

# Foundation Content Knowledge: Providing support for pre-service teachers

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This paper describes the assessment of primary pre-service teachers' mathematics content knowledge and the associated support services provided at the University of Otago during 2013. Most pre-service teachers believed that the results from the assessments accurately reflected their mathematics knowledge and gave them useful feedback about specific content knowledge. There was moderate take-up of the four types of support offered, with few making no use or minimal use and few making high use of the support services. Pre-service teachers who had access to all four types of support believed that the face-to-face teaching by a mathematics lecturer and the HOTmaths website were very useful.

Assisting primary pre-service teachers to develop their mathematics content knowledge within the constraints of university-based teacher education is a challenging task. Blömeke, Suhl, Kaiser, and Döhrmann (2012) found that opportunities to learn in mathematics rather than mathematics pedagogy were a significant determinant for developing mathematics content knowledge. As the mathematics content appropriate for primary teaching in New Zealand is generally regarded as being below degree level it is often difficult to include appropriate papers in teacher education programmes. Furthermore, about half of pre-service teachers already have strong foundation content knowledge at the start of their teacher education (Linsell & Anakin, 2012) and so a mathematics content course as a compulsory component of their degree could be considered unjustified given the time pressure and requirements of their other courses. This paper describes some approaches to meeting these challenges and the responses of the pre-service teachers to those approaches.

## Participants

One hundred twenty-three first year primary pre-service teachers participated in a study to determine their attitudes towards the mathematics content support services they used. Assessment data and data on the use of support services were collected for all participants. In addition, 71 pre-service teachers responded to an online survey, but did not necessarily answer every question. Overall, there was a response rate of 59% to the survey. Forty-four (62%) of the 71 pre-service teachers who met the numeracy requirement in February responded, and 27 (52%) of the 52 pre-service teachers who did not meet the numeracy requirement in February responded. There are three groups reported on, those who met the numeracy requirement in February, those who met it in June and those who received support until October.

## Assessment of Content Knowledge

At the University of Otago, primary pre-service teachers are required to demonstrate competency in numeracy to meet the requirements of the New Zealand Teachers' Council's graduating standards (New Zealand Teachers Council, 2010). To demonstrate this

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competency, an online assessment tool was used (Tertiary Education Commission, 2013). Primary pre-service teachers are required to reach a standard in the Tertiary Education Commission (TEC) online numeracy assessment of Step 6 (690 points). Previous research has indicated that the TEC online numeracy assessment is a reliable indicator of foundation content knowledge and that Step 6 is an appropriate goal for primary pre-service teachers (Linsell & Anakin, 2012).

In the online survey, pre-service teachers were asked whether the TEC assessments reflected their beliefs about their mathematical ability. Eighty-two percent responded that it did, with no significant differences between those surveyed in February, June, and October, even though the February group met the numeracy requirements at their first attempt ( $\chi^2(2, N=71) = 4.90$ , n.s.). Pre-service teachers were also asked whether the TEC assessments gave them useful feedback about specifics of their content knowledge. Seventy-seven percent responded that it did, with no significant differences between the three groups ( $\chi^2(2, N=70) = 3.16$ , n.s.). Many pre-service teachers commented that the feedback made clear which areas of mathematics they were strong or weak in, but they were disappointed that they were not shown specifically which questions they got right or wrong.

### Peer Tutoring

Pre-service teachers who did not meet the numeracy requirements in February were organised into groups of about ten and allocated a peer tutor. Third-year pre-service teachers were selected as peer tutors on the basis of their active participation and achievement in first- and second-year mathematics curriculum papers. Many of the peer tutors had themselves required support in their first year of teacher education. Peer tutors arranged meetings with the first-year pre-service teachers once per week and responded to their needs in a variety of ways, without being constrained by any pre-determined programme. Some of the peer tutors opted to teach lessons on specific content, while others responded to individual requests. The peer tutors were surveyed and they provided data on 42 of the 51 pre-service teachers assigned to them. They were asked to evaluate, on a 3 point scale, how much the pre-service teachers had engaged with them in terms of attendance and participation at sessions. As shown in Table 1, only 18 pre-service teachers engaged to a high degree, with no significant differences between the June and October groups ( $\chi^2(2, N=42) = 0.04$ , n.s.).

Table 1

*How much did pre-service teachers engage with peer tutors?*

Group	Student Engagement with Peer Tutoring		
	Not at all	A little	A lot
	<i>n</i>	<i>n</i>	<i>n</i>
June	3	3	5
October	9	9	13
Total	12	12	18

In the online survey, the pre-service teachers were asked whether they found the peer tutoring useful. Seventy-one percent responded that they did find it useful, with no significant differences between the June and October groups ( $\chi^2(1, N=24) = 2.27$ , n.s.). Comments from the pre-service teachers indicated that they found the peer tutors organised

and helpful. However, a number of pre-service teachers, who did not find the peer tutoring useful, commented that they thought the peer tutors had difficulties meeting their learning needs because their group members were all at different stages of learning.

### Pathways Awarua

The peer tutors introduced their groups of pre-service teachers to the online resource Pathways Awarua <http://www.pathwaysawarua.com/>. This resource is closely aligned with the TEC adult numeracy assessment and consists of modules on each of the topics assessed at each level of attainment. Thus, for example, a student who was assessed as performing at Step 5 and who had difficulties with questions on multiplicative strategies, could work on a number of modules on multiplicative strategies at Steps 5 and 6. We were able to evaluate how much the pre-service teachers engaged with Pathways Awarua by monitoring how many modules they attempted. As shown in Table 2, only 17 of the 52 pre-service teachers used the resource a lot (over ten modules attempted) with no significant differences between the June and October groups ( $\chi^2(2, N=52) = 0.85, n.s.$ ).

Table 2

*How much did pre-service teachers engage with Pathways Awarua?*

Group	Student Engagement with Pathways Awarua		
	Not at all	A little	A lot
	<i>n</i>	<i>n</i>	<i>n</i>
June	2	9	4
October	7	17	13
Total	9	26	17

In the online survey, the pre-service teachers were asked whether they found Pathways Awarua useful. Only 56% replied that they did find it useful, with no significant differences between the June and October groups ( $\chi^2(1, N=25) = 0.65, n.s.$ ). Comments from the pre-service teachers indicated that they had not used the resource as much as they felt they should. Also they thought the resource was useful as practice material for the lower steps on the adult numeracy framework but not so useful for those needing to work at Step 6. In particular, pre-service teachers wanted more and better explanations of the mathematics than Pathways Awarua provided.

### Essential Mathematics

Pre-service teachers who did not meet the numeracy requirements in June were advised to enrol in a mathematics content paper, Essential Mathematics for Teaching, during Semester 2. This face-to-face paper addressed the same content assessed in the TEC adult numeracy assessment. It consisted of a two hour class each week taught by a mathematics lecturer, supplemented by a large amount of recommended independent work, and individual help during office hours. The teaching approach made extensive use of problem solving, investigations, concrete materials, cooperative group work, and whole class discussions. Points from the paper did not count towards the pre-service teachers' degrees and attendance was not compulsory. Course work done on the interactive whiteboard and nominated homework were also available to the pre-service teachers via Backboard, the university's online student learning system. All of the 36 pre-service teachers who enrolled for the paper attended some of the thirteen classes and 26 (72%) attended at least seven

classes. In the online survey, all of the 16 pre-service teachers who responded said that they found the Essential Mathematics course useful. Comments indicated that the teaching approach made the concepts easy to understand and improved their confidence. Many of the pre-service teachers, however, found the pace of the course too fast and thought it would be better to spread it over the entire year.

### HOTmaths

All pre-service teachers who enrolled for Essential Mathematics were given access to the HOTmaths online resource <http://www.hotmaths.com.au/>. Primarily, this resource was used for independent work, although occasionally, resources from the site were used in class. Pre-service teachers always had the opportunity to work independently with the resource in class rather than participate in group activities. At the end of each class, lessons from the HOTmaths site were suggested to the pre-service teachers as recommended independent work. The recommended lessons were selected from the HOTmaths Global Upper Primary and HOTmaths Global Early Secondary sections of the website. Within each lesson, pre-service teachers could choose questions at a range of levels between basic and challenging. Pre-service teachers were therefore able to select independent work at a level of challenge they felt comfortable with and build their skills up to the point where they could cope with the more difficult work.

Only one of the 36 pre-service teachers enrolled for Essential Mathematics made no use of the HOTmaths resource. The mean time spent online using the resource was 26.4 hours during the thirteen week semester and the maximum use by any student was 85 hours. In the online survey, all of the 16 pre-service teachers who responded said that they found the HOTmaths resource useful. Comments by pre-service teachers indicated that they found the range of levels of questions very useful and the explanations of the mathematics were a useful supplement to those developed during the Essential Mathematics classes.

### Conclusions

The majority of pre-service teachers who responded to the survey accepted the results from the TEC online numeracy assessments as accurately reflecting their mathematics content knowledge. The pre-service teachers who had access to all four forms of support identified HOTmaths and the Essential Mathematics course as their preferred forms of support. This study suggests that to meet the perceived needs of pre-service teachers, mathematics educators can support them with a face-to-face mathematics content course and supplement it with a flexible online resource.

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