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Carole Steketee
University of Notre Dame Australia, carole.steketee@nd.edu.au

Keith McNaught
University of Notre Dame Australia

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The Complexities for New Graduates Planning Mathematics Based on Student Need

Carole Steketee
The University of Notre Dame Australia
<csteketee@nd.edu.au>

Keith McNaught
The University of Notre Dame Australia
<kmcnaught@nd.edu.au>

During 2006, two teams of preservice teachers spent a week in three rural schools and completed diagnostic assessment tasks in mathematics using the Nelson Numeracy Assessment Kit. The classes that were assessed were all being taught by newly graduated teachers. The results were collated into detailed profiles, which enabled these teachers to identify whole class, small group, and individual strengths and weaknesses. It was anticipated that the new graduates would find these profiles of great benefit in planning for mathematics. However, the teacher-educators who continued to work with the new graduates discovered that this assumption was flawed, and that the new graduates experienced difficulty in planning curriculum based on identified needs. This paper discusses the typical approaches to curriculum planning adopted by the teachers, which were largely teacher-centred.

Introduction

The challenges faced by newly graduated teachers working in "hard to staff" rural locations are well recognised. Western Australia has a number of rural locations where schools find it difficult to attract and retain staff. Although coastal locations are highly sought after by teachers, including new graduates, less desirable locations frequently attract a limited pool of applicants, and those applicants are often uncompetitive in a large field of applicants. The poorer academic performance of students in rural areas, compared to their metropolitan counterparts is well recognised (Pegg, 2005). Further, the more isolated the location, the more pronounced the negative impact on student learning is (Cresswell & Underwood, 2004).

During 2006, as part of an ASISTM project designed to support newly graduated teachers, a university-school partnership was established with three "hard to staff" locations (Northville, Eastville, and Westville Primary Schools). The project goal was to support newly graduated teachers with mathematics teaching and learning. Using final year undergraduate students, all of whom were completing a mathematics "specialisation" pathway, the plan involved administering diagnostic assessment to build detailed profiles of student needs. Given the physical isolation factors, video conferencing was used to provide ongoing support throughout the year. Fifteen final year students at the University were trained to administer the diagnostic tasks within the Nelson Numeracy Assessment Kit. The kit provides assessment tasks for four strands of mathematics: Number, Measurement, Space, and Chance and Data. The Number test was administered to a total of 14 classes across the three target schools, and each class was being taught by a newly graduated teacher.

Prior to testing occurring within the schools, a full day of professional development was provided on site for the teachers involved in the project. The teachers were trained in diagnostic assessment procedures and trained in the use of the Nelson kit. All three schools were independent schools, and needed to source their own staff. Northville was the least desirable of the three locations. All the classes at Northville were "split grades", with a total enrolment of less than 90 students. Although some schools chose to operate with

mixed-age/multi-age groupings, the use of composite grades at Northville was related to small student numbers within year levels and was an administrative rather than an educational decision. Both Eastville and Westville were hard to staff, but offered a range of social and recreational opportunities for staff, and school sizes not dissimilar to regular metropolitan schools. Eastville and Westville had staff with a range of experience and it was usual for a new graduate to stay 2 or 3 years before returning to the metropolitan area. However, Northville's most experienced staff member in 2006 was in her second year of teaching. In 2004 and 2005, Northville had experienced 100% staff turnover for class teachers; a support teacher and principal were the only two to remain on staff.

All three schools had identified that this lack of experienced teachers on staff, and small staff numbers, limited the capacity of the school to offer a mentoring program on site. The need for mentors for new graduates is well recognised and the benefits of "buddy teacher" on staff can provide invaluable assistance to a new graduate (Kyle, Moore, & Sanders, 1999).

Developing Profiles of Students' Mathematics Learning Needs

During term two, 2006, the final year students spent a week in residence in each school. They administered the diagnostic assessment tasks from the Nelson kit. With the tests administered, in collaboration with their teacher-educator also in residence, a whole class profile was created. Each child within each class was plotted on the full range of tasks within Number for each year level. In a small number of cases, children were assessed and plotted on tests from different year levels, in most cases to cater better for students who were working at least two years below their current grade level. For example, in Northville, two students in Year 7 were assessed on the tasks from the second grade battery of tests, and this provided valuable data about their performance level.

With the whole class profiles created, hand-over meetings were conducted. The pre-service teachers had assessed classes in collaboration with a peer, and both were present to hand over the profile and discuss the various components and results, with the teacher-educator facilitating the meeting. In all three schools, the principal was present for the handover meeting, and took an active role in the analysis of each profile. The class teachers responded to the profiles in range of ways. Most common was delight that this detailed profile had been prepared largely "for them", and they appreciated that a serious and sustained time commitment had been required. In most cases, the individual class profile appeared to confirm their understandings and sense of how individual performance would be shown. In all classes, there were at least some students who were a surprise to the principal and/or class teacher, either with better than expected, or worse than expected, performance.

The Year 4 class profile from Northville provides an example of the results of 13 students within that class (Table 1).

Armed with these profiles, and knowing the considerable amount of work that had gone into their creation, it was a clearly conveyed expectation that these profiles would provide the basis for future programming and planning in mathematics for each class. Each of the principals was explicit in this expectation, and the teachers were encouraged to use each other, physically and via video conferencing, and the two teacher-educators (via video conferencing, email, and telephone support) to do this.

Table 1
Northville Year 4 Class Profile

Topics in which there was an average student score of 75% and over	Topics in which there was an average score of 50% - 74%	Topics in which there was an average score of 26% - 49%	Topics in which there was an average score of less than 25%
Whole number	Mental strategies	Multiplication	Division
Addition	Subtraction	Problem solving	Mathematical laws
	Patterns		Computation with decimals
	Place value of decimal numbers		Computation with fractions

Using the Profiles for Curriculum Planning in Mathematics

The teacher-educators coordinating the project assumed that this planning process would occur quite naturally. That is, they assumed, that armed with the detailed class and individual profiles, the teachers would be able to identify the topics and skills that required whole class teaching focus. Additionally, it was expected that individual needs would be catered for, and that support programs would target specific skills for specific individuals within the classes. For example, it was expected that the Year 4 teacher at Northville's plan for the coming term would focus on multiplication, division, computation with decimals and fractions, problem solving, and mathematical laws.

Evidence suggests that expert teachers base instruction on student need. Hattie (1992) identifies that effective feedback, based on recognising student strength and weaknesses, is the variable that provides the most impact on improved student learning. The "coach" metaphor is regularly applied to teachers who are highly skilled at effective feedback. They provide specific, not generalised, feedback and implement a teaching (coaching) plan based on addressing specific sub-skills to improve performance (Wiggins, 1998). Although the teacher-educators did not expect this level of intervention, their aim was to introduce the graduate teachers to the concept of curriculum planning based on student needs – a form of practice they hoped would become common practice with experience.

However, this assumption was flawed and it was apparent almost immediately that the graduate teachers were largely overlooking the profiles and basing their curriculum planning on past practices. The fortnightly video conference sessions that commenced at the beginning of Term 3 were intended to support the teachers in their implementation of their mathematics program. The graduate teachers were expected to "drive" these sessions based on questions and concerns that arose in the course of their instruction. Instead, however, much of the conversation centred around trying to extract from the teachers what they were teaching, how they were teaching it, and what their purpose was in taking this approach (if not in the light of students' learning needs). It was becoming increasingly evident that the graduate teachers were not able to use the profiles as the basis of their planning and that a range of different methods of planning were emerging and ultimately affecting the success of the project.

As such, it was necessary to gain a deeper insight into these planning methods if the graduate teachers were to be supported in making the link between the profiles and

effective planning. Consequently, the data that emerged from the video conference session transcriptions were explored using a constant comparative method of data analysis (Glaser & Strauss, cited in Lincoln & Guba, 1985). Categories of meaning in relation to the various methods the teachers used for curriculum planning were described and refined into the following five themes.

Findings

Teachers' Preferences

A number of teachers openly discussed the fact that they mostly taught mathematics concepts that they enjoyed and/or were personally confident in teaching. Curriculum planning was in relation to their identification of concepts in the curriculum that they had sufficient content knowledge of, and those that they did not fully grasp. As the following quote below suggests, some teachers purposefully excluded certain concepts if they felt they were unable to understand it themselves.

> I have to admit maths is not my best personal area. I am good with things like times-tables, but when it gets technical, things like fractions and decimals, I have to revise all the work before I teach the class.

Ball (1997) argues that primary school teachers' self efficacy about their mathematical content knowledge and pedagogical ability is low.

Text-book Teaching

Text-book teaching was possibly the most common type of planning discussed by teachers in the project. Although this theme indicates that some form of forward planning is occurring, it is largely in relation to the order in which certain aspects of a text should be taught over the course of a term and year. The ideas of what to teach are extracted from the text along with the suggestions of how these concepts should be taught. As is indicated in the following quote, the ideas espoused by the book are often supplemented by the use of manipluatives and concrete objects, as well as worksheets.

> Yeah I use a few text-books. We've got some good ones at our school. I like how it helps you understand the sequencing of how the kids should learn how to do something. Yeah, I don't only use the text-book though … I get the kids working with lots of different materials …we use a lot of different worksheets, not just the ones from the text.

Research indicates that both experienced and beginning teachers rely heavily on commercially published materials to plan and deliver their mathematics instruction (Woodward & Elliott, 1990). The actual extent to which teachers use these materials, however, is possibly related to their level of confidence and experience in the classroom. More experienced teachers might use them to make decisions about what instruction to implement in the classroom whereas beginning teachers might use them to prescribe regimented, page by page activity.

Curriculum Driven Planning

Curriculum driven planning was also very common. Teachers identified a variety of mandatory curriculum documents as being integral to the mathematics programs they developed. The perception is that these documents are benchmarks of what students should be able to do/know at a certain year level. These benchmarks are subsequently used to source pre-made activities and worksheets from text-books and other commercially produced products. Typical of this theme is the notion that mathematics concepts are planned to be taught on the basis that the students "have not done them yet", as is indicated in the following quote.

> The progress maps tell you what your kids should be doing at their age. Not all the kids can do the same thing so I have a lot of group work going in my class with kids doing different things at the same time. We've spent a lot of time on measurement and time last term so this term we're going to do number … we haven't covered a lot of it yet.

This theme is closely linked to the previous one but differs in that use of commercially published text-books is guided by the Western Australian Curriculum Framework (1998), which all schools must use to base their curriculum planning on. Although this document was the first point of reference for these teachers, they mainly used it to discern the level of complexity at which students should be performing. Most of the teachers stated that it was of little use beyond that as it did not provide much detail and specification about what to teach and how to teach it.

School Focus Planning

School focus planning was prevalent due to the fact that the project coincided with the West Australian Literacy and Numeracy Assessment (WALNA) testing that all students in Years 3, 5, 7, and 9 in Western Australia must sit annually. WALNA is a curriculum-based assessment that tests students' knowledge and skills in numeracy, reading, spelling, and writing. The results provide schools with insight into their overall performance in these curriculum areas and, if used correctly, also assist teachers in setting improvement targets for their students for the following planning cycle. Teachers in this project did not discuss WALNA as a tool to make judgments about their students' learning needs. Rather, they saw it as something that they had to do given that it was a school focus, and something that would ultimately be used to evaluate the school as a whole. At least half of the term's planning was devoted to preparing students for WALNA, and then implementing it.

> We haven't got much time to do anything else just now. We've got WALNA this term so that's pretty much all we're doing in class at the moment.

Teaching Intuitively

As the term progressed and it became evident that the profiles of student numeracy learning needs had not been consulted by the teachers to plan their mathematics instruction, the project leaders began to question how mathematics classes were being taught and on what basis. In response to requests to see written mathematics forward planning documents and lesson plans, at least three of the teachers commented that they did not prepare handwritten programs. They stated that they were able to assess what the

students needed to learn instinctively and usually had a mental outline of what they would implement over the term. Decisions about what to teach and how to teach were usually made in conjunction with other curriculum documents such as the progress maps and other commercially published texts.

> No I haven't done a [hand-written] program since Uni. They're such a waste of time … I just know what the kids have and haven't done and have a good idea of what I want to do each term …then I use lots of resources to give to the students.

Although it is feasible that experienced teachers are able to plan intuitively and spontaneously (Jones & Smith, 1997), it is unlikely that beginning teachers would be able to do so successfully without a considerable amount of practice across a range of different contexts. Jones and Smith write, "In constructing [curriculum], an experienced teacher is able to draw on a range of experiences and knowledge in an attempt to fit the anticipated and observed needs of a particular lesson or set of lessons" (p. 3). This practice comes after repeated opportunities to structure series of lessons around explicit learning objectives in the light of a particular context and available resources.

Discussion

The five themes that emerged in this study represent the participating teachers' methods of curriculum planning in relation to mathematics instruction. A common link among these themes is that planning is largely teacher-centred and based on factors that are external to the students. The teachers' decisions to teach particular content, and their instructional method were influenced by their perceived mathematical ability, the schools' mandated priorities, system enforced curriculum documents and/or other commercially published curriculum documents. At no stage did the teachers identify students' learning needs as being the starting point for their planning, despite the fact that they were armed with the profiles.

This outcome was unexpected. The teacher-educators anticipated that the teachers would have little experience and expertise in identifying comprehensive overviews of their students' mathematical learning needs. However, it was assumed that if they were supported in producing this information they would intuitively use it as the basis for their planning. Surprisingly, the teachers overlooked these profiles and instead reverted to their typical approach to planning.

By far the most common method was the use of text-books and other curricular materials. In a case study of four beginning teachers, Kauffman (2002) also found that text-books were central to new teachers' planning. He suggests the reasons behind this are related to the teachers' perceptions of the superior quality of the materials, the extent to which aspects of the text can be used to fit their own purposes and the ease with which the text can be used. Certainly, the stresses placed on graduate teachers during their first year would warrant them turning to curricular materials that alleviated the pressure to some degree. This is problematic, however, if teachers develop an over reliance on prescriptive teaching materials rather than teaching to clearly identified learning needs. What is even more concerning is when the teachers believe they are capable of teaching intuitively and in such a way that their lessons are loosely guided by mental plans of what should be taught.

Consequently, the overall goal of this project was modified and plans have been implemented to support these teachers to develop methods of curriculum planning that are

based on clearly identified learning needs. Given that these same teachers are working in areas of recognised student-disadvantage, it is imperative that they are able to plan based on student need to maximise learning. Furthermore, the findings have been used by the teacher-educators to consider the extent to which curriculum planning is effectively taught in their pre-service courses. It may well be that curriculum planning taught during these courses is too hypothetical and the opportunities that pre-service teachers have to plan for real groups of students during their final internships is simply not sufficient and does not adequately prepare them for their first year of teaching.

Conclusion

The findings from this phase of the project suggest that the participating graduate teachers are not proficient curriculum planners. Even when made aware of their students' learning needs they chose to plan as they have in the past, adopting methods that were largely teacher-centred. Although there is a range of possible reasons, the fact remains that, if left unchecked, these methods could become common practice for these teachers. Consequently, the teacher-educators have entered into a new phase of the project and aim to support these teachers in the identification of the importance of basing their mathematics planning on their students' learning needs.

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