

## Mathematical Sequences of Connected, Cumulative and Challenging Tasks in the Early Years

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This symposium reports on a project that focused on *Exploring the Use of Mathematical Sequences of Connected, Cumulative and Challenging Tasks (EMC<sup>3</sup>)* with students in the early years (Foundation Level to Year 2). The project was funded by the Australian Research Council, Catholic Education Diocese of Parramatta and Melbourne Archdiocese Catholic Schools (LP180100600). Together with industry partners the EMC<sup>3</sup> project was designed to enhance the cognitive and affective experiences of students when learning mathematics by researching teaching approaches that utilise sequences of cognitively challenging tasks.

**Paper 1:** *Exploring the Potential of Sequences of Connected, Cumulative and Challenging Tasks in the Early Years* [Peter Sullivan, Melody McCormick]

This paper outlines the rationale for the teaching approach the EMC<sup>3</sup> project aimed at studying an approach to teaching and learning mathematics in the early years (students aged 5–9).

**Paper 2:** *Differentiating Mathematics Instruction through Sequences of Challenging Tasks in the Early Primary Years* [James Russo, Jane Hubbard]

This paper reports on post-program questionnaire data collected from 100 teachers who express their views about the effectiveness of various instructional approaches to support differentiation in mathematics.

**Paper 3:** *Changing Teacher Practices: A “Slow Burn” or Rapid with “Big Shifts.”* [Sharyn Livy, Janette Bobis, Ellen Corovic, Maggie Feng]

This paper reports on interview data collected from five teacher educators who provided support to the teachers when trialing the EMC<sup>3</sup> resources. The focus of this presentation will be on the notable changes to teacher practices.

**Paper 4:** *The Nature of Leadership and Other Support that Facilitate Innovation and Improvement in Teacher Practice.* [Ann Downton, Janette Bobis]

The final paper reports on survey data collected from 70 teachers about the forms of support that assisted implementation of project resources—in-class support and facilitation of planning.

## The Nature of Leadership and Other Support that Facilitate Innovation and Improvement in Teacher Practice

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In the context of a professional learning research project we investigated the nature of support offered to classroom teachers and school mathematics leaders to facilitate teachers' implementation of sequences of challenging tasks. End of year questionnaire data were collected from 70 Foundation to Year 2 teachers and ten numeracy leaders who participated in the project. Thematic analysis was used to analyse the open response questionnaire items. Findings reveal that two forms of support were helpful: in-class support, such as co-teaching, observation, followed by co-debriefing; and facilitated planning prior to instruction.

It is widely acknowledged that professional learning assists teachers to implement innovative pedagogical practices to enhance the teaching and learning of mathematics and ultimately improve students' learning outcomes (Akiba & Liang, 2016; Bobis et al., 2005). For professional learning to be effective there needs to be a bridge between research and classroom practice (Kretlow et al., 2012). Such a bridge is provided by external coaches or experts associated with an education system, who are educators with specialist expertise. These external experts are considered critical to the effective implementation of the new learning in schools (e.g., Cobb et al., 2018; Timperley et. al., 2007). They work in partnership with school leadership teams and their role includes collaborative professional support, mentoring school-based mathematics leaders, in-classroom instructional support, and leading professional learning within schools (e.g., Cobb et al., 2018). Critical to their work is the engagement of teachers in dialogue about the mathematical content, pedagogical practices and student learning (Campbell & Griffin, 2017). In this paper, these specialised coaches are referred to as Teaching Educators (TEs). These educators possess content-specific expertise and are employed by a school system to support school-based leaders and teachers to improve the quality of teaching and learning of mathematics.

Studies have highlighted the important role school-based mathematics leaders play in supporting teachers to implement new practices as part of a professional learning project (e.g., Sexton & Downton, 2014). Unlike the external coaches, these school-based leaders often have classroom responsibilities as well as their leadership responsibilities outside the classroom (Wenner & Campbell, 2017). Support by both the coaches and school-based numeracy leaders is provided alongside the daily work of teachers in the classroom, and is characterised by a cycle of planning, practice and reflection (Bruce et al., 2010). These studies highlight the importance of having both external and school-based support for teachers as they implement new learning.

The study reported in this symposium paper is part of the *Exploring Mathematical Sequences of Connected, Cumulative and Challenging Tasks* (EMC<sup>3</sup>) funded research project (Sullivan et al., 2020). Details of the project are provided in Sullivan and McCormick as part of this symposium (Paper 1). The focus of this study was the nature of leadership support provided by TEs and school-based leaders to classroom teachers to facilitate the implementation of innovative practices. The research question was:

*What leadership supports are provided for classroom teachers during the implementation of innovative pedagogical practices involving challenging mathematics tasks?*

## Method

Participants in the study were Foundation to Year 2 (F–2) teachers involved in the EMC<sup>3</sup> professional learning (PL) program during 2019 ( $n = 70$ ); five Lead Numeracy teachers (LNT); and five TEs employed by the school system who worked in project schools to support the LNT and teachers implement the new learning in the classroom. Some schools had an Instructional Leader (IL) who supported the LNT and classroom teachers. TEs followed up the main PL delivered by the researchers at the start of the year by facilitating PL in project schools at a point of need; implementing the co-teaching cycle (co-planning, co-teaching and co-debriefing) with LNT and classroom teachers, and observing and acting as a “guide on the side” (Morrison, 2014) for both LNT and teachers. At the second PL day in November participants completed a questionnaire that included open response questions focused on how they were supported in the classroom and in planning. We adapted Braun and Clarke’s (2006) thematic approach to analyse the open response items. Responses were collated, then categorised according to themes that emerged from the data. Where participants had written multiple ideas in one response, each was categorised and coded.

## Results

Seven main themes emerged from the analysis of the two open response items—one relating to how teachers were supported in the classroom and the other to how they were supported in planning. The results are presented in Tables 1 and 2 respectively.

Table 1

*Themes Relating to Classroom Support Frequency of Responses and Illustrative Quotes*

Theme	Illustrative quotes
1. Team teaching or co-teaching ( $n = 38$ )	TE taught in-situ with us and gave us an opportunity to reflect on our teaching and work with us to know where to take the students with their learning TE visited the classroom and co-taught with me so I could learn some new and different questioning techniques and enabling & extending prompts.
2. Providing feedback ( $n = 22$ )	[TE] feedback/feed forward time afterwards allowed me to get a better picture of the students' success and where to next.
3. Pre and post lesson discussions ( $n = 20$ )	Meeting with both [TE and LNT] to talk out the lessons, and time to prepare lessons was always helpful. We were given time to plan with our TE and lead numeracy teacher.
4. Modelling lessons (including reflections) ( $n = 19$ )	TEs modelled how the lesson structure should be like in the classroom. [TE] was also happy to run some parts of lessons (especially the reflections), which enhanced my learning and student learning.
5. Leaders helped them feel comfortable and supported ( $n = 8$ )	TE gave me confidence to not explicitly teacher rather let students explore. Both the TE and LNT were AMAZING support during the sequences TE supported me so much as a new LNT - I couldn't have done it without her!
6. Assisted with the reflection stage of the lesson ( $n = 8$ )	Our TE demonstrating reflection time throughout the lesson to see how probing questions facilitate the learning of the students. Suggestions given by [the TE] about students thinking to capture and share with the class as well as ways to reflect at the end of the session.
7. Observations by leaders ( $n = 4$ )	TE - visited weekly to observe a sequence in action. LNT and TE would come into the room and observe.

Note: TE (Teaching Educator), LNT (Lead Numeracy Teacher).

Table 2

*Themes Relating to Planning Support, Frequency of Responses and Illustrative Quotes*

Theme	Illustrative quotes
1 Planning ( <i>n</i> = 58)	The most effective support from [TE] was when we were able to plan together prior to the lesson and anticipate the possible problems or modifications TE also helped with planning of where the students were at and where to begin our sequences as we didn't want to begin where kinder would start etc.
2. Professional learning ( <i>n</i> = 10)	As someone who hadn't completed the beginning sequences courses it was really great having a release day to sit with the TE and IL [Instructional Leader] to go through tasks. Our TE was also there for our PL and assisted us to notice the maths content of tasks. We went through the tasks with [TE] and tried them out for ourselves. This helped us anticipate possible answer we would of received from the students.
3. In-class support ( <i>n</i> = 10)	TE would often come into the classroom and work closely with me as a teacher to help see what students' needs were and how best to support them. TE was able to model what this looked like and how to use Talk Moves for more student talk rather than teacher talk.
4. Time ( <i>n</i> = 16)	Leadership provided us time to plan together as a Stage and with our TE who guided us. Sequence planning time with TE and LNT allowed us to plan for the week.
5. Resources ( <i>n</i> = 4)	The school were fantastic at giving us .... resources to use during the sequences. Resources were sourced, organised in preparation to teach the sequence by the IL.
6. Data analysis ( <i>n</i> = 4)	TE and LNT answered all of my questions, in particular to tracking student's development in number through a variety of tasks. Met with the IL and TE to ...plan the next steps using evidence of data collected.
7. Feel supported ( <i>n</i> = 2)	[The TE] was advocating for me as a part-time teacher. We all felt very supported and comfortable to ask our TE questions. It was incredible to have [TE] with us as well. She assisted us to drive the learning.

While some overlap was evident in the data across the two tables, the themes that emerged from the analysis revealed the specific nature of the support provided by TEs in the classroom and in planning. Within the classroom, co-teaching, modelling of the lesson structure, and how to orchestrate the reflection part of a lesson featured prominently in the teachers' responses. The value teachers placed on the feedback they received and suggestions TEs had to progress students' learning, indicate that these teachers respected their advice and were committed to embracing this new pedagogical approach.

TE support with the planning prior to the enactment in the classroom was also recognised as being an important factor in the implementation. The teachers realised the benefit of engaging with the task before instruction, anticipating how the students might respond and the types of prompts that they could employ during the lesson. Some teachers also recognised the planning support as a form of ongoing professional learning for them. Time was a consideration in planning, post-lesson reflection and analysis of the data. Some teachers commented that leadership recognised the need to maximise the learning opportunities when the TEs were in the school and provided additional release time.

Theme 5 (Table 1) and theme 7 (Table 2) highlight the affective aspect of the support the teachers received. Teachers' felt comfortable with the TEs and were very supported when exploring this new learning. Comments related to these and other themes suggest the rapport the TEs had developed with the teachers was critical to the effectiveness of the implementation. Acknowledgment must be given to the support offered by the school-based leaders—LNT and IL who provided ongoing support on a daily basis.

## Conclusion

These results highlight the nature of the leadership support that the teachers found beneficial when implementing this innovative pedagogical approach, in particular the support offered by the TEs. Three findings are evident from these results. First, that the support of an external knowledgeable other (TEs), who has an understanding of the philosophy underpinning the project and of the pedagogical approach was essential when expecting teachers to embrace new learning. Second, schools needed to factor in additional time for collaborative planning, debriefing and reflecting on the new learning with TEs and school-based leaders (LNTs). Third, teachers valued and respected the expertise of the TEs and developed a rapport and positive working relationship with them. Building mutual respect and trust was a contributing factor to teachers' willingness to embrace the new learning.

These findings resonate with earlier research related to the importance of an external expert with specialised expertise who works in unison with school leadership teams to support the implementation of new learning (e.g., Cobb et al., 2018; Kretlow et al., 2012; Timperley et al., 2007). A key difference is that the TEs have a long-standing relationship with the school leadership team, LNTs and ILs had an understanding of school contexts, so they are considered a "guide on the side" (Morrison, 2014) to teachers and a critical friend or mentor to school-based leaders, rather than an expert who provides additional support from time to time. We acknowledge the following limitations of the study. First, the results reflect a small sample, which is not generalisable to the whole population. Second, these results present the responses of teachers only. Future papers will report the TEs perspective.

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