Searching for, Sifting Through, and Selecting Curriculum Materials for Mathematics Planning During Practicum

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This paper describes results from a case study about how a primary pre-service teacher (PST) used curriculum materials (CMs) when planning for a mathematics lesson during her final practicum. The data is drawn from a doctoral study (in progress) and results show how the PST initiated an active process of searching for and sifting through CMs on a familiar website to make selections for a lesson. Selections were based on several aspects, including the mathematics focus of her lesson, curriculum connections, her chosen teaching approach and mathematical representation for teaching multiplication. Implications for mathematics Initial Teacher Educators (ITEs) are discussed.

Planning for teaching is a complex process which occurs for teachers and PSTs at a psychological and a practical level. Psychologically it involves teachers thinking about and making decisions for lessons, then translating these into practical actions for teaching which are recorded on planning documents (Clark & Peterson, 1986; John, 2006). Shulman (1987) describes teacher and PST planning as a process of pedagogical reasoning where,

> An idea is grasped, probed, and comprehended by a teacher, who then turns it about in his or her mind, seeing many sides of it. The idea is shaped or tailored until it can in turn be grasped by students (p. 13).

In the field of mathematics education there is widespread recognition that what teachers and PSTs think about when planning for lessons is also complex, due to the many aspects of knowledge that need to be considered. Examples of these include what mathematics ideas to teach and what pedagogical approaches to use (Ball, 2000). These decisions are made with students in mind, particularly how lesson content can connect with their experiences, contexts, and interests (Grossman & Thompson, 2008).

Due to the complexity and importance of planning processes, planning is a core component of ITE programmes, including mathematics education courses. Course and assessment work often includes planning experiences which approximate the planning practices of more experienced teachers with the aim of supporting PSTs to learn how to plan in preparation for mathematics teaching during practicum (Grossman & Thompson, 2008). An important part of these experiences is how to search for and select CMs such as hard copies of textbooks, teacher guides, student texts, and internet sites. A rationale for this is that PSTs often rely heavily on CMs as the base for their lessons, looking to them for guidance about what to teach and how to do this (Grossman & Thompson, 2008). Unlike more experienced teachers PSTs are only beginning to build up a repertoire of CMs to use when planning, relying on those gained from course work and practicum experiences (Ensor, 2001). During practicum they can spend a considerable amount of time finding CMs for their lessons, and with limited experience can have difficulty making selections when planning (Mutton et al., 2011).

Within ITE courses it is important then, that PSTs are taught how to select CMs and sift through these with purpose before making selections for their mathematics lessons (Amador & Earnest, 2019). This is particularly important in countries like New Zealand (NZ) where there are no mandated CMs, meaning PSTs can choose what they like, and often use the internet as a main source (Caniglia & Meadows, 2018). Knowing how they are searching for these and how they select them for teaching during practicum would help ITEs provide targeted support for PSTs during course work. Unfortunately, examining how they do this is challenging, because PSTs thinking and decision-making processes during planning are often "invisible" (Choy et al., p.3). Whereas

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practicum teaching can be observed and lesson plans analysed, PSTs mental planning processes are harder to access (Kavanagh et al., 2020). Additionally, while there is some research about how teachers use CMs when planning for mathematics teaching, there is very little about how PSTs do this (Earnest & Amador, 2019; Wilson & McChesney, 2018). This means there is a research gap about these important planning practices. This paper offers a contribution to this limited field by presenting results about how one PST planned for mathematics teaching during practicum. The specific research question is:

- How did one final year PST search for, sift through, and select CMs when planning for mathematics lessons during practicum?

Background Literature

Beginning Teacher's Use of Curriculum Materials for Planning

In their study of beginning teachers (BTs) and how they used CMs when planning English lessons, Grossman and Thompson (2008) found searching for these was time consuming. Similar to the teachers in Ensor's study (2001), the BTs did not have a collection of CMs built up from experience, so had to develop this during the early stages of their career. Common sources of CMs were their teaching colleagues, libraries, and the internet, and included teacher texts, student books, and units from internet sites. They searched through these and made selections by looking for CMs which aligned with what they had to teach, and how they wanted to do this. Lesson overviews were popular because they provided a scaffold for their lessons. Some BTs initially stuck closely to published lesson suggestions when planning, eventually adapting these as they became familiar with learner needs. This was described as "playing around" with lesson suggestions (Grossman & Thompson, 2008, p.7).

Teacher's Use of Curriculum Materials for Mathematics Planning

Likewise, Kaufmann et al. (2002) examined how BTs used CMs; in their case they focussed on mathematics planning. Rather than having to search for CMs, the BTs were given a mathematics textbook and a teacher's guide. They began planning by reading the textbook lesson suggestions and teacher notes, searching for ideas for their lessons. Some also followed the lesson suggestions as written, others reordered activities to suit their lesson structures, and others made adaptations, for example, changing activities to better suit their students. The BTs also added tasks such as problem-solving tasks to add depth to their lessons. Overall, their choices of the CMs were influenced by their beliefs about effective mathematics teaching, for example, that mathematics lessons should include activities where students use critical thinking skills when finding solutions to problems. Similarly in her study, but with more experienced mathematics teachers, Superfine (2008) found the teachers also substituted suggested activities by providing alternative tasks for students. One example included adding in practice problems, instead of word problems, believing this was a better way for some students to learn the mathematics ideas that were central to her lesson. Importantly, in both studies the BTs and the more experienced teachers demonstrated agency when planning. They had the flexibility and the authority to make decisions about what to choose, adapt, substitute, and add from the CMs for their lessons. The needs of their students were an important consideration when making these decisions.

PSTs Use of Mathematics Curriculum Materials for Mathematics Planning

In one of the few studies which examined how PSTs used mathematics CMs when planning Amador and Earnest (2019) directed PSTs to use a textbook to plan a mathematics lesson plan during course work. While planning a fractions lesson one group of PSTs read the lesson suggestions in the textbooks and analysed these looking for word problems to use with students. They also decided to adapt these for their lessons. One example included changing the context in a word problem to a

context that was more familiar to students. The original context was a rectangular brownie which students had to split into equal parts, and this was changed to a rectangular chocolate bar. The PSTs thought that making this change would help students connect with the fractions concept at the centre of their lessons. Amador and Earnest (2019) caution that while this decision was well intentioned, the PSTs focus on adapting the context distracted them from making decisions about how to teach the mathematics concepts in the lesson. They suggest that when planning and making adaptations PSTs need to prioritise the important mathematics concepts they need to teach and only use real life contexts to support this learning.

In another study which examined the planning practices of first year PSTs during practicum, Wilson and McChesney (2018) found these novice teachers had to spend time searching widely for CMs for their lessons. Most of these PSTs searched the internet for CMs preferring to use websites they trusted, such as *nzmaths* (Ministry of Education, n.d). This was because they were familiar with the website and knew how to navigate within it to find CMs for their mathematics lessons. Aspects within CMs that they searched for included the mathematics focus, national curriculum connections, and like the PSTs in Amador and Earnest's (2019) study, activities which had real life contexts. They also searched for teacher notes which included suggestions for how to teach specific activities, and solutions for problems which they could learn before teaching their lessons.

Research Design

The doctoral study is a qualitative study which used an interpretive methodological approach, specifically a multiple case study (Yin, 2014). This approach was chosen because it enabled the author to carry out an in-depth investigation into the planning practices of the PSTs (Cohen et al., 2011). There are four individual cases in the study, where a case is a PST completing their final five-week practicum of their three-year undergraduate primary teaching degree. The four cases were selected from a group of volunteers and were purposely chosen because of the year level they were teaching (the author wanted a range of age groups), and their proximity to the author so that data could be easily collected during the study. The author was their mathematics education lecturer but did not teach or assess the participants' work during the data collection period. Ethical consent was granted for the study. Data collection methods included one focus group interview with all participants, and self-audio recorded think-aloud episodes which each PST carried out at three different stages during practicum. Additionally, individual interviews were carried out with each PST after practicum, and their mathematics lesson plans were analysed.

The data for this paper is from the first case study, a participant called Kate (a pseudonym). The data sources used are Kate's first audio recorded think-aloud episode which she recorded in the second week of practicum. During this episode, Kate talked aloud as she planned, describing what she was thinking about and deciding for her lessons. This recording was transcribed and returned to Kate for checking before being analysed. The lesson plan from this episode was also analysed, along with Kate's interview transcript. The analysis process followed an iterative process of coding and categorising the data into themes (Miles et al., 2018). Codes were developed by identifying and highlighting key words and commonly occurring planning decisions and actions that Kate made while planning. These codes were collated into categories which were then organised into themes within the case. The use of multiple data sources enabled the author to corroborate and strengthen these themes during the analysis process. The results from one of these themes, about how Kate searched for, sifted through and selected CMs when planning her first practicum mathematics lesson are now described.

Results

Kate's Practicum Setting

Kate's practicum setting was a rural school, with year three and four students (ages seven and eight). These students were organised into two mixed ability groups, and she had to teach multiplication, specifically multiplication as repeated addition. Her mentor teacher (MT) gave her "free reign" to teach how she wanted and to choose resources and tasks for her lessons. To help make these decisions, Kate observed her MT teaching mathematics lessons in week one to gather information to help with her planning decisions for week two lessons. She noticed students spent a lot of time listening during her MTs lessons, so decided to choose a word problem approach which she had used on a previous practicum. This approach allowed students to use and apply multiplication skills, for example skip counting, as well as arrays which she had observed them learning in week one. Kate also wanted them to talk and work together when solving the word problems.

Searching for Curriculum Materials

Kate began planning by searching for curriculum materials for her lessons and going straight to *nzmaths*, describing this as "jumping into *nzmaths*". In the interview she explained that she trusted the CMs on this site because they were authored by NZ mathematics educators and she had used it during previous practicums, so was familiar with its content. She searched for specific multiplication resources and tasks and found a unit of work called *Arrays Hooray*. She read it and noticed it used multiplication word problems and the multiplication representation of arrays. She had chosen both aspects for her lessons so decided to save the unit to look at later and continued searching on *nzmaths* for other CMs.

She returned to the *nzmaths* homepage and began another search for possible resources and tasks, this time finding an online copy of a teacher guide called *Book 6: Teaching multiplication and division* (Ministry of Education, 2008). She paused, before deciding she should have a look at this because it was a "Ministry book". She read the book and noticed a task in the teacher notes which had a word problem, "Kayla had four bags of marbles. There are six marbles in each bag. How many marbles does Kayla have?" (p. 4). This problem focussed on multiplication as adding equal sets and included an image of bags of marbles. Kate recognised this as being a different representation to arrays, and considered using it in her lesson saying, "hmm, it would be good to step away from doing arrays, and to throw in something different", but decided she didn't want "to confuse students with something new". She continued looking through the book and noticed two other tasks, *Three's Company* (p.12) which taught multiplication as skip counting, and *Animal Arrays* (p. 15) which used arrays. She thought back to the tasks in the *Arrays Hooray* unit she had already found and decided they aligned better with her chosen approach because they used word problems. She also saved *Book 6* and continued searching.

She returned to the homepage again, did another search for multiplication resources and tasks, and found the *Problem-Solving Activities* section. She focussed on the level two tasks which aligned with the NZC (2007) objectives and chose one called *Sharing Lollies* because it was labelled as multiplication activity. Kate read and analysed the activity and decided it focussed on fractions and division, so decided not to use it. However, she also saved it as a possible activity for future use.

Sifting Through Curriculum Materials

In the interview Kate described this initial searching through *nzmaths* as a process of "researching" which involved "navigating through the website", and "sifting" through what she found for suitable resources and tasks for her lessons. "Navigating" meant moving between different sections on the website, "sifting" meant analysing what she found and deciding whether to keep or

discard it for future use. Possibilities were saved as she searched and sifted, and these decisions were influenced by how they aligned with the word problem approach and the multiplication representation she had chosen. However, other options were also saved, such as the problem-solving tasks, and the *Book 6* tasks, as Kate anticipated what she might need in future lessons.

Searching Within the Unit Plan and Making Adaptations

Kate's next planning decision was to select the *Arrays Hooray* unit as the base for her first lesson. She opened this and began a second phase of searching and sifting through this resource, again, deciding what to use and what to adapt from it. This involved a more focussed evaluation of the contents of the unit, which Kate did by reading the unit carefully, and making selections based on her prior decision to use the word problem approach and arrays as the multiplication representation. She re-read the word problems, searching and sifting through these looking for examples which used multiplication with single digit numbers, deciding these were the number values that were suitable for her students. She selected one which was, "Tame has an orange orchard with 6 rows of trees. In each row there are 8 trees. How many trees does Tame have altogether?" (p.2) but decided to modify it by changing Tame's name to Tom, who was one of her students, the orange orchard to an apple orchard, and the multiplication factors to "five lots of four". Kate made these changes to connect the problem to her students. She explained students liked hearing their names in the problems, an apple orchard was more familiar than an orange orchard and working with groups of five was easier than groups of eight. A copy of the new problem that Kate wrote on her lesson plan is produced in Figure 1.

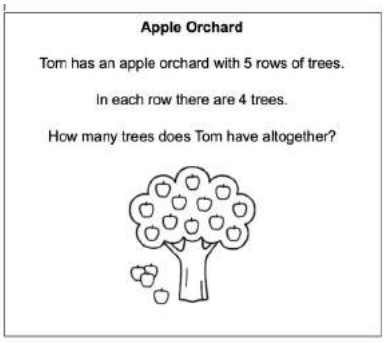

Figure 1. The apple orchard problem.

Kate continued searching through the unit and found teachers' notes with information about how to use the arrays, how students might solve the word problems, and useful mathematics terms for use in the lesson. Kate read these notes and commented that they were "very helpful" so decided to select this information and copy it onto her lesson plan for use during her lesson. This action completed her searching, sifting and selecting process for her first lesson.

Discussion

The results show that given "free reign" to choose the CMs for her mathematics lessons Kate chose one source, that is, the *nzmaths* website. This is contrary to the suggestions made by Grossman and Thompson (2008) that novice teachers access a range of sources of CMs. Throughout her planning session she did not look at any hard copies of teacher or student guides and did not mention the need to find other sources. This indicates that she trusted *nzmaths* to provide her with a sufficient range of CMs, and that these would be suitable for her lessons. This was like the PSTs in Wilson and McChesney's (2018) study who also found that PSTs opted to use *nzmaths* as a source of CMs for mathematics planning and trusted it because it was authored by the Ministry of Education which gave it status. The author as Kate's mathematics teacher educator often used this site during course work and was not surprised to see Kate using it, however, did not expect it to be the only source as

there are many hard copies of CMs available for NZ teachers to use, as well as a vast range of websites. This suggests a range of hard copy CMs were not available to Kate in her practicum setting, which led to her decision to only use an internet site. Her sole use of *nzmaths* suggests she decided that the site contained all she needed for her lessons and therefore did not need to search for other sites. This decision made it relatively easy for her to find CMs for her lesson, which questions the suggestion by Mutton et al, (2011), that PSTs can have difficulty finding these resources during practicum.

Kate searched and navigated within the site using the information she received from her MT to begin this process. Knowing the curriculum level and the mathematics focus of multiplication enabled her to carry out a targeted search for CMs for her lessons. These clear parameters meant Kate was only presented with CMs that aligned with this information which meant she did not have to search throughout the site herself looking for lesson options. She was also able to trust that the CMs she was presented with connected with her lesson focus in some way. Finetuning her navigating process also saved her time. In addition to the CMs she was presented with Kate also chose to broaden her search to find other possibilities. Her searches through the problem-solving section on *nzmaths* and within *Book 6* are example of this. This shows she did not want to be restricted to only using the website suggestions, preferring to have some control over her choices of CMs. Her prior decisions to use word problems and the representation, along with the curriculum level and mathematics focus of her lesson helped guide her search for these other CMs. Similarly, the teachers in the study by Kaufmann et al. (2002) looked beyond the CMs they were working with to find different options for their lessons. In both cases, these teachers and Kate wanted to ensure they had a range of CMs for their lessons, which shows they were considering their students and the kinds of activities that would promote effective learning of the mathematics ideas in their lessons. Both groups of PSTs were also confident to move beyond the main CMs they were using to find other options for their lessons.

Kate's next level of searching involved sifting through her selections using her pedagogical choices of the teaching approach (the word problems) and the mathematical representation (the array) to guide her final selection of CMs for her lesson. These aspects along with the curriculum alignment and lesson focus informed her decision to choose the unit plan, because it contained all of these aspects. Grossman and Thompson (2008) suggest that novice teachers often choose and rely on published lesson scaffolds to provide ideas for pedagogical approaches for lessons. However, Kate did this the other way around by choosing CMs that connected with her pre-selected pedagogical decisions. In this way the CMs did not direct her teaching, instead due to her clarity about how she wanted to teach she was able to discard or keep CMs based on her pedagogical decisions.

Kate's clarity about how she wanted to teach also guided her evaluation of the word problems within the unit. One of her final actions was to read these closely to determine if she needed to make changes to them for her lesson. During this process of searching through the problems she again used her pedagogical decisions to help her decide what to keep from the problems and what to change. Her checking of the multiplication factors and the context within the orange orchard problem are examples of this. Kate's decision to change the factors to numbers her students could work with shows she was thinking about the importance of ensuring the numbers she chose would be accessible for her students, ensuring they were not too hard or too easy. Additionally, her decision to also check that the mathematics in the problem could be represented using the array shows that she was prioritising using this tool as an important part of her lesson. Her decision to change the context to the more familiar apple orchard context was made to ensure students could connect with the mathematics within the word problem. While this was important, the other aspects of the mathematics focus and using the representation seemed to be a priority during her decision-making process. Unlike the PSTs in Amador and Earnest's (2019) study her adaptations had a broader focus

beyond merely changing the context for students. Again, her clear view about what she had to teach and how she what wanted to do this, guided her decisions, this time when making adaptations to the word problems. These final actions also helped her feel confident that the problems from the unit were ready to use in her lesson and that they were accessible to the students in her practicum setting.

During Kate's final look through the unit plan she noticed important information for teachers about how to use the array representation, what mathematical terms to use, and possible learner solution strategies. Her decision to copy these onto her lesson plan, shows she valued this information for teaching. While these aspects did not influence her choice of CMs they were selected as an important part of her lesson. This indicates that teachers' notes may be another aspect PSTs look for when making choices of CMs for their lessons and is worthy of future investigation.

Implications and Conclusion

The author acknowledges that this paper is limited to reporting the results from one case study, however the identification of the three phases of Kate's planning process, and the specific aspects she used to make CM selections for her lessons, makes visible how she used CM when planning during practicum. This information is useful for mathematics ITEs because it is an authentic example of a planning process originating from a PST and could therefore be used within course work to inform the design of a planning process, particularly related to the searching and selecting of online CMs and their use during planning. In this way processes like Kate's could be used to guide rehearsals during course work where PSTs could practise with guidance from ITEs, how to search for, sift through, and select CMs for mathematics lessons. This could also include making adaptations to activities for students. This would help PSTs prepare for carrying out similar processes during practicum, where they, like Kate may have to find their own CMs and work independently when preparing their mathematics lessons for teaching. Kate's familiarity with *nzmaths* from course work and previous practicums allowed her to easily navigate within it, which had the added benefit of saving her time when planning. Becoming familiar with the site during course work would also support PSTs to carry out efficient planning processes during practicum, where a challenge is often having enough time to complete planning for mathematics lessons.

Kate's pedagogical choices for her mathematics lessons helped her search, sift and select CMs and make final adaptations and selections for her lessons. It seems that the teaching of effective pedagogical approaches for mathematics teaching within ITE courses not only benefits PSTs understanding of how to teach mathematics, but also supports them to critically analyse and select appropriate CMs for their lessons. Superfine (2008) agrees that this is the case for more experienced teachers, so it is important that PSTs are also supported to do this early in their careers. As suggested by Caniglia and Meadows (2019) this is particularly important, given the variety and extent of hard copy and online CMs available for all teachers to choose from.

Finally, Kate is one case from a larger study, and the author was impressed by her sense of agency and her confidence to initiate this planning process which enabled her to choose and adapt CMs for her mathematics lessons. Going forward, the identification and naming of these planning practices will be used to examine how the other PSTs in the larger study worked with CMs as they planned mathematics lessons during practicum.

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