Harnessing the Expertise of Mathematics Intervention Teachers to Support Primary Teachers Through Co-Teaching Cycles

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This paper reports on a study that seeks new insight into how the expertise of specialist mathematics intervention teachers might be harnessed to support classroom teachers to assist students who experience difficulty learning mathematics. Findings show that the classroom teachers' confidence increased after engaging in co-teaching cycles led by the specialists. The most highly ranked helpful actions of the specialist intervention teachers were 'suggesting appropriate tasks for a given topic,' 'team teaching with me,' and 'suggestions about content for the next lesson.' The findings suggest that teachers' professional learning needs vary and require a personalised response.

Enabling all students to thrive with learning mathematics is an important goal for teachers. However, primary school teachers in Australia are generalists who do not have specific expertise or confidence in diagnosing or responding to the difficulties or diverse abilities of students. Hence, some schools employ a specialist mathematics teacher to implement a range of intervention approaches to support students (Bryant et al., 2008; Gervasoni, 2015; Sonnemann & Hunter, 2023). Although intensive intervention programs are effective (Gervasoni et al., 2021; Nickow et al., 2020), schools typically cannot resource intervention programs for all students who qualify, even if desired. A more strategic and sustainable approach may be to increase classroom teachers' expertise and confidence in providing high-quality inclusive mathematics teaching that enables all students to thrive. Our study explores how this goal might be advanced through professional learning involving co-teaching cycles (Sharratt & Fullan, 2012) that harness the expertise of specialist mathematics intervention teachers. The research questions addressed in this paper are: (1) How does the mathematics teaching confidence of primary teachers change after engaging in co-teaching cycles led by a specialist intervention teacher? and (2) What actions of the specialist intervention teachers in each phase of the co-teaching cycle do classroom teachers rank most highly to help them to support all students' mathematics learning? A particular focus for our study is considering the implications of the findings for designing approaches to assist students who are not currently thriving with mathematics learning.

Background Literature

Although intensive mathematics interventions are effective for increasing and accelerating students (Gervasoni et al., 2019; Nickow et al., 2020), not all students who may benefit are able to access these. Intervention approaches typically fall into three tiers (Bryant et al., 2008). Tier 1 approaches focus on high-quality classroom instruction to meet the needs of all students; Tier 2 approaches provide small group support for about 15% of students who fall behind; and Tier 3 approaches include intensive one-on-one support for students who make minimal progress in Tier 2 (Sonnemann & Hunter, 2023). With respect to Tier 1, teachers report that differentiating instruction to meet the needs of all students is one of the most difficult aspects of mathematics teaching (Downton et al., 2022; Gervasoni et al., 2021). Findings from the pilot phase of our study suggest that teachers find two aspects challenging when teaching students who are

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mathematically vulnerable: (1) differentiating instruction effectively; and (2) having sufficient time and opportunity in a lesson to work with students who experience difficulty (Gervasoni et al., 2023). Hence, building the capability and confidence of classroom teachers to provide high-quality mathematics instruction for all is vital.

Teacher Confidence

It has been long established that teachers' confidence about teaching mathematics is an important influence on their classroom practice (Munby et al., 2001). Indeed, Baxter et al. (2014) argue that there is a need to engage teachers in professional learning that supports the learning of content and pedagogy, while helping them to develop more confidence in their ability to teach mathematics. It is also established that large proportions of pre-service primary teachers, including in Australia, have low confidence in teaching mathematics (Norton, 2017) which is likely to influence their practice as graduate teachers. Teachers who lack confidence in teaching mathematics demonstrate this by avoiding teaching some aspects of mathematics, lacking variation in pedagogy, and relying on tightly scripted or unscripted approaches with minimal teacher input (Norton, 2017). It is likely that in situ professional learning that utilises co-teaching cycles for teachers led by a specialist mathematics teacher will be beneficial for building both the confidence and expertise of teachers.

Teacher Professional Learning and Co-Teaching Cycles

Previous studies have demonstrated the effectiveness of in-situ professional learning led by school mathematics leaders or coaches for enhancing mathematics teaching (Anstey & Clarke, 2010; Sexton & Downton, 2014), and for increasing student achievement (Bruce et al., 2010). Cobb et al. (2019) argued that modelling instruction, co-teaching, co-planning, and debriefing were potentially productive activities for mathematics coaches. Teachers have indicated that "modelling, observation, and debriefing were the most valuable components" of a professional learning model (Butler et al., 2004, p. 447). One model for leading classroom embedded professional learning that incorporates these approaches is the co-teaching cycle (Sharratt & Fullan, 2012) which comprises co-planning, co-teaching, co-debriefing, and co-reflecting. Professional learning based on co-teaching cycles aims to address aspects of practice that teachers wish to improve, so has potential for our study.

Given teachers have indicated that teaching mathematics for students with diverse abilities is difficult (Downton et al., 2022; Gervasoni et al., 2021), the use of co-teaching cycles for our study will need to address this aspect of practice. Previous research has highlighted that high-quality inclusive mathematics instruction promotes problem solving, collaboration, dialogue, and using tasks with enabling and extending prompts to enable all students to access the task (Russo et al., 2020). Further insight is needed about whether co-teaching cycles increase teachers' confidence to effectively differentiate teaching for diverse students, and which actions of the specialist intervention teacher are most helpful.

Context for the Study

Our study took place in primary schools situated within a System of 58 schools in Sydney that has focused on a constructivist aligned and problem-solving approach to mathematics education. In 2022 we conducted a pilot study, with a follow-up phase in 2023. The System approach to mathematics education has included using a task-based mathematics assessment (Clarke et al., 2002) enabling student progress to be monitored annually, and any students who were mathematically vulnerable to be identified, and supported through the Extending Mathematical Understanding (EMU) intervention program (Gervasoni et al., 2021; Gervasoni, 2015). The EMU program is taught by certified specialist teachers (ST) who complete a 6-day course and ongoing annual professional learning. More than 400 teachers in the system have

qualified as EMU specialist teachers. The theoretical underpinnings, lesson structure, and teaching approach for the intervention program are described in detail in Gervasoni (2015).

Given that not all eligible students are able to access an EMU intervention program in Year 1, and that there are many students in Year 2 to Year 6 who are mathematically vulnerable also, our study seeks to investigate how the expertise of EMU Specialist Teachers (EMU ST) may be harnessed to enable classroom teachers to more intentionally support the mathematics learning of this group in their classrooms. Through experience with EMU intervention, the EMU STs had developed expertise in differentiating instruction for groups of three students, guided by diagnostic assessment and the ENRP growth point framework (Clarke, 2013). They were also experienced with designing lessons based on problem-solving and engagement with open tasks, and identifying 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 practices are highly relevant for Tier 1 mathematics teaching.

Method

Qualitative methods were chosen as most relevant for our study. The research design involved EMU STs leading co-teaching cycles for classroom teachers for at least 10 weeks. At the conclusion of the co-teaching cycles, teachers were surveyed using an online platform (Qualtrics) and interviewed (via Zoom). The research followed the approved ethical guidelines, and pseudonyms used. Results and findings for classroom teachers are the focus for this paper.

Data Collection Instruments and Data Analysis

The teacher survey included items that invited teachers to rate their confidence in teaching mathematics and items that asked teachers to rank the helpfulness of a set of actions for each phase of the co-teaching cycle. Teachers were asked to rate their confidence at two time points: prior to the series of co-teaching cycles, and after. These time points allowed us to measure perceived changes in confidence. To gain insight about whether the teachers' perceived confidence was different when teaching mathematics for students who were struggling to learn, or highly capable, we asked them to rate their confidence for teaching these groups of students also. Open response items investigated what teachers considered most challenging about teaching students who were struggling with mathematics, and any other support from the EMU ST 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 survey responses were summarised. Open response items and the transcribed interview data were analysed and excerpts were used to further illustrate the survey findings.

Co-teaching Cycles

The co-teaching cycles in 2023 involved the EMU specialist teacher (EMU ST) co-planning with classroom teachers weekly across two terms, co-teaching a minimum of two mathematics lessons each week, and co-debriefing and co-reflecting after the co-teaching lessons. This process is known as EMU Level 2 (L2) intervention in our study. A series of professional learning sessions, facilitated by the System EMU Professional Learning Leaders, supported the EMU STs to lead the co-teaching cycles. Professional learning included role clarification, facilitating collaborative mathematics planning, professional readings, and observing and reflecting on an L2 co-teaching and co-debriefing session in one of the schools.

Participants

The six schools trialling EMU L2 in 2023 were invited to participate in the study. These schools had the support and commitment of the school's principal, were able to resource the

intervention with appropriate staffing and time, and an experienced EMU ST on staff who was willing to participate. Three schools agreed to participate. School leaders selected the grade level for the EMU L2 support based on the proportion of students who were mathematically vulnerable, using data from the Mathematics Assessment Interview (Clarke et al., 2002). School A chose Grade 2, School B chose Grade 3, and School C chose Grade 4. The proportion of students who were vulnerable in at least one whole number domain in each grade was 75%, 96% and 66% respectively. The participants from the three schools were an EMU ST from each school, one Grade 2 teacher (School A), three Grade 3 teachers (School B), and two Grade 4 teachers (School C). The classroom teachers' experience ranged from 2 to 19 years, and EMU STs had 5 to 8 years of experience teaching EMU programs.

Results and Findings

Confidence in Teaching Mathematics

An aim of the study in 2023 was to gain insight about whether EMU L2 support was associated with increases in teacher confidence. At the end of the 2023 school year, classroom teachers were invited to rate their confidence as a mathematics teacher prior to the co-teaching cycles, and after. Similarly, they rated their confidence for teaching mathematics for students who are struggling to learn, and for students who are highly capable. Results are shown in Table 1. Note that Teacher 1 did not respond to this question.

Table 1

Classroom Teachers Confidence Ratings (Out of 10) for Teaching Mathematics, for Students who Struggle and Highly Capable Students, Prior to and Following EMU Level 2 Support

Teacher	Confidence rating as a mathematics teacher		Confidence rating for teaching students who struggle		Confidence rating for teaching highly capable students	
	Prior to L2	After L2	Prior to L2	After L2	Prior to L2	After L2
2	5	7	6	7	4	7
3	5	7	6	8	4	7
4	4	7	4	7	3	5
5	6	8	5	7	6	8
6	6	9	3	7	5	8
Mean	5.2	7.6	4.8	7.2	4.4	7.0

Prior to the EMU L2 support, no teacher rated their confidence highly, with ratings ranging from 3–6 for teaching students who struggle, or who are highly capable, and from 4–6 for confidence as a mathematics teacher. Following the L2 support, the confidence ratings were mostly in the range of 7–8 for all categories, which suggests a positive increase in confidence. The mean ratings suggest that the teachers were slightly more confident teaching students who struggle than teaching highly capable students. The greatest variation in teachers' increase in confidence was for teaching mathematics for students who struggle (1–4 points).

Valued Actions of EMU Specialist Teachers

In the 2023 study, we used analyses of survey items and interviews transcripts to gain deeper insight into which EMU ST actions were most helpful in each phase of the co-teaching cycle. In the survey, teachers ranked of a set of actions for each phase. In the interviews, teachers described the role of the EMU ST during the co-teaching cycles. The results are described below.

Co-Planning

For the co-planning phase, the classroom teachers ranked seven actions of the EMU ST, according to helpfulness (Table 2). The most highly ranked actions were 'suggesting appropriate tasks for a given topic' and 'supporting me to anticipate students' responses, solutions, and misconceptions.' The least helpful were 'providing advice about choosing and using concrete materials' and 'assisting me with understanding the growth points.' Considerable variation in rankings for most statements suggests that the teachers' needs differed.

Table 2

Frequency of Classroom Teacher's Ranking of EMU ST's Actions During Co-Planning

EMU ST actions during co-planning	**Ranking for EMU ST actions**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Assisting me to design enabling and extending prompts	0	2	0	1	2	0	1
Suggesting appropriate tasks for a given topic	4	1	0	0	1	0	0
Supporting me to anticipate student responses/solutions/misconceptions	1	1	3	1	0	0	0
Supporting me to understand the mathematics related to the lesson	0	2	0	2	0	1	1
Providing advice about choosing and using concrete materials	0	0	1	1	0	2	2
Providing advice about questions to elicit students' thinking	1	0	1	1	2	1	0
Assisting me with understanding the growth points	0	0	1	0	1	2	2

> Data from the interview transcripts provided further insight into how the EMU ST helped teachers with suggesting appropriate tasks. For example: We'd be looking at tasks … we'd think about the area that we're … focusing on … then it was about that progression … and to have the enabling prompts and the extension prompts … ready to go. (Teacher 6)
>
> So how do we modify the tasks to allow it to be accessible to other students? How do we engage them … so that they are willing to have a go … have the topics of the tasks be something that they're familiar with or …interested in … things like that that Kay was able to facilitate for us. (Teacher 5)

Teacher 1 described how planning discussions assisted her teaching to be more purposeful:

> There's more anticipation now about student responses, …the reflection phase [of the lesson] is more purposeful. … And rather than us not being prepared for the task, we know perhaps student A has thought this …because he doesn't have the foundational understanding of this concept.

During Co-Teaching

The classroom teachers ranked six co-teaching actions by the EMU ST, according to their helpfulness. Table 3 shows the results. Note that the final two actions are not typical of co-teaching actions, but were described by teachers as helpful in the pilot study (Gervasoni et al., 2023). We included these to gain deeper insight into how teachers ranked these actions.

All teachers ranked 'Team teaching with me' as the most helpful of the six actions. 'Modelling the discussion at the end of a task or lesson' was highly ranked by most teachers. 'Modelling a full lesson' had the lowest overall ranking.

Excerpts from the interview transcripts provide further insight about the helpfulness of *team teaching*:

> She'd roam across the whole space and she'd come and suggest, "Oh, this work sample is really good," if I needed help, or I'd go to her and ask for advice to see if I'm on the right track. (Teacher 5)
>
> And I feel like the co-teaching was actually really helpful for me. She [EMU ST] would help with selecting work samples to put on the screen, helping make it visual. (Teacher 4)

Table 3

Frequency of Classroom Teacher's Ranking of EMU ST's Actions During Co-Teaching

EMU ST actions during co-teaching	Ranking for EMU ST actions					
	1	2	3	4	5	6
Modelling a full lesson	0	0	0	2	1	3
Modelling the discussion at the end of the task or lesson	0	4	0	2	0	0
Team teaching with me	6	0	0	0	0	0
Observing my teaching and providing feedback	0	0	4	1	0	1
Withdraw small group, focusing on moving to the next growth point	0	1	1	0	4	0
Reaching the students I can't get to in a lesson	0	1	1	1	1	2

The interview transcript data also illustrated how the EMU ST helped teachers by modelling or co-teaching during the discussion at the end of a task or lesson:

> Reflections in maths have always been a struggle for me because I never really know what to focus on. Kay [EMU ST] just showed me, … and that's what we reflect on. So I feel a lot more confident in my own teaching because of this. (Teacher 5)

> So on the spot, if we were looking at something … in a student's book that we wanted to reflect on, instead of us giving the game away, [the EMU ST] would often say, 'How can you prompt the students? What can you make them think?' I think it was the verbal cues. (Teacher 1)

During Co-Debriefing and Co-Reflecting

The classroom teachers ranked five actions by the EMU ST when co-debriefing and co-reflecting, according to their helpfulness. Table 4 shows the results.

Table 4

Frequency of Classroom Teacher's Ranking of EMU ST's Actions During Co-Debriefing

EMU ST actions during co-planning	Ranking for EMU ST actions				
	1	**2**	**3**	**4**	**5**
Feedback about what did not go well in the lesson.	1	0	0	1	4
Feedback about the students who were struggling.	1	0	4	1	0
Feedback about what worked well in the lesson.	0	1	1	3	1
Suggestions about content for the next lesson.	1	4	1	0	0
Suggestions pedagogies that may assist student learning in next lesson	3	1	0	1	1

The most highly ranked actions were 'Suggestions about content for the next lesson' and 'Suggestions about pedagogies that may assist students' learning in the next lesson.' Although four teachers ranked 'Feedback about what did not go well in the lesson' as least helpful, one teacher ranked it as most helpful. This result highlights the variation in rankings for most statements, suggesting that the needs of the teachers during debriefing differed.

The following interview excerpts further illustrate the helpfulness of debriefing actions:

> I also think the importance of our co-debriefing sessions during the lesson were crucial. After roaming, and then the three of us, 'let's have a reflection. What's our next step?' (Teacher 1)

> Kate [EMU ST] would always make sure that a couple of times a week … we'd be having the conversations with her, and she'll be seeing how we're going, what's working well, what can we adjust. (Teacher 2)

Discussion and Conclusion

The first research question sought insight into how the mathematics teaching confidence of primary teachers changed after engaging in co-teaching cycles led by an EMU specialist intervention teacher. The key finding is that engagement in the co-teaching cycles was associated with a positive increase in confidence for teaching mathematics for all five teachers, including for teaching students who struggle, and for highly capable students. This finding suggest that the EMU L2 support assisted teachers to be more confident in differentiating teaching for students with diverse knowledge. This finding is promising given the influence of confidence on mathematics teaching practice (Munby et al., 2001; Norton, 2017).

The second research question investigated which EMU ST actions classroom teachers ranked most highly, in each phase of the co-teaching cycle. The first key finding was the variation in rankings for actions, especially for the co-planning and co-de-briefing phases. This suggests that the professional learning needs of the teachers varied, and that a personalised approach for co-teaching cycles is warranted. This finding supports the view that co-teaching cycles need to address the specific aspects of practice that teachers wish to improve (Sharratt & Fullan, 2012). The second finding is the set of helpful EMU ST actions that teachers ranked most highly for each phase in the co-teaching cycle. These were: (i) suggesting appropriate tasks for a given topic, and supporting teachers to anticipate students' responses, solutions, and misconceptions (co-planning phase); (ii) team teaching, and modelling the discussion at the end of a task or lesson (co-teaching phase); and (iii) suggesting content for the next lesson, and suggesting pedagogies to assist students' learning in the next lesson (co-debriefing phase). It was clear from the interview data that these actions assisted teachers to become more confident, and to more effectively differentiate their teaching in response to the diverse range of student knowledge in a classroom. It is likely that these actions will be useful practices for other EMU STs to consider when leading co-teaching cycles. This would be a profitable area for further research. Also, it would be valuable to explore the impact of the EMU L2 support on the growth of students' mathematics learning and confidence.

Our study explored whether the expertise of specialist intervention teachers could be harnessed to increase the confidence and capability of classroom teachers to support students who struggle with mathematics learning. The findings provide new insight about the specific actions that teachers find most helpful in supporting their professional growth during co-teaching cycles. Although the overall goal of our research is to design approaches to assist students who are not thriving with mathematics learning, a surprising outcome of our study is that the EMU L2 approach also increased teachers' confidence and expertise in teaching highly capable students. This broader impact highlights the value of teachers learning in situ alongside a trusted and knowledgeable expert with whom they can engage in dialogue about what they are noticing about students' learning, and how to respond.

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