

Implementing Dialogic Pedagogies in Early Years Mathematics Teaching

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In this paper, we present the findings from the first year of our study into the use of talk with young children (ages 6 and 7) in their mathematics lessons following four teachers' implementation of dialogic strategies. Based on Alexander's (2017) dialogic principles and notions of productive talk, we delivered a professional implementation through a series of four spaced workshops. Teachers were interviewed to reflect on their implementation at the end of the year. These interviews are analysed according to Lefstein's (2010) theoretical model of dialogic pedagogies to identify the factors that enabled and constrained the teachers in shifting their pedagogies.

Dialogic pedagogies have the potential to enhance learning in educational contexts (Alexander, 2017) through a focus on the value of talk and sharing of learner ideas and opinions (Lefstein & Snell, 2014). As teachers and students engage in dialogue, content and new understandings build cumulatively and purposefully (Harper et al., 2018). In terms of teaching approaches, traditional classroom roles are revised to place less emphasis on teacher-directed instruction, with the provision of open-ended tasks (i.e., those with more than one correct answer or method of determining an answer), and a commitment to the co-construction of knowledge between students and teacher (Alexander, 2017). Alexander's (2003) indicators of dialogic teaching include the structuring of questions that are likely to provoke thoughtful answers that then provoke further questions. Questions and answers build blocks of dialogue, rather than reaching a 'terminal point' (p. 37) and teacher-student and student-student exchanges are channelled into coherent lines of enquiry, rather than left 'stranded and disconnected' (p. 37). This is not to say that dialogic pedagogies that have no place for teacher-directed instruction, or that tasks are always entirely open, just that there is a greater emphasis on opening up opportunities for purposeful dialogue.

This paper reports on a project which aimed to develop a dialogic approach that enhances mathematical talk by young students, ages 6 to 7. Through engaging in school-based participatory research (Hennessy, 2014), we worked with four early years primary teachers to design, trial, and reflect upon the implementation of dialogical pedagogies and the development of appropriate, engaging tasks for student learning in groups. The aim was to develop teacher practice with a focus on the use of language (both teacher and student) and reflection on their professional development. Specifically, our research question for this paper was:

- What factors enabled and constrained early years' teachers' uptake of dialogic pedagogies in mathematics teaching?

Literature Review

Research into dialogic pedagogy has focused on the value of talk between students in early learning (e.g., Feez, 2023), primary (Edwards-Groves & Davidson, 2023), secondary (Myhill & Newman, 2023), and tertiary contexts (Simpson & Wang, 2023). Several researchers have sought to understand the value of dialogic pedagogies. A study by Howe et al. (2019), for example, which focused on teaching and learning in mathematics, literacy, and science, found (2024). In J. Višňovská, E. Ross, & S. Getenet (Eds.), *Surfing the waves of mathematics education. Proceedings of the 46th annual conference of the Mathematics Education Research Group of Australasia* (pp. 391–398). Gold Coast: MERGA.

that “classroom dialogue matters as regards student outcomes” (p. 462). More specifically in mathematics, Murphy (2013) explained how talk was crucial for speakers and listeners to orient each other and share their intentions in mathematics contexts. Despite its importance, a recent study by Moser et al. (2022) found that there is often a scarcity of dialogic classroom discussions in mathematics. Compounding the problem, Mercer and Sams (2006) found that the lack of language and reasoning skills is a major cause of underperformance in school education and also of behavioural problems. Clearly, it is important to gain a stronger understanding of the kinds and features of talk that are conducive to learning in mathematics.

While the research literature provides examples of teachers successfully implementing dialogic approaches in educational contexts (e.g., Clarke et al., 2016; Jay et al., 2017), and the use of prompts in supporting exploratory talk in collaborative group work in mathematics (Mercer & Sams, 2006), virtually no research has focused on the initial uptake of dialogic approaches by teachers who are used to traditional pedagogies. This paper addresses this gap and reports on the findings of teacher reflective conversations and interviews analysed through the lens of Lefstein’s (2010) model of dialogic teaching. The findings are used to identify the factors that enable or constrain student learning through dialogue.

Conceptual Framework

Dialogic pedagogies move beyond monologic and teacher-centred dominance of Initial-Response-Evaluation (IRE) to the development of patterns of classroom interaction that open up the talk and, subsequently, the thinking of the learners (Alexander, 2003). Lefstein (2010) expanded Alexander’s characterisation of dialogic content as purposeful and cumulative to include the criteria of critical and meaningful and so developed a model that “pedagogised” (p. 11) dialogue appropriate to contemporary school contexts. The model outlines four dimensions that can be considered when negotiating the various role demands of teaching through dialogue.

The first dimension is the meta-communicative, which involves teachers and learners giving attention to the role and features of the dialogue itself. Teachers can foster the meta-communicative dimension by establishing and maintaining communicative norms and encouraging and facilitating reflexivity (Lefstein, 2010). Second is the ideational dimension, which is concerned with the exchange of ideas, the building of knowledge and the pursuit of truth. Teachers foster the ideational when they open up the curriculum, relate students’ contributions to each other, and probe and challenge students’ ideas. The third is the interpersonal dimension, which focuses on the relationships between those engaging in dialogue. Teachers foster the interpersonal through building a classroom community and encouraging broad participation. The fourth is the aesthetic dimension, taken here to mean the enjoyment in and reasons for dialogue. While it can be related to all four dimensions, we see the design of mathematics tasks to be largely about the aesthetic, ensuring that tasks are appropriately challenging and engaging. For Lefstein, teachers promote the aesthetic when they “set the stage for engaging discussion” and “orchestrate pupil participation” (p. 16). Together, the four dimensions provide researchers with a useful tool for unpacking the complexities of dialogic teaching in educational contexts. We used this model to show what enabled and constrained learning for our focus teachers as they implemented dialogic pedagogies into their mathematics lessons.

Our project design was also informed by Clarke and Hollingsworth’s Model of Professional Growth (2002). Through the workshops we were able to serve as an “external source of information or stimulus” and spaced workshops provided for teacher engagement in “professional experimentation” (Clarke & Hollingsworth, 2002, p. 951). We were seeking “salient outcomes” through uptake of dialogic teaching pedagogies and increased student

participation in mathematical exploratory talk, and evidence of shifts in teachers' knowledge, beliefs and attitudes.

Methodology

The wider project involved a school-based participatory design (Hennessy, 2014), which began with the collection of baseline data through three lesson observations in each of the four classrooms, interviews with teachers about their approaches to teaching mathematics, and focus group and individual interviews with children about their mathematics learning and understandings. The first year of the project, which is the focus of this paper, involved four teacher researcher workshops, four lesson and small group task observations, and a reflective interview with each of the teachers about the implementation and evolution of the design. Interview questions focused on teachers' facilitation of mathematical talk, such as 'How are you facilitating student talk in your maths lessons?' and 'Can you describe instances where you have observed students engaging in productive mathematical talk?' The data collected from workshop reflections and teacher interviews are reported on in this paper. The participants were one Grade 1 and three Grade 1/2 teachers and their students.

In the first workshop, teachers were introduced to principles underpinning dialogic pedagogy that covered the four Lefstein dimensions. A key strategy based on the use of ground rules for productive talk (Mercer & Sams, 2006) was introduced, including prompts such as 'I agree/disagree because...'. These rules were intended to promote metacommunicative and ideational dimensions. Subsequent workshops explored different ways of arranging students in small groups; how to promote safe, respectful learning environments (interpersonal dimension); and how to design small group tasks with appropriate timing, explicitness, and challenge (aesthetic dimension, Murphy, 2011).

Following a design cycle in line with the participatory nature of the project, the format of each workshop allowed for teachers to interpret and trial strategies that they could take into their classrooms ready for the video lesson observation visit. Each workshop started with an evaluation of the implementation of their strategies based on the video recording, followed by a discussion of strategies to further promote productive talk to take into their class for the next video lesson observation. Teachers were supported in resourcing and trialling challenging tasks that matched their planned teaching content. In this way, the workshops afforded the teachers opportunities to reflect on experiences in their classrooms and for the research team to listen, respond, and suggest ways forward based on previous research into dialogic practices. A key aspect of this approach was that different practices emerged for each teacher based on the four dimensions.

Results and Discussion

Following a summary of teachers' illustrative mathematics lesson structure and task examples, this section reports the findings of teacher reflections collected during the teacher workshops and reflective interviews. The findings are referenced to Lefstein's (2010) four dimensions of dialogic teaching.

The four teacher participants engaged in the first year generally followed the gradual release of responsibility (GRR) model (Pearson & Gallagher, 1983) for their mathematics instruction. Henceforth, the GRR model seemed to leave a residue across much of the dialogue between teachers and researchers and in the teachers' decision making while implementing the design. This lesson structure involved three main stages: first, a setting up stage, in which the teacher would introduce the mathematics focus, introduce and talk children through a task or problem, and remind the children about the ground rules for productive talk about mathematics; second, an exploration stage, in which the students would split into small groups and talk through a mathematics task/problem, and the teacher would cycle around the groups offering assistance

as required and keeping children on task; and third, a conclusion stage, in which the whole class would be brought back together to report their findings and for the teacher to facilitate a final discussion about the main learning outcomes for the experience. Importantly, this dialogic approach was not the only way students were taught mathematics; they still engaged in their usual GRR-based mathematics lessons, but the teachers committed to including at least one dialogic lesson per week and to increase the opportunities for students to talk and share ideas and opinions about mathematics in all lessons.

Based on Murphy's (2011) review of mathematical tasks, the research team supported the teachers to develop and implement small group tasks that were relatively short and with an explicit outcome that also included some ambiguity. The teachers avoided tasks where the students needed to take a long time discussing how to complete the task (e.g., what to cut out, where to stick it, etc.), as well as tasks that involved writing. The teachers were encouraged to use images (e.g., odd one out; sorting/pairing; true or false), and to create tasks where students would direct each other to the mathematics focus. Finally, teachers were encouraged to repeat given tasks several times, but with variations each time, such as using different numbers, shapes, and so on. Figure 1 provides an example of a task that was used.

Figure 1

Cubby House Task (Sullivan et al., 2023, p. 15)

Thirteen friends are playing in a cubby house.
Some of the friends play inside the cubby house, some play under the cubby house and some play outside the cubby house.
Draw a picture to show how many friends might be inside, how many might be outside and how many might be under the cubby house.



Metacommunicative Dimension

All four teachers talked about establishing and maintaining communicative norms and explicitly talked about rules for talking and listening. For example, James explained:

I started to introduce some of the talking rules and some of the things like that. So then, when we were doing more stuff, where they're challenging and disagreeing with each other, they already had the kind of rules of communication in place. And I think that worked relatively well. I think it worked well.

In addition, James explained that his rules were loosely based off "established listening rules like the five L's anyway, which I assume are pretty universal. So that's eyes looking, ears listening, legs crossed, lips closed, hands on lap."

Similarly, Jill noted:

I do feel like a lot of the work we've done has helped them to do that ... and to cement their more foundational level of skills. It's given them more confidence to talk about the things that they've got going on.

The 'work' referred to by Jill includes the establishing and maintaining of communicative norms throughout the year's mathematics lessons, such as practicing established listening rules. In the reflective workshop sessions, we talked about moving beyond generic rules for listening and talking, and for looking for evidence that constructive listening was occurring. The teachers were reminded of the aim to engage students in productive talk, which required inviting criticism of participation in the direction of dialogue (Lefstein, 2010). This emphasis on the metacommunicative dimension was key to developing student confidence to share mathematics-related ideas and opinions during group and whole class learning, since the students had a shared understanding of what productive talk in mathematics lessons involved.

Ideational Dimension

A feature of the workshops was the opportunity for teachers to collaboratively view classroom footage of student talk collected throughout the project. These opportunities highlighted the importance of the teacher's role in maintaining conversational cohesion, which Lefstein (2010) described as an aspect of the ideational dimension. When teachers connect the contributions made by different students, this helps to draw together and summarise conversational threads, helping them see a developing logic in the talk. This appears to be particularly important when engaging in dialogic pedagogy with younger learners, since they often require more support in this area. In early primary contexts, dialogic pedagogy cannot be 'set and forget'; the teacher needs to scaffold conversations for students, threading their comments together when they do not have the language or thinking skills to do so themselves. If students are not drawn into a task quite quickly, they can lose interest and miss the learning experience. It appears that this dimension may have been the most challenging for teachers, and hence required more support to implement as the following quote illustrates:

I think even just to debrief with you guys straight after and go, so this happened and this happened Is that normal? Like this is how the activity went. Should I try it again, with different numbers? Or should I just try and move on to something else? Yes, I think that's partially because I'm not as experienced as a teacher, but I think also just because what we're doing is a little bit different to what we've been trained to do and what I've done in the past. (James)

All four teachers actively encouraged students to use the terms 'I agree because' and 'I disagree because' as a means to foster respectful challenging of ideas. This strategy required explicit modelling and perseverance on behalf of the teachers before it became part of the talk routine. Anne said, "[We've been using] 'I agree', and 'I disagree, because' we need to use those, but they, you know, took a while to get to that language, [but now] they're actually using that language."

This way of teaching was new for these teachers and it was understandable that teachers lacked confidence with the implementation of dialogic pedagogies and the need for additional support will be noted in future iterations of the project.

The ideational dimension can also refer to opening the curriculum, which the teachers enacted through the provision of open-ended tasks and problems, such as the cubby house problem depicted in Figure 1:

I introduced a few of those. And I think they changed some of the questions that I was asking, to more open-ended questions. And introducing some of those problems. As I said, with the cubby house problem, for example, having things like that a much more regular occurrence in my teaching planning. And yeah, the best listener was something I implemented a lot. (James)

Interpersonal Dimension

This dimension appeared to be particularly relevant, with all four teachers highlighting the importance of building a classroom environment which provided a safe space for talk, with one teacher, Jill, being particularly cognizant of modelling caring behaviours. She played lots of circle games with her students and used a puppet to model respectful listening:

I definitely think those games were good for tuning everyone's thoughts around to you know, what, what you need to be when you're listening. And even just your volume when you're talking and taking turns to talk. I also introduced my little puppet, Bun-bun, and we had to teach Bun-bun how to listen. So it was looking at the person who was speaking, not interrupting and hands up and with Bun-bun, it was more about where his eyes were, where his body was; if he was paying attention, we could tell because he was looking at the person. So that was actually fun. They really loved that, and it was also us teaching him how to talk, which was good.

Teacher interview feedback received after the final workshop, indicated that the introduction of dialogic pedagogies had a positive impact on students' ability and willingness to talk:

[The students] definitely did show a better ability to talk to everyone and to convey their own opinions. (Anne)

It does feel like they have a better understanding of how to explain their thoughts ... that could be because I now know them better, and it could be because, you know, I've seen them in different areas. (Sharon)

This feedback is related to the interpersonal dimension of dialogic pedagogy in that the teacher's efforts to build a classroom community and encourage student participation in many mathematical discussions with their peers developed their confidence to share their thinking about mathematics when working through problems.

Teachers also encouraged broad participation and structured discussions that maximised the chances that students would have something significant to say. The following quote demonstrates how the teacher orchestrated opportunities for all students to actively participate:

I explicitly came back to how they needed to work together. There tended to be that dominant person still just doing the job and the others sort of waiting around, especially on the first attempt with things. So maybe on that first attempt, those people who weren't so sure, were watching and observing how to do it. And then when they had a second chance, and maybe a different group, it's like a fresh start, but they came with some knowledge, and they would then participate. I did find it wasn't always collaborative, especially as it was new learning. (Jill)

James was also aware of broadening participation and ensuring fairness, particularly in terms of roles:

And then I'll have a listener for that. And then the listener will report back to the class on how they think their group was listening. And then I'll take their notes, and then I pick a different listener. And I did that so that everyone gets a chance to be a listener. But like, if I have one person to listen to for too long, other kids get a bit upset, because they wanted a turn to be the listener. That worked really well because there are times when I've been able to compare the listeners with each other like, when this student was a listener, he was doing this, so maybe think about how you can see what he did and copy that.

Aesthetic

As Lefstein (2010) described, teachers can attend to the aesthetic dimension through setting the stage for engaging discussions and orchestrating student participation by injecting good humour or a sense of drama into task design. The teachers recognised early on that they needed to model and facilitate respectful listening and talking generally in whole class and small group situations before they could focus on mathematical talk and ultimately exploratory talk, "I guess we spent two or three weeks just doing talking and listening sort of games and activities. So it wasn't really in maths it was just talking about, [just] in general yes."

Jill's use of a puppet as mentioned earlier in relation to the interpersonal dimension also provides an example of attending to aesthetic considerations. Lefstein (2010) acknowledges that the dimensions can overlap and that there can be tensions between them. For example, protecting students' social needs may mean not probing their thinking in public. There is also arguably a hierarchy of priorities as different dimensions may take priorities over others.

Setting up ground rules for talk and encouraging small group participation was not always enough to enable effective learning of mathematical concepts for these young students. Another teacher commented:

I guess [it is a challenge] when you were applying it to maths and when the lesson's going on for a little while, especially if they're not engaged, say it's a little bit dry, or the content is hard. So if you're covering a new maths focus or something like that, I find that they're not as engaged as once they have some knowledge around it, and then they're happy to participate and talk and, you know, do that talking and listening stuff. Whereas otherwise, they seem to just tune out, which, you know, so they're not listening at all or talking. So, yes, I found there were just some difficult times with that. So, I often found the first time we did the activity, this is groups, there wasn't much really

going on, especially when it was a bit challenging. But then if we repeated the activity, they were really good. (James)

Here, the teacher is aware of what can go wrong with dialogic pedagogy when the aesthetic dimension is not given enough attention. The young learners in these classrooms did not seem to cope well when the tasks were too open or too long, and care needed to be taken in scaffolding new mathematical concepts in a way that students could engage.

Conclusions

The research findings so far highlight that the teachers reported taking a dialogic approach to teaching mathematics had a positive impact on their students' ability to listen and participate in talk in mathematics lessons. In particular, teachers noted improvements in students' confidence to share their thinking during small group work, which other research has pointed to as a key enabling factor in older students' mathematical and science learning (e.g., Mercer et al., 2004). Giving attention to the metacommunicative and interpersonal dimensions was crucial here, as the teachers took time to establish and maintain ground rules for productive talk and to build positive classroom communities that valued the sharing of student ideas when solving mathematical problems.

At the same time, challenges were also apparent, especially in maintaining students' engagement in learning during difficult or unfamiliar mathematics tasks. Paying more attention to the aesthetic dimension was identified as a key factor in addressing this challenge, through meaningful task design personalised for the children in terms of the level of challenge. Additionally, aspects of the ideational dimension such as maintaining conversational cohesion would support the learners to grasp the developing logic in group discussions. Looking forward, Lefstein's (2010) framework has proven helpful in suggesting key areas that require further designing, trialling, and reflecting, as the teachers grapple with key questions such as how to shift from, what is essentially, co-operative listening and talking in completing a task together, to productive talk where the dialogue opens up and orients thinking.

Clarke and Hollingsworth's (2002) model proved useful in understanding how teachers' professional growth could be facilitated especially through attending to the first two elements of provision of an external stimulus and professional experimentation. Workshop design ensured that the teachers were provided with research-informed practices and resources to assist with the implementation of dialogic pedagogies. Spaced workshops and classroom visits allowed for trialling, professional experimentation, and reflection. Future directions for this project will include broadening participation, use of control groups to evaluate impact on students' learning and refinement of the project design to better support teachers with implementation.

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