moment. The practice that is referred to in this study is classroom talk, particularly student contribution. I use data from two South African science teachers' lessons to illustrate instances where they employed specific discursive moves as a result of noticing and responding and the interaction unfolded in a dialogic manner. I also illustrate instances where they 'failed' to notice a pertinent feature of a student's contribution and the interaction did not move beyond the IRE triad. This illustration is expected to contribute to an understanding of what the teacher notices (or does not) in students' inputs during whole-class teacher-led interaction determines how the interaction unfolds.

1.1. Teacher Talk in Science Classrooms

Teacher talk in science classrooms has been researched extensively in the last decade. All the research was perpetuated by the need for science classrooms to go beyond Sinclair and Coulthard's (1975) IRE triad (Aranda et al., 2020). As stated earlier, in the current times, many science classrooms are going beyond this pattern where students are afforded opportunities to voice their ideas (see Aranda et al., 2020; Khoza & Nyamupangedengu, 2018). The key player in the interaction is the teacher, who, through the discursive move, directs the interaction (Tytler & Aranda, 2015). According to Chin (2007) and Haverly et al. (2020), one of the key aspects that contribute to the organisation of classroom discourse is the teacher's realisation and/or ignorance of the nature of moves used. With the realisation that teacher talk has a significant contribution to how students engage in the science classroom, there has since been an interest in science classroom talk and characterizing the kinds of discourses that could take place in science classrooms (see Mortimer & Scott, 2003). These developments revealed that focusing on teacher moves may be a good approach to understanding discourse (see Bansal, 2018; Ruthven et al., 2017). That is, although discourse is established from both the learners' and teacher's utterances in the classroom, the key moves are that of the teacher as they can either close- or open up an interactive chain (Msimanga & Lelliott, 2012). Close interaction patterns happen when the teacher evaluates the learner's response instead of probing further. This results in an authoritative discourse where only one voice is dominant (that of the teacher) whereas prolonged chains characterized by probes and feedback may lead to a more interactive and dialogic discourse allowing students to voice their ideas (Mortimer & Scott, 2003). In other words, it is the feedback/evaluation move that determines whether the interaction is opened or closed. A study conducted by Maseko and Khoza (2021) with

Malawian teachers revealed that teachers would resort to telling learners information instead of opening interaction through probing. In this study, I argue that probing students requires a teacher to unpack a student's answer.

For the teacher to employ a suitable move that could result in a prolonged interaction and dialogic discourse, they must note and respond at the right moment to a student's contribution (Haverly et al., 2020; Luna, 2018). The moves that the teacher uses are called rejoinders (Correnti et al., 2015) conceptualised by Tytler and Aranda (2015) as having three broad categories. The first category is eliciting and acknowledging moves where the teacher would employ a move that serves the purpose of eliciting more information from the student. These moves "vary from simple recognition of student contribution and to marking out contributions for special attention" (Tytler & Aranda, 2015, p. 432). The second category is termed clarifying moves and these moves are aimed at re-wording students' inputs for clarifying the meaning. This may involve putting students' ideas into more scientific language. The third category is extending where the aim is to move students beyond recalling information. In these moves, students are challenged (Tytler & Aranda, 2015). In this paper, I am focusing on these categories and arguing that the teacher must notice a pertinent feature of a student's contribution to respond with a suitable move that could potentially result in a prolonged interaction.

1.2. Teacher Noticing

In this study, I am drawing from the notion of teacher noticing. Teacher noticing as a construct is defined as "a set of three interrelated skills: attending to children's strategies, interpreting children's understandings, and deciding how to respond on the basis of children's understandings" (Jacobs et al., 2010, p. 172). This definition perceives noticing as both perceptual and action based. The perceptual aspect is the thinking that goes into the teacher's mind at that moment. The vocalisation (through a discursive move as in this study) explains the action aspect. The notion of noticing is traced back to mathematics education where Sherin et al. (2010) argued that like any other profession, teachers have a specific way of looking at specific aspects of their classrooms and that teachers have the capabilities of identifying and responding to salient and unique features of their classrooms. These features are the complex interactions that prove to happen in every classroom. Teacher noticing has been used in studies that investigate mathematics classrooms to encourage teachers to use student-centred approaches that are responsive to how students learn (see, for example, Biccard, 2020; Güler et al., 2020; Superfine & Bragelman, 2018). As such, the teacher's ability to notice, interpret and respond to classroom events becomes an important skill to foster student learning (Luna, 2018). Recently, there is an emergence of studies utilising notion of noticing in science classrooms (see, for example, Haverly et al., 2020; Tekkumru-Kisa et al., 2018).

Teacher noticing is characterised by two interrelated dynamic processes: selective attention and knowledge-based reasoning (Sherin, 2007; van Es & Sherin, 2010). According to Sherin (2007), selective attention is about how teachers 'decide' to respond to some events and interactions and not others. Different reasons can be attached to this including teachers not seeing the importance of some events or interactions. Haverly et al. (2020) note teacher knowledge and understanding of the subject matter as a factor. This means selective attention would vary from one teacher to the other and from one context to the other. However, a teacher side-lining certain events/incidents could compromise students' learning (Chan, 2021; Luna, 2018). For example, a teacher's deliberate side-line of a student's misconception displayed during a whole class discussion could lead to the misconception being acquired by other students. As Sadler et al. (2013) argued, the ability of science teachers to notice and respond accordingly is a determinant of how well students grasp the science content. Researchers who have focused on the abilities of teachers to be selective have noted that it is also dependent on their professional knowledge and their experience (e.g. Lefstein & Snell, 2011; Seidel et al., 2011; Star & Trickland, 2008). For example, Star and Trickland (2008) illustrated that experience is the main factor as they have shown that newly graduated teachers struggled to select between highly important and less-useful incidents that could potentially influence students' learning. In this paper, I argue that during interactions, all students' contributions are important, but it is the teacher's duty to notice, interpret and respond, through the use of discursive moves in ways that favours the students and could potentially lead to heightened interactions in the classroom.

2. Methodology and Design

In this study, I used a qualitative research approach that falls under the interpretivist paradigm. Qualitative research approach looks at settings to provide significant meanings of incidences and phenomena embedded in a certain context (Cresswell, 2012). This approach allowed me to have an in-depth analysis of the data from the teachers' lessons and interviews. The qualitative approach in this research took a case-study design (Hancock, 2006).

2.1. Participants and Context

The participants in this study were two South African secondary school Physical Sciences teachers (Phidel & Zweli) and their students conveniently sampled because they were accessible. The selection criterion was that they need to be teaching Physical Sciences and have at least 3 years of teaching experience. The reason for using the criterion of teaching experience is that the idea of noticing is usually prevalent in experienced teachers (Rooney & Boud, 2019). Both teachers have at least 7 years of experience in teaching Physical Sciences. In the South African context, Physical Sciences is comprised of both Physics and Chemistry and is usually taught by the same teacher. The two teachers were teaching in the same school. Apart from the Physical Sciences subject, Phidel and Zweli also teach other subjects like Mathematics and Natural Sciences. Phidel was teaching one Grade 10 class with 26 students while Zweli was teaching one Grade 11 class with 32 students. Both Phidel and Zweli possess a Bachelor of Science degree and a teaching qualification (Post-graduate Certificate in Education).

2.2. Data Generation

Three data sources were used in this study: classroom observations, post-lesson reflection and video-stimulated recall interviews (VSRI). The teachers were video-recorded while teaching their students different topics. Table 1 illustrates the lessons that were video-recorded.

Table 1
The observed lessons per teacher

Teacher	*Lessons taught*	*Duration (min)*
Phidel (Grade 10)	Chemical reactions	74
	Chemical reactions	42
	Empirical formula and empirical composition	67
Zweli (Grade 11)	Coulomb's law	50
	Electromagnetism	62
	Electromagnetism	83

As can be seen in Table 1, the teachers were teaching different topics. In the school, one lesson is 50 minutes in duration. The duration of the lesson is counted from the time the teacher begins the lesson up to when he concludes the lesson. All the video-recordings were transcribed verbatim for analysis. The video-recordings were accompanied by the field notes that I took during the observations. In the field notes, I only recorded what I considered to be critical moments in terms of the student contribution and how the teacher responded instead of narrating how the lesson went. These reflections formed the basis of the post-lesson reflections with the teachers.

The second data source was the post-lesson reflection. These reflections were audio-recorded and they took on average, 20 minutes. The purpose of these reflections was to get the immediate teachers' thinking on some of the incidents regarding talk identified during the classroom observations.

The third source of data was VSRI with the teachers, alongside the post-lesson reflections, to determine instances where they notice and did not notice the underlying message behind a student's contribution that in turn influenced how the interaction unfolded. Three VSRI (one interview for each lesson) were conducted for each teacher, and they all lasted between 30 and 42 minutes. Some of the questions asked to the teachers included: Why did you ask this question to the student (s)? Would you have asked a different question? Instead of just saying "okay, it makes sense" to the student, what else could you have said? In the VSRI I identified episodes that I could focus on. Most of these were based on what I considered striking underlying student contribution. For example, a contribution that shows a potential misconception or a contribution that reveals a student seeking for help regarding certain concepts.

2.3. Data Analysis

Data analysis was in two phases. In the first phase of the analysis, I coded the teacher's and students' utterances. The first step was to code the teacher utterances, I used the framework of teacher discursive moves developed by Tytler and Aranda (2018). Since I was interested in how the teacher would notice and choose a specific move, to code for student, I used the framework developed by Hardman (2019) that characterise students' contribution at the 'R' move of the IRE pattern. In addition to the students' utterances, I interrogated the student utterances to understand what could be the underlying message behind the student's contribution. Table 2 illustrates how I applied the framework to the transcripts.

Table 2
An example of how the teaching transcripts were coded from Zweli's second lesson

Speaker	*Utterance*	*Assigned code*
Teacher	What do you understand by the term electromagnetism if I may ask?	New question
Student 1	Electrons with magnets	Brief student contribution
Teacher	Electrons with magnets…mmmm…okay, another view?	Acknowledging, Eliciting Further Responses
Student 2	Electrons that generate magnetic field around them…	Brief student contribution
Teacher	Electrons that generate the magnetic field around them…any other view?	Acknowledging, Eliciting Further Responses
Student 3	I can say something like electrons that generate electricity	Brief student contribution
Teacher	Electrons that produce electricity. Someone else?	Acknowledging, Eliciting Further Responses
Student 4	Accelerating electrons producing electric field around them	Brief student contribution
Teacher	Okay, what I heard is that we talk about electricity and magnetism. Do you have any idea of the relationship between the two?	Acknowledging, Re-framing Question
Student 5	Electric field in a way produce magnetic field	Brief student contribution
Teacher	So how?	Requesting Clarification
Student 5	Sir, what I am saying is the electric charge creates the magnetic field so that… (inaudible) so, electric field, in a way creates magnetic field	Extended student contribution
Teacher	Ohhh…okay, explain…how do they produce the magnetic field?	Eliciting Further Responses

As can be seen in Table 2, the third column shows the codes allocated to each teacher or student utterance. The second step in this phase was to divide the coded transcripts into episodes. In this case, the episodes are defined as teaching segments where the teacher would initiate a discussion until the closure of the interaction. I then categorized the episodes as authoritative or dialogic. The authoritative ones were episodes that displayed the IRE interactive pattern and the dialogic episodes were those that displayed a prolonged interaction pattern where the teacher used a variety of rejoinder moves. I characterised the level using Tytler and Aranda's (2018) framework of teacher discursive moves. This phase of analysis led to the identification of episodes that became the focal points for the VSRI as described above.

The second phase of data analysis included analysing the post-lesson reflections and the VSRI interviews. I analysed these using a narrative analysis approach as highlighted by Polkinghorne (1995). Since the data were in the form of interviews, I constructed and analysed the narratives to interpret and tell a story. I used this approach to re-tell a story of the teachers' reflections on the incidents that happened in classroom talk.

3. Results and Discussion

The coding of the teaching transcripts revealed authoritative patterns of interaction and dialogic interactive patterns in both teachers' lessons. Table 3 shows these results. The first figure in the table shows the number of authoritative and dialogic episodes per teacher in that lesson. The second figure after a comma indicates the number of episodes that were the focus of the VSRI as pre-determined (randomly sampled) after the preliminary analysis of the teaching transcripts.

Table 3
Patterns of interaction in the two teachers' classrooms

Lessons	*Phidel*		*Zweli*	
	Authoritative	Dialogic	Authoritative	Dialogic
1	14, 3	3, 2	8, 3	4, 2
2	12, 3	3, 2	6, 2	6, 3
3	9, 2	2, 2	10, 3	8, 2

As can be seen in Table 3, for each lesson, the VSRI focused on at least two authoritative and dialogic episodes as observed in the lessons. Below, I present the 2 examples for each teacher where they noticed or did not notice the underlying message of student contribution resulting in either an authoritative or dialogic discourse.

3.1. Authoritative Discourses

Results from the analysis of the teaching transcripts and the interviews indicate aspects of teachers not noticing the underlying message from student contribution and responding by employing a suitable discursive move. The students are given codes (Student 1, Student 2 …) in order of their contribution in the excerpt used and not necessarily as taken from the whole teaching transcript.

3.1.1. Example 1

This excerpt comes from Phidel's first lesson on chemical reactions. Phidel had just introduced (by writing on the board) the topic of acid-base reactions and wanted the students to begin by defining an acid and a base.

(1) Phidel: So, let us start by defining an acid. What is an acid Student 1?
(2) Student 1 Mam, acid?
(3) Phidel: Yes
(4) Student 1 It has bubbles mam…like it produces bubbles.
(5) Phidel No, and you? [pointing at Student 2]
(6) Student 2 It is a substance that dissolves in water to produce protons.
(7) Phidel: Right, an acid is what? A substance that dissolves in water to produce an acid [writing the definition on the board]

In turn 1, Phidel asked a new question to initiate a whole class discussion. Student 1 responded in turn 4 with a short answer that seemed to not be what Phidel was looking for, thus, resulting in the interaction taking an authoritative discourse (Kaya et al., 2014; Scott et al., 2006). This is evident in turn 4 when she said, "No" signaling a negative evaluation (see Tytler & Aranda, 2015) of

Student 1's response. Student 2 responded with what Phidel regarded as the correct answer (see turns 6 & 7). This episode was regarded as a missed opportunity for Phidel to tap into Student 1's thinking about acids, and perhaps begin to direct learners into acid-base reactions as the focus of the lesson. According to Haverley et al. (2020) such opportunities are not easy to spot as they require the ability of the teacher to notice and respond. During the VSRI, Phidel was asked to reflect on the incident and the following dialogue took place.

Interviewer:	What was happening in this particular interaction?
Phidel	I wanted them to define an acid because I wanted them to have that solid foundation…you know…My idea at that time was that I would engage with them
Interviewer:	Okay, but S1 gave you the definition, right?
Phidel	That was not what I was expecting. In the textbook, they should know that an acid is what produces a proton and that is why I did not accept the answer from S1.
Interviewer	Alright…now that you can watch the video again, what can you say about S1's response? Would you have said something different instead of rejecting her answer?

In the dialogue above, Phidel agrees that she initiated the question to spark an interaction like any teacher would do. However, in her mind, she was expecting only the correct responses as aligned with what is presented in the textbook. As seen in many science classrooms, science teachers are only interested in the correct answer, thus, breaking the interactive chain (Kaya, 2014). A study conducted by Khoza and Msimanga (2021) also indicated that science teachers' facilitation of interaction resembles an interest in students' correct responses rather than providing students with opportunities to reason. In In this particular instance, Phidel failed to interpret Student 1's response that resembles a prominent feature of acid-base reactions. Phidel was prompted further.

Interviewer:	So, what happens when acids react with a base
Phidel:	You get water as the product and a gas
Interviewer:	Okay, but what happens during the reaction? What would one observe
Phidel:	I think popping sounds and bubbles and…yeah…
Interview:	So, what was wrong with the learner's response that you rejected straight-away?
Phidel:	Ohhh…she mentioned bubbles. I did not realise that she was ahead of me
Interviewer:	If you had realised during the lesson, how would you have responded?
Phidel:	I would'nt have rejected her answer. I think at that point I would have asked others.
Interviewer:	Asked others what? The question?
Phidel:	No not the question…*ukuthi bona bacabangani nge mpendulo yakhe* (what they think about the student's response)

In the conversation above, Phidel agrees that she overlooked the student's response – that the student was hinting about what happens when an acid reacts with a base. This finding resonates with Biccard's (2020) findings in mathematics classrooms that teachers tend to overlook salient features of student input. Phidel's inability read in between the student's contribution led to her evaluating negatively as, in her mind, she already had a summary of the answers that she was expecting from the students, thus resulting in an authoritative discourse (Mortimer & Scott, 2003). She states, "I did not realise that she was ahead of me" to explain why she did not notice and analyse the student's response. When asked how she would have responded she said she would have asked other students what they think about the student's response. This could have resulted in a prolonged interaction where links between what happens during acid-base reactions (even if this was to be covered later), and what defines an acid could have been to allow better student understanding of the concepts. Due to the complex nature of classroom dynamics (Sherin et al., 2010), teachers can priorities what they pay close attention to (Barnhart & van Es, 2015). In this case, it should be the students' contributions as they contribute to the overall classroom discourse and sense-making (Haverly et al., 2020).

3.1.2. Example 2

This example comes from Zweli's third lesson. It was in the introduction when they were preparing to mark the work he had given the students. He then asked a question to the students in preparation for marking the work-done

(1) Zweli:	So, they are talking about the compass there. Can anyone describe its purpose?
(2) Student 1:	Sir, the arms rotate and face the direction of electrons…yah, where the electrons are going
(3) Zweli:	No… Anyone who wants to try
(4) Students:	(Students mumbling)
(5) Zweli:	Grade 11s, can someone give us the correct answer
(6) Student 2:	Sir, doesn't it show the direction of the magnetic field?
(7) Zweli:	It shows the direction of the magnetic field…yes…around the conductor, isn't it so?
(8) Student 1:	But sir that is what I said mos…
(9) Zweli:	No, that is not what you said Student 1, okay…let's move…

In this excerpt, Zweli opened a line of inquiry by asking a question followed by Student 1's short response in turn 2. Zweli disregarded the fact that Student 1 mentioned the concept of electrons, thus, asking for another contribution. This is an element of what leads to a typical IRE triad (Mortimer & Scott, 2003). In turn 5, Student 2 provides an answer that Zweli was looking for, making the whole interaction authoritative. In turn 7, he emphasises Student 2's response to affirm that it is the correct answer. However, Student 1 tries to bring Zweli's attention to what he had said in turn 2 which can be considered as the student's attempt to gain some epistemic authority for the purposes of making sense of the content, thus disturbing the hierarchies (Engle et al., 2014; Rosebery et al., 2015). However, Zweli seems to not have noticed and fully interpreted the student's response in the first place. During the post-lesson reflection, Zweli's attention was drawn to the incident, and he said the following:

Zweli:	I think the learner's answer was wrong because we are not talking about electrons here. We are talking about magnets, you get it…so I just had to give others a chance, those that can get it right so that she can also learn

In the above extract Zweli confirms that he was looking for a specific answer. Therefore, anything that is not close to the answer was regarded as irrelevant to the discussion. However, it seems like he failed to notice the link between electrons, the flow of electricity and magnetic field in Student 1's response. This was revealed during the VSRI.

Interview:	Mr Zweli, I want us to go back to this incident that we also talked about after your lesson [as he plays the video]
Zweli:	Yes, I remember this…yeah [Laughter]
Interviewer:	So, why did you just say no to the student?
Zweli:	Eish, *ke phazamisitswe ke he a re electrons* (I was disturbed when she said electrons)
Interviewer	So you did not realise how electrons are related to the compass
Zweli:	At that time, yahhh, I couldn't understand where the learner was coming from but now, coming to think about it, she might have thought of electricity but went back to use the term electrons because there is a link also with magnetic field
Interviewer:	Okay, I get you. So, if you had known at that time, you have rejected her answer?
Zweli:	I don't know but maybe I would have tried to question the student more for me to know why she gave me that answer or maybe others could have understood why

In the above conversation, Zweli came to realise that his move for evaluating the student negatively only resulted in an authoritative discourse. He further acknowledges that at that time, if he had noticed that there could more to what the student uttered regarding electrons where if he had questioned the student, the discussion could have unfolded in a dialogic manner. This is evident when he says, "maybe others [students] could have understood" Student 1's response. The fact that Zweli talked about other students in relation to Student 1 indicates that he realises that his inability to notice during the interaction might have denied Student 1 and other learners to make sense of the content and link concepts for a better understanding. However, in this instance, it seems that subject matter played a major role in the sense that Zweli's understanding of the concepts in question was not at the tip of his fingers. Haverly et al. (2020) argue that this is expected as the act of noticing and responding is influenced by teachers' understanding of the subject matter. Similarly, Thomas et al. (2017) argue that teacher responsiveness in classrooms is dependent on a developed subject matter knowledge including how various concepts relate to each other.

3.2. Dialogic Discourses

The two teachers' teaching resembled dialogic discourse episodes and from the interviews, it was apparent that they could maintain those interactions because of being aware of certain things that underlie the students' contributions. I illustrate this using two examples.

3.2.1. Example 1

This example comes from Phidel's first lesson. In this episode, Phidel had just finished talking about different types of bases and acids (strong and weak) and she now focuses learners' attention by letting them give examples.

(1) Phidel:	Let us hear, an example of a weak base?
(2) Student 1:	Salt mam
(3) Phidel:	Salt, which is Sodium chloride neh… [Writing the chemical formula of salt] why salt? [directing the question to the whole class]
(4) Student 1:	Is it wrong of right mam?
(5) Phidel:	I do not know, that is why I am asking
(6) Student 2:	But salt as in NaCl, I doubt it is correct mam because, what is a base again?
(7) Phidel:	Yes, *siqale lapho futhi* (let's start there again) S1, what defines a base?
(8) Student 1:	Ohhh…it has to do with the OH
(9) Students:	And there is no OH in NaCl [many students confirming]

In the above episode, Phidel initiated a discussion by asking students to provide an example of a weak base. Instead of Phidel rejecting Student 1's response, she first acknowledges the student's response and further writes down the chemical formula of salt then asks for elaboration from the whole class (see turn 3). The use of acknowledging and eliciting moves during classroom interaction has the potential to move interaction beyond the IRE triad (Khoza & Msimanga, 2021; Tytler & Aranda, 2015). Since Student 1 expected an evaluation, she asks if his answer is correct or not, but Phidel probed the whole class that led to other students joining the discussion. During the post lesson reflection, Phidel uttered "*Angazi ke lapho kodwa ngicabanga ukuthu* (I don't know there but I think…) she did not grasp the definition of an acid and a base" This shows evidence that Phidel was aware of her talk move as shown in turn 7 in the above excerpt. Otherwise, she would have just acknowledged or evaluated the response then continued with the lesson. This awareness, according to Haverly (2020), is what drives interaction, thus, sense-making in science classrooms. During the VSRI, the following conversation took place.

Interviewer:	Any thoughts on what was happening here mam?
Phidel:	Ohhhh yeah (laughter), I was trying to find out if *la bantwana* (these children) understand what acids and bases are
Interviewer:	Okay, when S1 provided that answer, why did you decide to write it on the board, and specifically the formula
Phidel:	From his answer, I saw that he is failing to understand the concept, like what makes a base a base. So, I decided to ask the rest of the group

Phidel still maintained her position that she noticed that Student 1's response had underlying messages. Unlike in the authoritative pattern of interaction as described earlier, in this interaction, Phidel noticed that the student did not get what defines a base in chemical reactions, hence her move of writing down the chemical formula of the example given by the student. This finding is similar to that of Haverly et al. (2020) who found that novice science teachers' notices of student confusion, misconceptions and mistakes led to meaning-making in the classroom. In this case, the way in which the interaction unfolded was due to Phidel's noticing and responding (through a discursive move) after Student 1's contribution.

3.2.2. Example 2

The following excerpt comes from Zweli's second lesson on electromagnetism. Zweli had just got students' understanding of the concept of electromagnetism then asked one student a question, referred to as Student 1 in this excerpt, who has said that an electric charge can create a magnetic field.

(1) Zweli:	Ohhh okay, explain…how do they produce the magnetic field?
(2) Student 1:	Okay so, let me put it like this…there would be a magnetic field…current passing around…(inaudible)
(3) Zweli:	[Pause] That is an interesting response, you said that when there is current passing, there is…?
(4) Student 2:	There is a magnetic field…
(5) Zweli:	There is a magnetic field around it. So, if this was a conductor (drawing on the board) and I have charges there flowing…you are saying, around this space, where the charges are flowing, there will be a magnetic field around it?
(6) Student 2:	Yes
(7) Student 3:	But the strength of that field depends on the current that is passing
(8) Zweli:	The strength depends on the current?? If the current is how…can you explain?
(9) Student 3:	Charges of high voltage have more magnetic field than those of small voltage
(10) Zweli:	Basically, what Student 3 is saying is that the strength of the magnetic field depends on the voltage. Is that what you are saying?
(11) Student 3:	Yes
(12) Zweli:	Okay, So, less voltage, less magnetic field. Are we clear? less flow means slowly moving but high voltage, the charged will be fast because remember voltage is the electromotive force…the force that in which the electrons or charges will be moving…Not really the energy as you say. I think we now understand this part. Now can we now shift a little bit to magnetism? Here we said electricity can produce a magnetic field. But can magnetism produce electricity?
(13) Students:	Yes…No…(Chorus responses)
(14) Zweli	Okay…I see some faces and hands up…?
(15) Student 4	Sir, what I am saying is that…looking how electricity is produced…they use a wind mill, something like a windmill…So while that is rotating, there are magnets between…when they are busy something there, electricity is produced
(16) Zweli	S4 has got an idea… I will demonstrate exactly what he is talking about…when a magnet spins next to something…something will happen. I do not want to go there yet. We need to start from the beginning. How do you think magnets or magnetism can induce electricity or induce voltage or flow of current?
(17) Student 5	Sir, it simply means if the electric charges can produce magnetism, therefore magnets can produce electricity.
(18) Zweli	Okay, that is what you thinking…let us break this up.

In the excerpt above, Zweli began with a question that was emanating from the previous discussion but began a new line of inquiry regarding the relationship between electricity and magnetism. Zweli uses interesting moves in turn 3 but first acknowledges what Student 1 said is an interesting point to show that he interpreted Student 1's answer. Although just acknowledging students' responses is not enough to heighten interaction in science classrooms (Khoza & Msimanga, 2021; Worku & Alemu, 2021), it provides assurance to students that the teacher is interested in their responses (Tytler & Aranda, 2018). In this episode, instead of Student 1 confirming his response, Student 2 responds leading to his response to Student 2's contribution in turn 5. In turn 16, Zweli makes an explicit statement in terms of his interpretation of Student 4's response and then asks a follow up question that is then responded by Student 5 (see turn 17). His ability to notice what is inherent in the students' responses helped him to ask follow up questions and use suitable discursive moves to engage not only the learner responding but also other learners as they could also relate (Barnhart & van Es, 2015). This episode was one of the focuses of the post-lecture reflection and was also replayed during the VSRI to get Zweli's reflection.

Interviewer: Let's have a look at your talk here, what motivated it?
Zweli: You see sometimes to motivate the learners, you have to listen to what they are saying and take it from there instead of giving and giving…they end up losing hope.

Zweli's utterances in the above extract illustrate that part of what he does to motivate learners to talk is to listen to their responses. Listening to students' responses according to him include "knowing exactly what the student could be thinking before answering like that if the answer was motivated by another student's answer…" This is an aspect of noticing where the teacher would interpret the student's contribution and respond in line with what the student had said instead of what is desired from the student (Rosebery et al., 2015). This act of noticing in turn results in a prolonged interaction for co-construction of science knowledge because the talk 'in context' as dictated by others' utterances (Michaels & O'Connor, 2012). The VSRI of the same episode resulted in the following dialogue.

Interviewer: Did you have to say "interesting response" to this student (referring to Student 3) here…?
Zweli: Yes, that was after I realised that I can use his response to invite his peers because…you know, the learners, they don't see what we as teachers see. So, by saying interesting, I help them think on their own what could be interesting. It's not like saying correct or incorrect, well his answer was somehow correct but I wanted others to come into the party.
Interviewer: So, for you it is about giving them a tool to engage?
Zweli: Most definitely sir. Otherwise they do end up not learning anything is they cannot see what is wrong or right in their peers' answers and I believe that it is my job as a teacher to direct them by listening carefully to how they answer

In the dialogue above, Zweli confirms what he had uttered during the post-lecture interviews. To him, the phrase "interesting response" was well-thought considering the student's response. In particular, he marked the response as important to drive the interaction (Tytler & Aranda, 2015). This illustrates his careful attention to the discursive move he uses to drive the interaction (Haverly et al., 2020).

4. Conclusion and Implications

In this article, my aim was to illustrate that establishing a prolonged interaction in a science classroom is influenced by teachers' ability to notice and respond to the underlying messages in students' contributions. The examples presented above, and the interviews illustrate that in instances where the science teachers were unable to notice the underlying messages from student contribution, the resulting classroom discourse would not go beyond the IRE triad. The findings also indicate that in instances that the teachers were able to notice, the interaction heightened, thus going beyond the IRE triad to a dialogic discourse. These findings confirm that noticing can be a difficult task as one has to do it amidst everything that is happening in the classroom. According to Braaten and Sheth (2017), science teachers are usually confronted with the dilemma of maintaining authoritative control over the science subject matter while trying to create opportunities for students to engage. In this study, it was found that teachers' noticing can deny students the opportunities to interact at deeper levels than they would have. For teachers to do this, they require teachers flexible but strong understanding of the subject matter (Larkin, 2013) while paying attention to the many student voices during interaction.

Although this was a case study of two teachers in a specific context, hence not generalisable, the findings in this study have implications for the training of the upcoming science teachers. In science teacher education programmes, teacher educators can explicitly teach the notion of noticing parallel to the use of discursive moves to facilitate classroom interactions. This can be done by fostering pre-service teachers' skills to notice and respond by showing them teaching videos (Kleinknecht & Gröschner, 2016) and asking them how differently they would have responded to student contributions.

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