

Resource Materials as Structured Guidance in Practice Change

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This study reports on an early career Year 2 teacher's reflections of enacting specifically structured resource materials and her practice change when participating in a mathematics professional learning project. A qualitative case study was designed to examine the reflections of a teacher's pre-service and in-service teaching experiences. Data collection instruments included a timeline graphing tool and a semi-structured interview to capture and communicate her reflections. Findings reveal that providing structured resource materials within a professional learning project supported changes in pedagogical practice.

Professional learning (PL) is a critical component in enhancing quality teaching and learning of mathematics, which impacts student learning outcomes (Guskey, 2002). Further, curriculum resources are frequently used as instruments to support or drive professional learning and teachers' change in practice (Rezat et al., 2021). Educational research on the impact of mathematical resource materials typically focuses on textbook use and student outcomes rather than changes in teachers' practice (Pepin, 2018). However, in the last decade, a focus on how and why teachers used an array of resources to support change in practice has become of increasing interest to researchers (Remillard, 2018). Utilising a range of resources may be challenging for early career teachers.

Curriculum resource materials may be defined in many ways. Typically, they are referred to as, "a package of resources assembled by developers for the purpose of guiding instruction and student learning" (Rezat et al., 2021, p. 1189). Educative curriculum resources are those "that are intended to promote teachers' learning" (Davis & Krajcik, 2005, p. 3) in addition to supporting student outcomes. In the context of this study, the term resource materials will be used to describe the educative curriculum materials the PL project team provided to the project teachers.

We report a case study of an Australian early-career Year 2 teacher's reflections of enacting practice change and her use of specifically structured resource materials. The teacher was participating in a two-year mathematics professional learning project titled *Exploring Mathematical Sequences of Connected, Cumulative and Challenging Tasks* (EMC³). The project explored "ways to support both teacher and student learning [through]... an approach to resource development and teacher professional learning that uses the notion of relentless consistency to encourage innovative practices" (Sullivan et al., 2020, p. 11). These practices include sequences of cognitively demanding tasks, and lesson structures that support problem-solving and reasoning. (Sullivan et al., 2020).

The research question we sought to answer was:

How do resource materials support the experiences of an early career Year 2 teacher to change her practice when participating in mathematics professional learning?

Literature Review

This section provides an overview of the literature pertinent to this study, including professional learning and resource materials, concluding with a framework for analysing teacher change.

Professional Learning and Teacher Change

PL evolved from professional development with an aim to enhance student learning through improving teacher practice. The shift to PL recognises the continual, reflective, and critical thinking characteristics of effective teacher learning (Bobis & Tregoning, 2019). Teacher change is an outcome of participation in PL. “[C]hange is identified with learning, and it is regarded as a natural and expected component of the professional activity of teachers and schools” (Clarke & Hollingsworth, 2002, p. 948). While change is open to many interpretations, Darling-Hammond et al. (2017) purport that “teacher knowledge, practices, and improvements in learning outcomes” (p. 2) are frequently the subject of teacher change. In our study, we focussed on self-reported practice change but acknowledge that the three are interrelated.

In her small-scale qualitative study of Year 7 and Year 8 teachers, Lee (2001) identified four factors that influenced teacher change. These four interrelated factors were time, professional development opportunities, support from policy-makers and administrative decision-makers, and availability of resources. Similarly, Forrest et al. (2019) described six factors that influenced teachers’ change in practice: teacher knowledge, collaboration, reflection, ownership, time, and pressure. While these combined nine factors are all interconnected, in this study we focused on the impact of specific resource materials from the EMC³ project and a case study of one teacher.

Curriculum Resource Materials

A resurgence of research on curriculum resource materials was evident in the 2000s, which led to the emergence of educative curriculum materials to support school reform (Remillard, 2018). Curriculum materials were often constructed to support grade or age-level student learning on a particular topic of goal, whereas educative curriculum materials were designed to enhance teachers’ pedagogical approaches and promote student learning (Davis & Krajcik 2005; Rezat et al., 2021). According to these authors, educative resource materials should help to enhance teachers’ knowledge for teaching mathematics and assist the development of general knowledge, which could be applied in new situations. Choppin (2011) termed this phenomenon as *learned adaptations* describing “knowledge-based adaptations designed with respect to what teachers have learned from prior enactments” (p. 335). Learned adaptations suggest teachers’ understanding of the intentions of the educative curriculum resource and an ability to apply observations from previous experiences when enacting the material. Lloyd et al. (2008) stated that:

...teachers are central players in the process of transforming curriculum ideals, captured in the form of mathematical tasks, lesson plans and pedagogical recommendations, into real classroom events [and] what they do with curriculum resources matters. (p. 3)

In other words, understanding what teachers do with resource materials and how these resources influence teachers’ practice change is of importance. Both Choppin (2011) and Lloyd et al. (2008) called for further research to investigate how such materials support teacher learning and the materials influence classroom activities and future learning.

Resource materials are intended to deliver messages about teaching mathematics. The extent to which teachers adopt these messages is dependent on their beliefs, knowledge of the curriculum and pedagogical approaches (Choppin, 2011; Stein & Kim, 2008). Remillard’s (2018) study in the United States of a Year 4 teacher’s participation in the *Maths in Focus* project captured this complex relationship between resource materials and teacher interpretations and enactments. Findings showed that a proficient teacher was more likely to interpret and enact resource materials aligned to the designers’ intent. A study in the United States by Stein and Kim’s (2008) of curriculum resources concurred with the aforementioned

author that educative curriculum materials are more likely to be enacted to the intentions of the designer than resources that provide no support.

When curriculum materials are not transparent, teachers can have difficulty redirecting students who fall off the expected learning route; in such cases, teachers' on-the-spot decisions about how to guide them back to the path can be hampered by limited understanding of the underlying purpose of the lesson. (Stein & Kim, 2008, p. 51)

Clarke and Hollingsworth's (2002) framework offers a lens to analyse and investigate the complexity of teacher change in practice. *The Interconnected Model* of professional growth encompasses four interconnected domains that represent key change factors. The External Domain represents elements that sit outside of the teacher's personal world. It may involve stimulus from professional learning, such as the one described in this study. The Personal Domain recognises individual teachers' personal knowledge, beliefs, and attitudes. The Domain of Practice represents teachers trying new things in professional experimentation. Lastly, the Domain of Consequence describes the salient outcomes observed by teachers (Chan et al., 2019). The domains are linked via enactment or reflection (Clarke & Hollingsworth, 2002). Where enactment is the process of putting new ideas into action, reflection requires "active, persistent and careful consideration" (p. 948). The model depicts the complex nature of the teacher change process and is a suitable framework for this study when analysing the impact of resource materials on an early career teacher.

In summary, teacher change is an expected outcome of participation in professional learning. Educative curriculum resources are designed to support teacher learning and their interpretations. The Interconnected Model (Clarke & Hollingsworth, 2002) offers a way to analyse complex change processes and the impact of EMC³ resource materials on an early career teacher's practice change.

Method

This case study employed a qualitative methodology to investigate an early career teacher's reflection of her experiences when using resource materials as part of the EMC³ project. The context and participant along with the instruments, data collection and analysis are described here.

Context and Participant

The larger EMC³ project provided PL to early years teachers over two years in the form of workshops, a mentor to support implementation, and project resource materials (14 learning sequences). Each sequence focused on a different mathematical concept, providing sequences of illustrative challenging lessons and supported differentiation, consolidation, and student agency (Sullivan et al., 2019; Sullivan et al., 2020). The explanatory statement for each task and planning documents assisted teachers to interpret and implement innovative pedagogical approaches when teaching. While the lesson sequences played an important role in teachers' PL, the goal was for teachers to adopt the pedagogies into their practice. This may include adapting the EMC³ resource materials or incorporating the pedagogical features into other resources (Sullivan et al., 2020). Case study participant Andy (pseudonym) was selected from seven Victorian Catholic primary schools that participated in 2020-2021 PL. Andy, an early career teacher, was selected to reflect on her teaching experiences including practice change when implementing EMC³ resources.

Instruments, Collection, and Analysis

Two instruments were used to collect data related to the teacher's experiences of using the resource materials. The instruments were a timeline graphing tool (Bobis et al., 2021) and a semi-structured interview (Galletta, 2013). The purpose of the timeline graph was to elicit Andy's pre-service and in-service experiences of teaching mathematics, including her participation in the project. Data were collected via an online interview (due to COVID-19), 18 months after the commencement of the project. Prior to the interview Andy was required to complete the first graphing tool (due to time constraints); the second was completed during the 45-minute semi-structured interview and video recorded for data analysis. The recorded file and Andy's timeline graphs were uploaded to NVivo and coded using a thematic analysis (Braun & Clark, 2006). Following a process of becoming familiar with the data, initial codes were developed. Initial codes included: resource materials, collegiate support, leadership support, team planning, team cohesion, and personal attitudes. Codes were grouped under themes of External, Personal, and Salient Domains, and the Domain of Consequence (Clark & Hollingsworth, 2002). For this research paper, we focussed on Andy's reflections and report the impact of the EMC³ resource materials, on her change in practice.

Results and Discussion

Following a brief overview of Andy's background, data from her semi-structured interview and time-line graph tools will be reported, discussed, and analysed.

Summary of Andy's Background

Prior to participating in the project, Andy's mathematical confidence was low; "Growing up, I knew that I wasn't very good at maths. So, I've always had a negative perception." At the commencement of the project, Andy was in her second year of teaching Year 2 after having previously completed one year as a casual relief teacher (CRT).

Summary of Andy's Experiences

Andy was quite daunted to join the EMC³ project. First, as an early career teacher, she was nervous about the intensity of simultaneously commencing her career and participating in a PL project. The initial negative reaction was expressed in her timeline graph (see Figure 1), as "doubtful of expectations." Andy elaborated on this further in the interview. "Coming in with having pre-service and CRT [experiences], and then expecting to learn and follow what our school implements for maths and coming on to the project. I thought it was all a bit blue."

The reaction stemmed from Andy's perception the project would add rigidity to her teaching. She thought her involvement would lead to a lack of flexibility in her practice. Second, at the time of the PL, the COVID-19 pandemic occurred across the world leading to an unstable environment in education. With possible impending government restrictions to manage the health crisis, Andy was concerned her team planning arrangements and teaching being may be impacted.

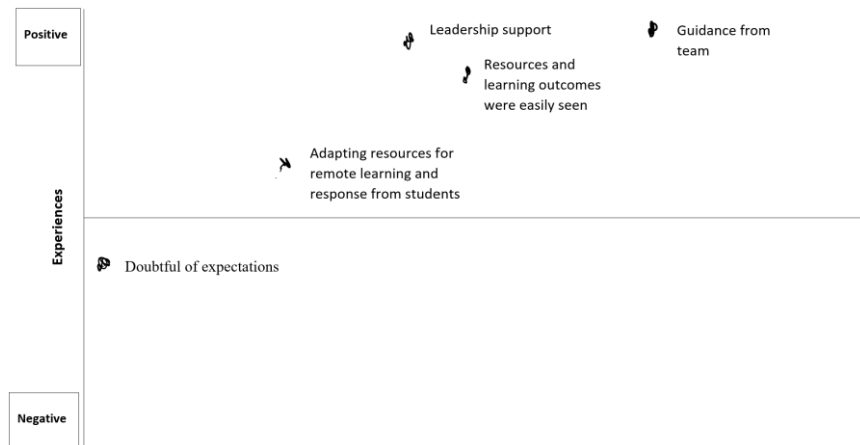


Figure 1. Andy's timeline of EMC³ project experiences.

However, after commencing the project, Andy's hesitation changed. In particular, she found the resource materials helpful for implementing the pedagogical approach for teaching with challenging tasks. Her positive reflection and shift in her practice can be seen in her timeline graph with the comment "adapting resources for remote learning and response from students." In the interview she elaborated further with:

I think having resources and examples are really important. As a graduate teacher, I kind of second guess what I'm doing and I'm always asking, 'Am I doing it right?'... So having the examples from the resource book is great.

Resource materials provided Andy with structured guidance in the first instance to assist her to implement the EMC³ pedagogical practices. The resource materials provided a structure to be guide her teaching so that she wouldn't "second guess herself".

It was great having all these tasks and ideas to implement. It was easy to follow, for us to make into seesaw tasks [remote learning tasks]. It was already there, what was expected, and the curriculum was there for us to follow... So, it [the resource materials] was quite good.

The resources provided her with practical exemplars of sequences of lessons, consisting of challenging tasks, curriculum content, and pedagogical considerations. As Andy became more familiar with teaching and planning with the resource materials, she reflected that they had a positive influence on her practice change. She reflected that the "resources and learning outcomes were easily seen" (see Figure 1) making it easier for her to interpret the pedagogy and the curriculum.

Andy noticed that when using EMC³ resource materials, her students were experiencing mathematical success. She reflected that launching the lesson before instruction enabled students to make mathematical connections and apply their skills during the lesson. Such experiences provide students with positive learning experiences where they share their mathematical thinking and strategies. This approach is a key EMC³ pedagogical practice. This was evident in Andy's reflection of the "Making Things Equal" number sequence (Sullivan et al., 2019) elaborated next.

One of my favourites would have been the tasks Making Things Equal, and how this particular quiet student finds maths challenging ... she actually got the concept before anybody else. She was saying, "hold on, it doesn't say that I can't take away and I can't add, so I can keep adding." I said, "Yes. What do you mean about keep adding?" [Student responded with] "Because I can do 100?" And I said, "Yep, exactly! Well done. Show me what [strategies] you can do."

Witnessing students' positive learning experiences helped Andy gain confidence and this, in turn, supported her practice change. With continued guidance from the resource materials, she reported building confidence in her mathematics pedagogy by adapting the tasks to meet

her students' needs. An example of how Andy adapted a task was through her experimentation with differentiation. She implemented enabling (helping students who are struggling) and extending prompts (for those who finish the main task). Andy's reflection of using prompts was, "You can actually differentiate them [the tasks] to modify them for the enablers or those who are extending." The prompts made it easier for Andy to implement this approach.

I would plan to teach it one way. Then I would go back into the [resource] book and say, "Okay, I'm on the right track." Or I would see that I could do something else instead and adapt my plan.

Once Andy developed her pedagogical approach, the resource materials became a source of confirmation rather than structured guidance. Instead of following the tasks as outlined in the learning sequence, Andy demonstrated learned adaptations (Choppin, 2011). She would continue to use the resources and apply her knowledge of teaching and students, and the EMC³ pedagogies to develop a teaching plan.

Summary of Andy's Change Process

The experiences above are summarised next to describe Andy's change process. Figure 2 shows these changes mapped to an adapted Clarke and Hollingsworth (2002) model. The following numbered bullet points describe our interpretation of Andy's change process.

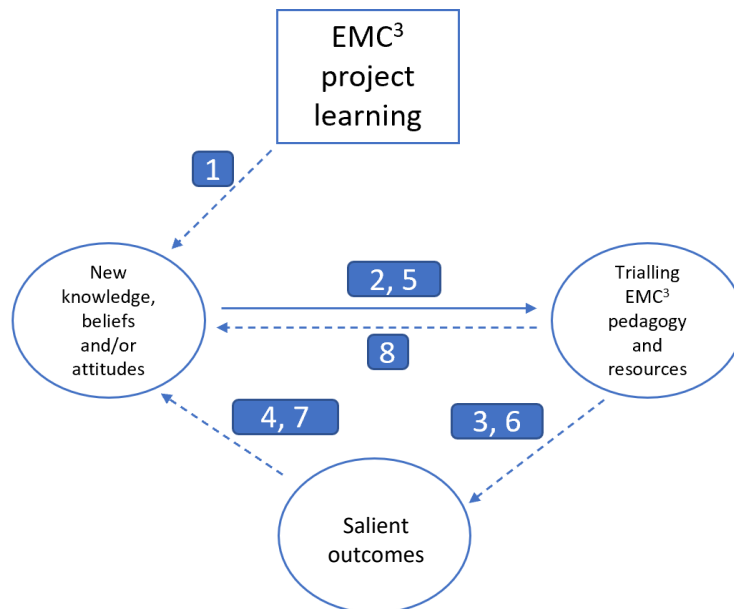


Figure 2. Andy's change sequence as interpreted by the researcher.

1. *Reflecting* on the introduction to the project during the COVID-19 pandemic, and adapting to online teaching, was overwhelming.
2. *Enacting* new knowledge of teaching sequences of challenging tasks.
3. *Reflecting* on students' positive learning outcomes supported confidence when implementing the pedagogical approach.
4. *Reflecting* on adapting the resource materials to meet students' needs, supported confidence to teach mathematics.
5. *Enacting* new knowledge of differentiation.
6. *Reflecting* on adaptation and implementation of resource materials supported student learning.
- 7 & 8. *Reflecting* on new pedagogical knowledge supported confidence in teaching mathematics with EMC³ pedagogies. Now describing learned adaptations of the resource materials as confirmation rather than structured guidance.

In summary, there are four results. 1) When participating in professional learning, resource materials were one factor that supported an individual's practice change. 2) The combination of PL and resource materials provided opportunities to enact a new approach. 3) Witnessing her students' success, the teacher's confidence, and motivation to continue increased. 4) Once the teacher was confident with the approach, she adapted the resource materials to meet her students' needs while maintaining the EMC³ pedagogical intentions.

Conclusion

The intention of this research was to investigate the experiences of an early career Year 2 teacher and the influence EMC³ resource materials had on her practice change. Results suggest that the EMC³ resource materials supported Andy's increased confidence to teach mathematics and her adoption of pedagogical practice change. The main finding from these results is that the provision of structured resource materials combined with the professional learning increased the teacher's confidence to implement an innovative pedagogical approach. A subsidiary finding was the benefit of using the timeline graphing tool to capture a teacher's reflections over time.

The main finding supports Davis and Krajcik's (2005) research on educative curriculum materials. They suggested that these materials "should help to increase teachers' knowledge in specific instances of instructional decision making but also help them develop more general knowledge that they can apply flexibly in new situations" (p. 3). In addition, our finding strengthens Stein and Kim's (2008) conjecture that educative curriculum materials are "more likely to lead to successful enactments in the classroom than materials that do not provided these [pedagogical approach] supports" (p. 44). However, we acknowledge that focusing on one teacher's reflections of her experiences as captured in a short interview, was a limitation.

As researchers we found inclusion of the timeline graphing tool facilitated questioning to generate rich dialogue and valuable reflections. As Bobis et al. (2021) posited, "combining a graphing tool with a semi-structured interview "encourages participants to provide rich descriptions of past experiences" (p. 137). Further exploration of this tool with experienced teachers will be of interest and extend this current study. Other research opportunities could include investigating the effects of combining PL with resource materials with larger cohorts of teachers.

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