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Triadic Dialogue: An Analysis of Interactions in Multilingual Mathematics Primary Classrooms

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This paper seeks to explore at least one aspect of interactional practices in two different multilingual mathematics classroom contexts with learners drawn from different socio-cultural backgrounds. The data collection strategies for this ethnographic study of multi-age primary multilingual mathematics classrooms (with learners aged 12-14) in the EC (Eastern Cape) province of SA (South Africa) included classroom observations, audio-recordings, video tapes and field notes. This study is framed by communicative and socio-cultural perspective (Lemke, 1995; Vygotsky, 1987) for analyzing dialogical interactions in these classes. The results of this study raise awareness of how some pedagogical practices of classroom engagement could be socially predetermined to serve as contributory factors of either effective or ineffective participation in classroom dialogue. Utterance is seen as the basic unit of analysis, and the triadic view implies that the pattern, content and the use of the utterance are mutual, reciprocal and hence triadic. In brief, the findings of this study indicate that even the dominating discourse structure has the form of a triadic dialogue, classrooms can be places in which knowledge is dialogically co-constructed.

Keywords: triadic dialogue, participation, talk, discussion

Introduction

The gains of classroom interactions in the construction of mathematical meaning have been well documented, particularly by those working in the areas of classroom mathematical and scientific discourse (Cobb, Wood, & Yackel, 1993; Lemke, 1990). Brissenden (1988) pointed out that discourse in primary mathematics classrooms can be limited and follow predictable patterns. One pattern of discourse, widely referred to as the IRE or IRF, is designed as a teacher initiation (I), frequently taking the form of a test or displaying question, which predicts a pupil response (R) that provides the known information. The option available to the teacher in the following turn is to evaluate (E) the response in terms of its closeness to the expected answer or to provide feedback (F) (Mehan, 1982; Mercer, 1995). The most common form of interaction consists of a practice in which a teacher initiates a question, the students respond and the teacher evaluates that response which Lemke (1990) referred to as “triadic dialogue”.

Primary multilingual mathematics classrooms in the EC (Eastern Cape) province of SA (South Africa) are embedded with mathematical discourse that reflects classroom culture. Richards (1991) identified four domains of discourse associated with different cultures having different assumptions, goals and methodologies. He argued that each culture was associated not only with a different linguistic domain, but also with different mathematics. Zevenbergen (2001) argued that learners enter the mathematics classroom from a range of

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socio-cultural backgrounds, whereby learners, whose socio-cultural background is congruous with that of the culture represented in and through the practices embedded within the mathematics classroom—including linguistic practices, are more likely to be constructed as successful students.

Moschkovich (2002) explored three perspectives (acquiring vocabulary, constructing meaning and participating in discourses) on bilingual mathematics learners in her works, which expanded our view of what counts as competence in mathematical communication. She pointed out that in reform-oriented mathematics classrooms, students are no longer grappling primarily with acquiring technical vocabulary, developing comprehension skills to read and understand mathematics textbooks or solving traditional word problems. Students are now expected to communicate mathematically (Lampert, 1990) both in speaking and writing, and participate in mathematical practices, such as explaining solution process, describing conjectures, proving conclusions and presenting mathematical arguments (Forman, 1996).

This study is based on a communicational perspective to the teaching and learning of mathematics in multilingual primary classrooms.

The belief is that students' active engagement with mathematical ideas will lead to the development of specific student competencies and identities, which are presumed to make a positive difference in students' life chances and future civic participation (Ball, 2003). Recent mathematics initiatives have legitimated this kind of thinking by calling for changed classroom communities in which learning rules for manipulating symbols give way to learning to communicate about and through mathematics.

Initiatives, such as principles and standards for school mathematics (NCTM (National Council of Teachers of Mathematics), 2000), replace traditional classrooms with learners talking to each other and by groups of students voicing their opinions in the whole class discussions (Sfard, Forman, & Kieran, 2001). The notion of learners talking for others and themselves is explored by Pimm (1987). He argued persuasively that learners do not speak only in response to the teachers. When participants do not orient to talk in the preferred way, interactional troubles are produced (Heap, 1990; Freiberg & Freebody, 1995).

Talking about mathematics becomes acceptable, indeed essential, in the classroom and mathematical discussion (Goos, 2004; Moschkovich, 1999; Walshaw & Anthony, 2008), explanation (Brophy, 2001), defense of ideas, and exchange of ideas (Sherwin, 2002) become defining features of a quality mathematical experience and construction of knowledge (Crotty, 1998). The knowledge is shaped through the turn-by-turn interaction during which students' and teachers' talk orients to prior and subsequent turns at talk (Mehan, 1979; Freiberg & Freebody, 1995; Baker, 1997a). This is especially evident across and within the triadic dialogues, and the predominant activity structures in lessons (Mehan, 1979). Bakhtin (1986) offered a conceptual framework for interpreting the difference between teacher-dominated styles of talk versus those in which the agenda is shared between teachers and learners. Teachers adopting monological strategies to dominate the talk, implying that they are in possession of the truth and engaged in the instruction of others who lack it. By contrast, dialogic discourse involves a greater degree of interaction and shared responsibility for the agenda (Alexander, 2004).

Unlike the former model C primary classroom lesson that the author has observed, the township primary classroom showed that talk usually fits into a pattern whereby the teacher initiates the talk, the student responds and the teacher follows up with an evaluation and maybe elaboration (Sinclair & Coulthard, 1975; Edwards & Westgate, 1994; Edwards & Mercer, 1987; Mercer, 1995; Lemke, 1990; Mehan, 1979).

Theoretical Perspective

This study is framed by communicative and socio-cultural perspective (Lemke, 1995; Vygotsky, 1987). The socio-cultural perspective proposes that collective and individual processes are directly related (Cobb & Yackel, 1996). From a socio-cultural perspective, what is unique in human cognition emanates from the need and ability of human beings to mediate their actions through cultural means that are transmitted, in the course of history, from generation to generation (Vygotsky, 1978).

Promoting the work of Lemke, Mehan (1982) had named three fundamental phases of a lesson: (1) the introduction; (2) the work phase; and (3) the concluding phase. In each of these phases, there is a change in the power relations between the learners and teachers which permits different forms of interactions to happen (Mehan, 1982; Schultz, Florio, & Erickson, 1982). The author's purpose is to discuss both introductory and work phases, because these are the phases where the teachers should retain control of the content and interactions through triadic dialogue during the lesson.

Method

A six-month ethnographic study of two multilingual primary classrooms was undertaken. Learners of the two primary classrooms were drawn from different socio-economic and divergent social-cultural backgrounds, in which one was a marginalized public school attended by learners from poor to low-income households and families receiving social grants from the government. The other school (a former model C) attracted predominantly upper-class households.

Data gathering included mainly classroom observations of the lessons, video tapes to capture the body language and movement and audiotapes, supported by field notes. These methods of data gathering are appropriate for research designed with a communicative and socio-cultural perspective because they allow for the opportunity to examine interactions.

Both classrooms were in the final year of primary school, and learners' age ranged from 12-l4 years old. Observation schedule results were analyzed, and the data from the video-taped lessons were transcribed and analyzed using a form of discursive analyses.

Research into classroom interaction has demonstrated how classroom knowledge is produced through various types of talk (Heap, 1985; Baker, 1997a). Preparing the data for analysis required transcription of the audio- and video- tapes. The transcribed audio- and video- tapes demonstrate an account of the everyday occurrences in the classroom (Baker, 1997b; Silverman, 1998). Examining the transcripts of the classroom dialogue enables an analysis of how and what knowledge is produced and co-constructed.

For the purpose of this paper, few extracts from some of the lessons from each classroom would be used as illustrations. The extracts were analyzed with annotations to show where non-verbal interactions happened. The analysis was mainly on the use of triadic dialogue in introducing concepts to be taught in the lesson, and how learners reacted to the pattern. Because of its ethnographic nature, this study uses the data that seek to establish consistency in interactional patterns observed within diverse aspects of the lesson.

Examples

The two examples below are extracted from the observations of two seventh grade classrooms. In SA, primary school education (Grades R-9) is divided into three phases: the foundation, the intermediate and the senior phases. Foundation phase covers Grades 1-3 and now includes the reception year, i.e., Grade R, which is

not yet compulsory for other schools. Intermediate phase starts from Grades 4-6, and the remaining Grades (7-9) are covered in the senior phase of primary schooling. The seventh grade is a period of transition after the first two phases when each subject (or learning area) is taught by a specialist teacher.

The observed classrooms have six periods of mathematics per week, a third of which is committed to concepts of space, shape and measurement. It was evident in these classrooms that not only teachers tried by all means to maintain dialogue in their introduction to the lesson in the process, but also learners were channeled to settle down quickly and respond to challenging questions posed by the teacher.

Extracts From Two Primary Schools

(All the names of schools and learners mentioned in these extracts are fabricate names.)

Neo primary school (Episode 1). The lesson on algebraic word problems was facilitated by a relatively experienced mathematics teacher, boasting just over ten years of experience and has recently obtained a second degree in mathematics education pedagogy. The school is located within a semi-urban area, serving middle to upper class households. The average teacher-learner ratio in this school is at most 1:30. The teaching and learning of mathematics in this classroom is outcomes-based and more emphasis is put on promoting cooperative learning, routine preparation for formative assessments and learner-centered pedagogy. Most of the learners in this classroom are fluent and competent in the language of learning and teaching English. In the lessons facilitated here, learners were presented with an activity to complete the previous lesson at home, and the teacher used this activity to introduce concepts that are about to be taught and learned.

> Teacher (T): From the activity you were given as homework yesterday, you were told about Lerato, who was the best runner in the eighth grade. One day she ran 100 m in 40 seconds, 200 m in 1 minute and 10 seconds, and 200 m over low hurdles in one and a half minutes. How many more seconds did it take her to run the 200 m over low hurdles then it did to run the 200 m dash? Let me give you a hint: you will need to identify what information is important in this question, and then it will be easier for us to calculate how long it took her to run 200 m. Will this help?
>
> Class (C): No.
>
> T: Perhaps we have to discuss more about concepts of distance and time mentioned in the activity, do you know how to find the speed at which Lerato ran the 100 m? Dumi?
>
> Dumi: We should know the time and distance… ehr; she ran 100 m in 40 seconds.
>
> T: What does that mean? How fast did she complete the 100 m? Mimi?
>
> Mimi: I think we must find out the time taken by Lerato to complete a meter.
>
> T: Good girl. We are getting somewhere now. So this will be distance covered over time, right Donald?
>
> Donald: (Unclear) So, do you actually mean meters in seconds? Just like dividing meters by seconds?
>
> T: Good, we are almost there now, let's get going now and not spend more time on this! What do you think, Manto?
>
> Manto: (Manto uses the calculator) I think she ran at a speed of two and a half meters in a second. (Surprised) Wow, is that possible? Sho! (Teacher interrupted)
>
> T: Good, Manto, she ran at a speed of 2.5 m/s, which is not really fast. Ben, can you help us now compare the speed with the two 200 m?

In this episode, the teacher is aware that most of the learners in her class have done the homework task correctly. However, instead of giving them the correct solution, she engages them in such way that she maintains classroom discussion among the learners through dialogue. In this process, she retains control of the flow of the lesson and drives the construction and negotiation of meaning with and among the learners.

The teacher adopts the triadic dialogue identified by Lemke (1990) in order to take firm control of the interactions and the context in content that is used to introduce new concepts to be taught in this lesson. In using this approach to introduce the lesson, the teacher takes parts of the activity to broaden the conceptual

understanding of the related concepts of speed, as can be seen in the first interaction was Dumi who has identified “time and distance” which the teacher then takes as a stimulus for dialogue in linking time and distance in a way which satisfies her purposes.

The teacher commands and maintains total control of both the interpretation of the content in the activity and the mathematical discussion that guarantees mutual understanding of the concepts being taught and learned.

In fewer occasions, the intervention of the teacher through triadic dialogue leads to the learners not only making more precise definition of speed, but also to extending it to the interrelationship between distance, time and speed. In this way, she does not encourage the learners to review her contributions to the mathematics being discussed, but allows them to construct the scientific meaning of speed from the context in content that is used within the activity. Triadic dialogue in this classroom led to brief answers from learners’ initiative in using scientific language (Lemke, 1990).

The success of the interactions in the classroom indicates that there is an understanding and agreement of the rules of engagement between the teacher and learners to actively and positively contribute towards the classroom discussions and confidently participate in the interactions. This is more beneficial to the teacher because she is able to cover more concepts from the planned lesson content.

Triadic dialogue in this lesson provides learners with opportunities to communicate and reason mathematically in order to learn mathematics, and consequently, learners become more confident in talking and arguing about the mathematics that is being taught.

Resego primary school (Episode 2). Resego is a relatively big previously marginalized school in a remote township area of the Nelson Mandela Municipality. The school draws learners from lower class families, most of which rely on government social development aid, such as grants and food parcel. The literacy level in this area is very low. The classrooms are smaller than Neo, but an average teacher-learner ratio is at most 1:40, providing the teacher with limited space to walk around different groups during the lesson. The teacher has taught mathematics in this school for more than 15 years now, and he employs problem-based learning to introduce the lesson, using group work as a cooperative learning technique. Most of the learners are actively engaged in their task with certain members of the groups dominating the discussions during problem-solving. The learners use papers and parts of the hard boxes to model their mathematical solutions. The extract below represents the introduction to a lesson in which the teacher instructs learners to investigate the area of a rectangle.

Teacher (T): (With small pieces of squares in his hands, cut from a paper and an A4 sheet on the table in front of him). What shape is this?

Mogaka: Quadrilateral.

T: Good. What type of a quadrilateral is this shape, Ben?

Ben: Four sides, eh ... and four equal angles.

Buti: It is a four-side figure, with four corners.

T: Buti, I’m telling you for the last time, wait for your turn. Does anyone know what this shape is called? (Somebody shouts at the back of the classroom—rectangle!) No shouting please.

Kgatlhiso: No! A rectangle has only two sides equal in length.

T: We need to move now, time is being wasted.

(More shouting from the back)

T: Let us go back to Ben’s answer, four equal sides, and four equal angles. What is the word we are looking for? The shape is commonly used for tilling floors. Raise your hand please—no shouting.

Ben: A square.

Buti: Yep! Exactly what I said, the same thing.

In this episode, it is apparent that a learner's behavior disrupts the management of the classroom, and the discussion between the teacher and learners and among learners themselves. In this classroom setting, triadic dialogue is not assisting the teacher to take total control of the flow of the lesson, but encourages maximum learners' participation which is high in quantity, informal and low in quality, as identified and stated by Lemke (1990).

There is evidence of unspoken rules of classroom interaction before and during the lesson, which results in control of the academic content of the lesson and control of the learners lost in the process. The flow of the lesson is at disconnected as learners dispute the teacher's authority during the lesson. There is no evidence of negotiation of meaning between the teacher and the learners.

Only few learners participated in the discourse because they were not confident and competent in linguistic exchanges (Zevenbergen, 2001) of the mathematical interactions as their upper-class peers thereby marginalizing them in the process of learning.

Conclusion

It is a major challenge for many teachers to include classroom discourse as an integral part of an overall strategy of teaching and learning in an introductory phase of the lesson. Teachers who facilitate mathematics lessons to learners coming from low socio-economic households with low literacy levels, are faced with crisis of how and when to set up practices that will enable learners to participate in mathematics dialogue. This is partly contributed by the LoLT (language of learning and teaching) that is used in these classrooms, which is learners' foreign language. It is apparent that these learners from marginalized schools, such as Resego, are unable to gain access to mathematical contexts in content and processes more readily than others. It is for this reason which the proposes that triadic dialogue is useful for certain classroom contexts that boast highly trained and motivated teachers, serving learners with "preferred" linguistic habitus that is encouraged and approved by the classroom linguistic exchanges practiced within the school's system values.

According to Collins (1993), pedagogies that tacitly select the privileged and exclude the underprepared are not regrettable lapses; they are systemic aspects of schooling systems serving class-divided societies. The author argues that honouring students' contributions is an inclusive pedagogical strategy, which could promote maximum and quality classroom participation and discussion. The author found that mathematics teachers, who facilitate learners' involvement, evoke learners' contributions and engage in an exchange of thinking and perspectives, exemplify one of the sound pedagogical practices. This study shows that even the dominating discourse structure has the form of a triadic dialogue, classrooms can be places in which knowledge is dialogically co-constructed and learning and teaching is negotiated. Classroom work is made more enriching when discussion involves the co-construction of mathematical cognition through the respectful exchange of meaningful ideas. When teachers work at developing inclusive partnerships for the exchange of ideas, they ensure that the ideas put forward are, or become, commensurate with mathematical convention and curricular goals (Walshaw, 2008). Teaching for inclusion ensures that participation in classroom discussion is safe for all learners, irrespective of their academic achievements and social class.

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