Utilising the Expertise of Specialist Intervention Teachers in Primary Mathematics Classrooms

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Typically, more primary students qualify for mathematics intervention support than schools have the capacity to assist. This highlights the importance of every primary mathematics teacher having the expertise to design inclusive and responsive curricula and instruction for students who may experience difficulty. Our study addresses this issue through exploring how specialist intervention teachers can support the mathematics professional learning of teachers using co-teaching cycles. The findings provide insight about the challenges experienced by classroom teachers when teaching students who experience difficulty with mathematics, and the actions of the specialist intervention teachers that assisted the teachers' professional growth.

Most primary teachers face the dilemma of how best to support the students in their class who are not yet thriving with learning mathematics. Typically, in Australia, primary teachers are generalists who have not had the opportunity to develop the specialist knowledge associated with diagnosing the mathematics difficulties that some students encounter, nor planning responsive teaching. To assist teachers to support students who experience difficulty, some principals employ a specialist mathematics teacher to run intervention programs or engage mathematics leaders to collaboratively plan with teachers and provide professional learning. Our study proposes that the school's specialist mathematics intervention teacher has the expertise to support classroom teachers with whole class mathematics planning and instruction.

The pilot study presented in this paper aimed to gain insight into how the expertise of the school's specialist mathematics intervention teacher might be utilised to support classroom teachers to increase their capacity to assist students who experience difficulty with learning mathematics. Within the context of the broader study, the specific research questions addressed in this paper are:

- What are the challenging aspects of teaching students who experience difficulty with mathematics for classroom teachers; and
- What actions of the specialist intervention teachers do classroom teachers report help them to support students who experience difficulty with mathematics.

Background Literature

According to the OECD's Programme for International Student Assessment (PISA), 22% of 15-year-old Australian students are low performers in mathematics and around 46% do not attain the National Proficient Standard (Thomson et al., 2019). In response, schools employ a range of intervention approaches that typically fall into three tiers (Bryant et al., 2008). Sonnemann and Hunter (2023) described Tier 1 as high-quality classroom instruction that meets the needs of all students, Tier 2 as targeted small group support for about 15% of students who fall behind, and Tier 3 as intensive one-on-one support for students who make minimal progress in Tier 2. While intensive

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interventions have been shown to be effective (Nickow et al., 2020), not all students who may benefit are able to access these. Hence, building the capacity of teachers to provide high-quality mathematics instruction for all is paramount.

Professional Learning

Many schools employ a mathematics leader or coach to provide in-situ professional learning for teachers focused on developing high-quality instruction. Previous studies have demonstrated the effectiveness of this approach for enhancing mathematics teaching (Anstey & Clarke, 2010; Sexton & Downton, 2014), and for increasing student achievement (Bruce et al., 2010). One model for leading classroom embedded professional learning is using the co-teaching cycle (Sharratt & Fullan, 2012) comprising: co-planning, co-teaching, co-debriefing, and co-reflecting. Cobb et al. (2019) also identified modelling instruction, co-teaching, co-planning, and debriefing as potentially productive activities for mathematics coaches, and teachers have indicated that "modelling, observation, and debriefing were the most valuable components" of a professional learning model (Butler et al., 2004, p. 447).

Typically, professional learning based on co-teaching cycles address aspects of practice that teachers wish to improve. Previous research has highlighted that high-quality student-centred mathematics instruction promotes collaboration, problem solving, dialogue, and using tasks with enabling and extending prompts through which all students can access the task (Russo et al., 2020). However, teachers and mathematics leaders have indicated that one of the most difficult aspects of teaching mathematics for students with diverse abilities is knowing how best to differentiate instruction to meet the needs of all students (Downton et al., 2022; Gervasoni et al., 2021). Further insight is needed about the particular challenges that teachers face when addressing the needs of students who are struggling to learn mathematics within inclusive, student-centred settings, and how teachers' professional learning can be supported.

Context for the Pilot Study

The pilot study took place in three primary schools situated within a system of 58 schools in Sydney. Twelve years earlier this school system launched a mathematics initiative that included professional learning for principals and teachers (Roche & Gervasoni, 2017) based on constructivist aligned and inquiry-based mathematics teaching (Russo et al., 2020). The initiative included an annual task-based mathematics assessment (Clarke et al., 2002) enabling each student's growth to be monitored, and those who were mathematically vulnerable to be identified. The *Extending Mathematical Understanding* (EMU) intervention program (Gervasoni et al., 2021; Gervasoni, 2015) was introduced for students who were mathematically vulnerable. The EMU program is taught by certified specialist teachers (ST) who complete an initial course and annual professional learning. The theoretical underpinnings of the intervention, teaching approach, and lesson structure are described in detail in Gervasoni (2015). Each lesson focuses on whole number learning, mathematical problem-solving, engagement with open tasks, and reflection on the mathematical focus of the lesson. More than 400 teachers in the system qualified as EMU STs over the past 12 years.

An issue faced by school leaders in this system is that not all eligible students are able to access an EMU intervention program. For example, in a 2018 study involving 57 schools in the same system, Gervasoni et al. (2019) found that only 23% of 1471 Grade 1 students who were mathematically vulnerable were able to access the EMU intervention program in their school. Our study responds to this situation through harnessing the expertise of EMU STs to support classroom teachers' professional learning. Through experience with EMU intervention, the STs had developed expertise in differentiating instruction for groups of three students, guided by diagnostic assessment and the Early Numeracy Research Project (ENRP) growth point framework (Clarke, 2013). They

had designed lessons based on problem-solving and engagement with open tasks, and were experienced with: selecting concrete models to assist students' construction of knowledge; prompting students to visualise and explain their thinking and strategies for each other; and developing students' confidence and positive dispositions for mathematics. These were all examples of high-quality instruction relevant for Tier 1 mathematics teaching.

Method

Mixed methods were chosen as most relevant for addressing the research questions in this pilot study. The research design involved EMU STs leading co-teaching cycles for Grade 1 and Grade 2 classroom teachers for at least 10 weeks during Term 2 and Term 3. At the conclusion of the co-teaching cycles, participants were surveyed using an online platform (Qualtrics) and interviewed (via zoom). The research followed the approved ethical guidelines, and pseudonyms are used for the classroom teachers. Results and findings for classroom teachers are the focus for this paper.

Data Collection Instruments and Data Analysis

The teacher survey included Likert style items in which they rated their confidence for teaching mathematics, any change in knowledge and pedagogical approaches following the co-teaching cycles, and the extent to which the actions of the EMU ST during the co-teaching cycles contributed to their professional learning. Open response items investigated what teachers considered most challenging about teaching students who were struggling with mathematics, and any other support from the EMU Specialist that they found valuable. The semi-structured interviews aimed to provide greater depth and clarity about the nature of the EMU ST support that teachers received, and their perceptions of the impact of the support. The Likert-style survey responses were summarised. Open response items and the transcribed interview data were analysed using constructivist grounded theory methods (Charmaz, 2014). A narrative is used to present the findings concerning the challenges teachers described and insights about the support provided by the EMU ST.

Co-Teaching Cycles

The co-teaching cycles for the study took place during Term 2 and Term 3, and involved weekly planning meetings, co-teaching at least twice each week, and time for co-debriefing and co-reflection. Each school selected classes for the pilot based on analysis of their school mathematics assessment data (Gervasoni et al., 2021) and the proportion of students who were mathematically vulnerable. School A selected Grade 1 for Term 2 and Grade 2 for Term 3, and 21% and 39% of students in these classes, respectively, were vulnerable in at least one number domain. Both School B and School C selected Grade 1 classes for both terms. The proportion of students who were vulnerable in School B and School C was 19% and 25%, respectively.

Each EMU ST in the pilot received professional learning prior to implementing the co-teaching cycles, which was facilitated by the system EMU Professional Learning Leaders (PLLs) in 2021. The professional learning focused on the key components of the co-teaching cycle (Sharratt & Fullan, 2012), the features of high-quality instruction for student-centred learning (Russo et al., 2020) and processes for monitoring the progress of students. In 2022, ongoing support from the PLLs included two check-ins via zoom or email each term, collegial visits, providing professional readings, and discussing student assessment.

Participants

The three schools for the pilot were purposefully selected based on: (1) support and commitment of the school principal; (2) having an EMU intervention program in place; and (3) having an experienced EMU ST on staff who gave consent to participate in the study and was released from classroom teaching. The participants were an EMU ST from each school, four Grade 1 teachers, and one Grade 2 teacher. One classroom teacher participated in the survey but chose not to participate

in the interview. The classroom teachers had between one- and seven-years teaching experience. The EMU Specialist Teachers in School A, School B, and School C had implemented EMU intervention programs for 7, 4, and 5 years, respectively.

Results and Findings

Challenging Aspects of Teaching Mathematics to Students who Experience Difficulty

To gain insight about the challenges that classroom teachers faced when teaching students who experienced difficulty in mathematics, the five participating classroom teachers were invited to describe their challenges in an open response item in the survey, and in the semi-structured interview. Two themes emerged from the analysis of data: (1) Differentiating instruction to respond to student difficulties in the moment; and (2) Finding time within a lesson to work with students who are mathematically vulnerable. These themes are described below, using illustrative examples from the survey responses and interview transcripts. It is important to note that all teachers typically implemented a student-centred approach for mathematics using challenging tasks with enabling and extending prompts (Russo et al., 2020) to differentiate instruction. The teachers also used the ENRP growth point framework to identify students in their class who were mathematically vulnerable and to inform their lesson planning.

Theme 1. Differentiating instruction to respond to student difficulties *in the moment.*

A fundamental challenge for the teachers was further differentiating their instruction when enabling prompts were insufficient. For example, in her survey response, Angela explained:

> I find it very challenging to differentiate the instruction for students who were vulnerable as some enabling prompts worked well for some students but didn't work well for others.

This dilemma was further elaborated in Angela's interview. She found it challenging to provide *in the moment* direction to cater for "the exact need for each child". She noted that some prompts promoted engagement for those who were vulnerable, "the child has really gotten into it" but sometimes "it did not work". Bec highlighted in her interview that it was challenging to provide tasks that were sufficiently scaffolded so "that [students] were able to start the task and able to complete it and understand the concept". Similarly, Deb found it challenging to anticipate (Stein et al., 2008) how students "might go with a task" and whether the enabling prompt might be too difficult for some. In the survey Deb wrote,

> Students' learning is unexpected and if my already differentiated task does not cater to the students learning needs during the lesson, it is hard for me to find ways in which I can further help them.

The challenges for teachers arising from selecting suitable tasks and anticipating the range of student responses for a task is apparent in these data, along with the challenges of (1) planning suitable enabling and extending prompts to differentiate learning prior to a lesson, and (2) adapting tasks and instruction to differentiate learning *in the moment*.

Theme 2. Finding time to support students who are mathematically vulnerable.

The interview data for Deb, Bec and Emma highlighted their struggle to find the time and opportunity to assist individual students amidst the complex work of leading inquiry-based learning for a diverse group of students. For example, Bec explained that having time in a lesson to "get to" each one, including the capable students, is challenging, and this challenge was also apparent in Bec's survey response:

> Having the time to work with vulnerable students one on one in an effective way while also catering to the needs of and supervising the other students in the class.

Deb noted in her interview that:

> My other students, they may seem like they're so confident, usually, but if you go up to them, sometimes they're actually not doing so well. It's that remembering I need to go back to everyone … which is something that I did struggle with as well.

This tension was also noted in Emma's survey response.

> There are so many students in a class. It is difficult to spend quality time with vulnerable [students] doing activities that are helping them, whilst still fulfilling the requirements of a proper maths lesson—taking photos of student work samples, reflecting, repeating the process.

Underpinning all these challenges was the desire of the teachers to have the time, opportunity, and expertise to differentiate mathematics instruction for students *in the moment* amidst the complexities and demands of whole class mathematics teaching.

Valued Actions of EMU Specialist Teachers

In the survey, classroom teachers rated (out of 10) the value of ten supports provided by the EMU ST during co-teaching cycles. Table 1 provides a summary of results. The Likert items have been ordered from lowest to highest mean. These data suggest that the teachers valued the EMU ST: (1) observing their teaching and their students for the purpose of providing feedback; (2) co-planning, including anticipating students' solutions and misconceptions, and suggesting manipulatives and representations to support students' learning; (3) modelling the use of questioning and prompts to develop students' thinking; and (4) meeting to discuss the mathematics progress of their vulnerable students.

Table 1

EMU Specialist Teacher Supports for Classroom Teachers

Type of Support from the EMU Specialist Teacher	Class Teacher Rating (out of 10)					Mean
	Amy	Bec	Clare	Deb	Emma	
a. Suggests professional readings to enhance my mathematics Knowledge for teaching.	9	2	5	8	3	5.4
b. Modelling or demonstrating mathematics lessons.	8	9	7	9	5	7.6
c. Modelling the discussion during the summarise phase of the lesson.	8	9	8	9	5	7.8
d. Co-teaching (team teaching) mathematics lessons.	8	9	8	9	7	8.2
e. Observing my classroom mathematics teaching for the purpose of providing feedback.	9	9	7	9	8	8.4
f. Observing my students' learning and providing me with feedback.	9	9	7	10	7	8.4
g. Modelling the use of questioning or prompts to develop students' thinking.	9	10	7	10	6	8.4
h. Co-planning with me including anticipating student responses, solutions, & misconceptions.	9	10	7	10	7	8.6
i. Co-planning with me, including suggesting manipulatives and representations.	9	10	7	10	7	8.6
j. Meeting with me to discuss my vulnerable students' progress in mathematics.	9	9	7	10	8	8.6

Aspects of the actions listed in Table 1 were also apparent in responses for the survey item that invited teachers to describe any *other* supports from the EMU ST that they found valuable. Seven supports were described, but these mostly elaborated the actions listed in Table 1. Illustrative examples follow for Deb's response related to item (i) co-planning, and for Bec's response related to both item (d) co-teaching and item (g) modelling.

> Meeting to co-plan allowed an outside perspective with more ideas on how to extend my students who need to be challenged, as well as differentiate tasks to cater to my more vulnerable students. [Deb]

> It was also very helpful to co-teach with her and watch the way she questioned the students to promote their curiosity and have them articulate their understanding. [Bec]

Analysis of the interview transcripts provided more insight about how the EMU STs assisted the teachers to deepen their understanding of high-quality instruction. These insights are described below.

1. Using questions to probe student thinking.

Angela explained that the EMU ST would go further with questioning than she would. For example, "Show me how many 10s are in this number first and then we can look at the 1s," rather than simply asking, "Show me this number using the paddle pop sticks."

Bec also valued the EMU ST modelling how to use questions and provide time for thinking.

> I just learned from Tina [ST], just give her that little bit of time to process and then just wait … and Tina asked questions like, 'Well, why did you pick that shape? What is different from that shape to that shape? Can you tell me what the difference is?' Just drawing out her thinking.

2. Materials and representations.

The EMU ST helped Deb learn about the importance of using materials such as counters to represent groups in multiplication, and to "place them on black-coloured paper to make the grouping more visible… just things like that that helped a lot."

3. Differentiating instruction.

The EMU ST shared with Deb many ideas about how to differentiate instruction.

> I found it very challenging to find ways that I could help them without just doing the same thing every single time. So, when [the EMU ST] would come up with all these ideas, it was like, you know what? Maybe I can try one of these ways.

4. Anticipating solutions for tasks.

When co-planning, the EMU ST helped Bec appreciate the worth of anticipating students' solutions for tasks.

> The importance of working out—particularly where it's an open-ended question. [The ST said,] 'Let's work out some solutions so we can anticipate questions. We can anticipate what they're going to come up with. We can anticipate any confusion', so that was really helpful. Just in terms of clarifying the language … the types of resources and materials that worked best.

5. Summarise phase of the lesson.

During the summarise phase of the lesson, the EMU ST and Emma would "*bounce ideas off one another*" and this helped Emma select work samples that would enable students to see and hear different approaches to thinking about the content. For example,

> When there's an extra person in the room you sometimes see different things and you see things differently to be able to then pick a few different work samples and one that you perhaps wouldn't have chosen originally.

Overall, it is apparent that the classroom teachers valued the suggestions offered by the EMU STs throughout the co-teaching cycles, but particularly when co-planning and co-teaching.

Discussion

The schools participating in this pilot study had insufficient resources to provide an EMU intervention program for all students who were mathematically vulnerable. This situation highlighted the need to provide high-quality instruction in their classrooms for all students. The findings of this pilot study suggest that classroom teachers find two aspects of teaching students who are mathematically vulnerable challenging: (1) differentiating instruction effectively; and (2) having sufficient time and opportunity in a lesson to work with students who experience difficulty.

Previous research has highlighted the value of high-quality instruction that involves problem solving and using challenging tasks with enabling and extending prompts (Russo, et al., 2020). However, generalist classroom teachers need the knowledge and confidence of how to differentiate mathematics instruction within a student-centred inquiry approach in order to engage all students and enable all to learn. This is complex work requiring substantial expertise. Given that EMU STs have this level of expertise for teaching students who are mathematically vulnerable, it makes sense to utilise them in classrooms to support the professional learning of teachers.

Following a period of engagement in co-teaching cycles (Sharratt & Fullan, 2012) led by EMU STs, the classroom teachers in the pilot study described the actions of the specialist teachers that helped them to support students who were mathematically vulnerable. These actions included observing their teaching and their students for the purpose of providing feedback; co-planning, including anticipating students' solutions and misconceptions, and suggesting manipulatives and representations to support students' learning; modelling the use of questions and prompts to develop students' thinking and to differentiate instruction; and discussing the progress of their vulnerable students. Teachers work during the co-teaching cycles was supported by the ENRP Growth Point Framework (Clarke et al., 2002) that assisted the teachers to identify students who were not yet thriving, recognise misunderstandings, and plan for the next step in student's learning (Gervasoni et al., 2021). The EMU STs were able to apply their expert knowledge of the Growth Point Framework to highlight the resources and pedagogical actions that would support the learning of students.

The support of a trusted mathematics leader or coach has been highlighted in previous studies as a way to assist classroom teachers develop effective pedagogical actions to support mathematics learning (Anstey & Clarke, 2010: Sexton & Downton, 2014), and this was confirmed by our findings. The co-teaching cycles also provided teachers with an opportunity to re-conceptualise how they supported the students who they previously felt unable to assist during a lesson due to lack of time or opportunity amidst the complexity of teaching a class.

Conclusion

The findings from this pilot study suggest that classroom teachers valued the opportunity to work with specialist intervention teachers through a series of co-teaching cycles, and that this opportunity promoted their professional growth. Furthermore, the findings highlight the potential value of utilising the expertise of an EMU ST to support classroom teachers to develop high-quality mathematics instruction that responds to the needs of students who are mathematically vulnerable. Overall, a larger study seems warranted to investigate whether the professional learning approach explored in this study is effective in other school settings, and the impact on mathematics teaching and learning.

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