

Empowered to Teach: A Practice-based Model of Teacher Education

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This paper examines a practice-based component of a primary teacher education program to gain insight into the type of experiences which assist beginning teachers translate theory-based knowledge to their teaching practices. Eighty-six prospective teachers participated in the study. Data were collected from (a) weekly lesson plans; (b) researcher field notes; (c) reflective journals; and (d) interviews with four participants. A theoretical rationale for various aspects of the practice-based component is provided and the implications for teacher education programs are discussed.

A persistent problem in mathematics teacher education is the general inability of beginning teachers to translate theory-based knowledge of the university context into their own teaching practice once in the classroom (Korthagen & Kessels, 1999; Moore, 2003; Zeichner & Tabachnick, 1981). A major concern for teacher educators has been the need to find more effective ways to address this apparent theory/practice gap and better prepare our teachers to master the realities of teaching (Bobis & Aldridge, 2002; Tobin & Roth, 2006).

The field experience (or “practicum”) is overwhelmingly considered by experienced and prospective teachers as one of the most powerful – if not *the* most powerful – component of their teacher education programs (Wilson, Floden, & Ferrini-Mundy, 2002). Yet, the nature of this potentially powerful experience can determine whether teacher preparation is enhanced or hindered. Study after study confirms that for the majority of practice teachers, the focus of field experiences is on procedural and management concerns such as behaviour management and whether expected lesson content is covered (Liston, Whitcomb, & Borko, 2006; Moore, 2003). Although such procedural matters are important, beginning teachers’ preoccupations with them generally means that they are unable to consider new, more cognitively demanding, teaching approaches advocated in key policy documents (e.g., Australian Education Council, 1990; National Council for Teachers of Mathematics (NCTM), 2000) during their teacher preparation programs. A challenge facing teacher educators is to design teaching-learning environments that will empower beginning teachers to translate theory into their practice more effectively.

The aim of this inquiry was to gain greater insight into the type of experiences that will assist beginning teachers translate the theory-based knowledge of mathematics teacher education courses to their teaching practices. This paper examines a particular component of a primary mathematics methods course in an attempt to reflect, improve it and share what has been learnt. Multiple cohorts of prospective and beginning teachers have resoundingly confirmed that a “practice-based” component of this methods course provided *the* most influential experience in their mathematics teacher education preparation (Bobis & Aldridge, 2002).

A Practice-based Model of Teacher Education

The focus of this study is a 3 to 4 week in-school component of a semester-long mathematics methods course for prospective primary teachers. This practised-based

component arose from the need to address an apparent gap between their university-based knowledge of theory and what they did in the classroom. It has evolved to its current form over many years and is based on “what works” best in practice. Through a continuing process of design, implementation, evaluation, and refinement, the component and the methods course in which it is nested, has taken on three distinct characteristics – alternating situated learning contexts, co-teaching, and embedded assessment. Although derived from practice, each characteristic has a well-developed theoretical rationale for its usefulness in a teacher education program. Taken together, they form a practical and theoretical framework for the current study.

Alternating Situated Learning Contexts

A situated perspective on learning acknowledges that some types of knowledge are best constructed in one context rather than another and that the more authentic the context, the more effective the interplay between theory and practice (Brown, Collins, & Duguid, 1989; Putnam & Borko, 2000). The mathematics education course in question alternated between 6 weeks of theory-based lectures and tutorials at university, 3 to 4 weeks of practice-based teaching in a local primary school and then 3 more weeks of lectures and tutorials at university. Hence, prospective primary teachers were first introduced to important knowledge for the teaching of mathematics (e.g., mathematics content knowledge, pedagogical content knowledge, and knowledge of curricula) in a traditional university-based learning situation. In the school-based context, student teachers spent their normal tutorial times working with one or two peers to teach a small group of primary-aged children – still under the supervision of their normal mathematics education tutor and a classroom teacher. The final three weeks of university-based learning served as a “debriefing”. It focused on issues that had arisen during the school-based teaching and aimed to further contextualise theory-based knowledge drawing on shared experiences from the previous 3 to 4 weeks. Korthagen and Kessels (1999) found that an important factor in determining the extent to which beginning teachers could translate their knowledge into practice was the degree to which teacher education programs integrated and alternated theory and practice in a similar way. Although the focus of this paper is on the in-school component, it is important to note that its impact is made more powerful due to the overall course structure of alternating learning contexts.

Co-teaching

Co-teaching occurs when two or more “persons teach a group of students with a dual purpose: providing more opportunities for students to learn and providing opportunities for the persons to grow as teachers” (Tobin & Roth, 2006, p. 17). Co-teaching is different from “team teaching” in that it involves colleagues working together at all phases of the teaching/learning process, from initial planning to implementation to assessment and evaluation. Team teaching, on the other hand, normally requires the persons involved to divide the work and take on different and clearly defined responsibilities. According to Tobin and Roth (2006), co-teaching helps bridge the gap between theory and practice as it allows two or more individuals (not necessarily peers) to teach and subsequently to discuss, debate, and reflect together about their teaching and their students’ learning.

The principles of co-teaching have been implemented in the practice-based component of the mathematics education course in question long before the term was first coined, because, like Tobin and Roth (2006), they have been found to work in practice. Hence, two

or three student teachers work together to plan and teach a sequence of lessons based on an initial assessment of a small group of students' mathematical needs. After each lesson, the student teachers reflect on the children's learning and their own teaching. They then use this information to plan subsequent lessons. In this particular co-teaching situation, routine and procedural management concerns are minimised due to the size of the "class" and the fact that the teachers (student teachers, classroom teacher, and mathematics educator) learn from each other how to implement them effectively. In this way, student teachers are able to focus more attention on their own teaching and on the children's learning.

Embedded Assessment

Black and Wiliam (1998) found that formative assessment feedback can enhance student learning when it focuses on what is needed for improvement. Although they concluded that such practices are rarely found in schools, it is probably even rarer in universities. Shavelson (2006, p. 65) outlines a continuum of formative assessment practices for teacher education. He refers to "on-the-fly" formative assessment as that which is unplanned, requiring intuition or wisdom of practice, and very difficult to teach teachers. Towards the other end of the continuum, he refers to "embedded assessment", which is formally planned formative assessment tasks that are integrated into the learning experiences of the students and where feedback on performance and remediation is immediately provided.

Embedded assessment best describes the formative assessment task undertaken by prospective teachers as part of the practice-based component of their course. Teachers in each group submit their co-constructed lesson plans to their tutor who observes teaching "snapshots" and provides immediate written feedback about their plans (e.g., appropriateness of content, clarity of goals, etc.) and their teaching. Brief field notes, in the form of observation notes and reminders about the aspects each group of teachers are asked to attend to, are made by the tutor. It is expected that student teachers take account of the tutor's feedback and their reflective evaluations of their own teaching and the children's learning in subsequent sessions. They are not required to rewrite lesson plans that have already been taught. The field notes help the tutor keep track of student teacher progress and ensure that feedback is considered as they learn to teach. At the end of the practice-based component, a mini-program of work consisting of all original lesson plans, formative comments from the tutor, student teacher responses to the feedback, and their own reflections on their teaching and the students' learning, is submitted along with a summative comment for final assessment.

Method

Previous investigations of mathematics' methods courses that situate prospective teachers' learning in alternating contexts such as those just described, indicate that they offer an effective vehicle for the translation of theory-based university knowledge into practice (Aldridge & Bobis, 2001; Bobis & Aldridge, 2002). The same body of research found that a practice-based component was perceived by multiple cohorts of graduating students and beginning teachers to be *the* most powerful mechanism by which this was achieved. To date, reasons for this perception have not been fully explored and evidence to support this view has not been sought. Hence, there were two main foci of the current investigation. First, it sought evidence to support the hypothesis that the practice-based component provided an effective mechanism for the translation of theory into practice.

Second, it sought to explore prospective teachers' perceptions of their own learning and teaching during this component in an effort to highlight strengths and weaknesses of the methods course.

Participants and Setting

Eighty-six prospective primary teachers (78 female and 8 male) enrolled in a 4-year Bachelor of Education degree participated in the study. The mathematics education course at the centre of the study is nested in the third year of the degree and is the second of three mathematics methods courses, each of 12 weeks duration. Prior to this course, student teachers had undertaken an introductory 8-day (one day a week for eight weeks) field experience and one block field experience of 15 days. Importantly, the practice-based component of the mathematics method course is not linked to the normal field experiences as it occurs totally within university-based tutorial times with the same mathematics educator supervising each of the four tutorial groups.

Prior to the practice-based component commencing, each participant selected to work with one or two other student teachers from the same tutorial group. This resulted in the formation of 40 groups of student teachers across the four tutorials. The methods course focused on the mathematics content area of measurement so it was negotiated with the four cooperating teachers that the weekly practice-based sessions would cover content from the volume and capacity sub-strand of the K-6 Mathematics Syllabus (Board of Studies, New South Wales, 2002). Each tutorial group was informed of the grade level they would be teaching two weeks prior to their first in-school session. They were asked to draw on theory and practical experiences of recent lectures to prepare suitable activities that would enable them to assess children's needs in the target content area. This information was expected to inform their lesson planning and co-teaching for the next 3 weeks. At the start of the first session, each group of student teachers was matched to a group of approximately four children of mixed ability.

Data Collection and Analysis

Data were collected from the following sources: (a) weekly lesson plans produced by each group of student teachers; (b) researcher field notes made while observing groups of student teachers co-teaching and during conversations aimed at providing additional feedback to that which was recorded on their lesson plans; (c) reflective journal entries from student teachers concerning their teaching and learning made after each in-school session; and (d) semi-structured interviews with four participants at the end of the methods course.

The field notes acted like an initial analysis of the lesson plans so these two forms of data were jointly analysed. Together they gave insight into the types of pedagogy prospective teachers sought to employ or did not employ and to changes in pedagogy over the three weeks as a result of formative feedback from the supervising mathematics educator.

Reflective journal entries made by prospective teachers gave insight into their abilities to use theoretical information to analyse and reflect on their teaching practice. Additionally, participants who had indicated their willingness to be interviewed individually were invited to a follow-up interview at the conclusion of the methods course. Four female students accepted the invitation and participated in a 30-minute semi-structured interview. Importantly, the interviews were conducted by an interviewer

independent of the methods course and were not part of the assessment for the course. The purpose of the interviews was twofold: to provide further insight on the findings that emerged from other forms of data gathered and to validate these findings via a process of triangulation. The interviews were tape-recorded and later transcribed for analysis. The focus of the questions was on the effectiveness of the practice-based component and its impact on the process of learning to teach. They were also asked to explain their reasoning for their comments. Analysis of data from the various sources involved multiple readings of lesson plans, transcripts and journal entries to pinpoint emerging themes in the data.

Results and Discussion

Field Notes and Lesson Plans

It is beyond the scope of this paper to explore all aspects of the lesson plans and the associated shifts in pedagogy over the three weeks. Hence, the focus of the analysis will be on the most salient features to emerge.

Analysis of the first week of lesson plans and field notes revealed that prospective teachers were experiencing difficulties implementing higher-order questioning. Although the initial plans showed that 75% or 30 groups of student teachers deliberately planned higher-order questions at some point in their lessons, they generally occurred towards the end of a lesson and were often “surrounded” by a much larger number of lower-order type questions (e.g., requiring recall of knowledge). Although the higher-order questions were considered well-designed and appropriate – ranging from open-ended questions to those requiring children to explain their reasoning – there was concern that they may have been omitted altogether if timing of the lesson became an issue or if allowed to be dominated by the lower-order questions. Hence, feedback was given suggesting student teachers integrate the questioning throughout the lesson plans and that they experiment initiating activities with such questions. Analysis of field notes and lesson plans for the subsequent weeks revealed a major shift in the number of higher-order questions integrated into lessons and that five groups actually used open-ended problems to initiate extended investigations.

Analysis of lesson plan tasks indicated a significant change in the nature and focus of tasks across the three weeks. Given the nature of the content being treated (volume and capacity), the use of tasks requiring children to manipulate materials physically was never an issue. However, the preoccupation with providing “busy” or “fun” activities that lacked directionality if children’s understandings of difficult concepts were to be enhanced was obvious when prospective teachers were questioned about the purpose of such tasks and why they were not consistent with the stated outcomes for their lessons. Forty-two percent of the lesson plans in the first week did not contain clear statements of purpose for the tasks planned. If goals were stated, they generally referred to an action or behaviour students were expected to perform. For example, a typically cited “goal” in the first week of lesson plans was “measuring and ordering the capacity of containers”. Lesson plans for the second and third weeks showed a major shift to tasks that focused on concept or skill development with associated goal statements explicitly referring to strategy development and conceptual understanding. For example, goal statements included: “Students will create a calibrated measuring container to increase their understanding of mL and the need to measure more accurately”, “To increase student’s understanding that capacity refers to the amount a container will hold”, “To make comparisons through accurate measuring and reflecting on the reasons why containers differ in capacity”.

Another major change in the nature of the tasks presented over the 3 weeks, was the increased occurrence of tasks requiring children to explain their strategies and to communicate their reasoning orally or in writing. It was also noted in the third week that there was an increased number of tasks and their associated goals that explicitly addressed children's misconceptions of volume and capacity. For instance, six plans referred to tasks designed to address confusion surrounding an object's mass and its displacement. By the third lesson plan, analysis revealed that 37 of the 40 plans explicitly planned for the enhancement of conceptual understanding and integrated working mathematically processes such as applying strategies, communication, and reasoning, as indicated by their goals and the nature of the learning experiences presented.

A final notable shift in lesson plans over the 3 weeks, was the increased occurrence of detailed explanations of the concepts prospective teachers considered more difficult to relate to children. Although only explicitly occurring in five lesson plans, field notes also made reference to conversations with another four groups of students about their need to "rehearse" or "script" detailed explanations and complex instructions to assist the flow of their lessons. It was perceived that such scripting raised prospective teachers' confidence levels to teach complex mathematical concepts and when considered successful, provided powerful memories that became useful sources for reflection during subsequent debriefing sessions.

Reflective Journal Entries and Interviews

Reflective journal entries and the interviews provided evidence of two main aspects of prospective teachers' knowledge: (1) their ability to use theoretical information to interpret and analyse the teaching of mathematics in practice; and (2) perceptions of their own learning, strengths, and weaknesses during this component of the methods course.

Ability to use theoretical information. Although many aspects of the prospective teachers' plans and teaching indirectly provide insight into their abilities to analyse theoretical knowledge in terms of their practice and vice versa, some journal entries and interview data explicitly referred to theory and practice relationships. For instance, when interviewees were questioned about the benefits of the practice-based component, all four considered that the "experience enabled us to place our theoretical knowledge into practice". To illustrate how this was achieved, Lauren explained that she and her partner built "upon the mind map idea from tutorials, we were able to see how the students' knowledge developed. We will definitely use this strategy in the future" and Rebecca referred to the "whole teaching and learning process" because it enabled "us to try out ideas rather than just write about them."

Three different groups of prospective teachers commented in their journals on the way "we structured a sequence of learning activities that reflected the stages of the measurement framework". One group considered that "this allowed us to clarify not only the stages of student understanding but also our own understandings of the concepts" learnt about in tutorials (Andrew and Lucy, journal entry). Another group reflected on their ability to "sequence individual lessons that scaffolded student learning through initial engagement, the introduction of new concepts and concluding with a reflection upon both prior and new knowledge" as a real "strength" of their teaching. These comments validated what was evident in student teachers' lesson plans as being "deliberate" and "successful" translations of their theory-based knowledge to their practice. They also indicated that a small number of prospective teachers were not only able to integrate theory and practice,

but were able to theorise about their own practice when given the opportunity to critically reflect on it.

Perceptions of their own learning, strengths and weaknesses. The two most commonly discussed aspects of their teaching in both journal entries and by interviewees was the use of explanations and higher-order questioning. Higher-order questioning was considered a shortcoming in more than 60% of journal entries for the first two weeks. Student teachers regularly conceded: “in our eagerness to ask the students questions we were consistently asking directed questions focused on producing the correct answer”. However, by the final week of the practice-based component, journal entries referred to how their questioning had “improved” with one prospective teacher indicating that she learnt to ask better questions from her co-teacher. “N... showed herself to be an excellent questioner”, asking questions that required “a deeper and higher order of understanding. We organised our lesson plan with a “questioning” column, and this enabled me to really think about what I wanted the students to achieve...”. This comment also illustrates the benefits of co-teaching, when prospective teachers can not only jointly share and reflect on their experiences, but also learn from the strengths of each other.

Time and behaviour management issues, as found by Moore (2003), remained an important consideration for student teachers as they were mentioned in 37% of the reflective journals. However, unlike Moore, who found that the comments related to unresolved issues, a large number of the reflective journal entries outlined what the student teachers had learnt that would help them in the future. For example, a group of three prospective teachers wrote about their need to be flexible with their time management:

We concluded that it is better to spend a little extra time to ensure that students comprehensively understand the concepts of one activity, than abide by a time frame at the expense of having students with little or no understanding of 2 or 3 activities. (Brian, Kim and Sue, journal entry)

Another group of prospective teachers discovered that “since the students were always engaged in the activities there were only a few behaviour issues. This is definitely something to think about when working with a whole class”. Given that the children were regularly working with water and were located outdoors or in “wet areas” for their lessons, even small groups of children required careful behaviour management skills. Hence, many prospective teachers learnt after the first lesson “not to leave any aspect of management to chance – we needed to have clearly thought-out instructions for all procedures” (Emma, interviewee).

Over the 3 weeks in which reflective journal entries were made, 75% of the prospective teachers considered “catering for different abilities” as one of the most challenging and “frustrating” aspects of their teaching. However, as one group confided, it also “proved to be a very worthwhile lesson to learn and something which we will be more prepared for in the future”. In their interviews, both Emma and Lauren mentioned a need to modify the planned activities and to use more open-ended questions after their initial assessment because they had not anticipated the “variation in the children’s understandings”.

In her interview, Rebecca commented that her group “became more explicit in what we wanted the students to do ... we clearly know the purpose of each activity in the lessons. Without this, the activities looked pointless”. Her comments reflect similar sentiments in a growing number of journal entries by the third week and indicate an increasing concern for directing student learning according to a perceived research-based trajectory.

The interviewees were asked to comment on aspects of the practice-based component that were considered of most and least benefit to prospective teachers and to explain their

reasoning. The only suggestions for improvement referred to extending the “time in the school”. Reasons for their positive perceptions varied, but Emma and Lauren considered the “cumulative assessment” very helpful as it “helped us learn step by step and target the areas of our teaching in most need of improvement”. Rebecca emphasised the importance of “sharing the experience, and learning from my” co-teacher. This sentiment was echoed in a number of reflective journal entries. For instance, one group of three co-teachers wrote in the third week that they “found working together as a group of three teachers very helpful. We got ideas from each other, and thought it was valuable as well for the students as they were presented with similar lesson content through different approaches”.

Journal entries indicated that the co-teaching arrangement also helped address perceived weaknesses in content knowledge and the confidence levels of prospective teachers.

Initially, our main fear was our lack of content knowledge...after a little research it did not take long for the ideas to flow between us. In our first session we were quite nervous and our questioning fumbled several times ... For the next lesson, we made sure we used more open-ended questions. (Clare, Anna and Sohpie, journal entry)

Another aspect of the practice-based component mentioned by a quarter of prospective teachers in their journals was the benefit of focusing “on one content area for three lessons” as this “enabled me to fine-tune my teaching strategies – particularly questioning and explanations and to deepen my own knowledge” (Andrew and Lucy, journal entry). The ability to “fine-tune” and “reflect on” strategies, skills and knowledge was repeatedly mentioned as a benefit of the practice-based component in journal entries, as was the “ability to teach our own way without worrying if we were teaching the way another teacher wanted us to”. A sense of “empowerment” was conveyed by many prospective teachers as a result of the practice-based component:

This in-school experience was my most successful practical experience to date in terms of the achievement of intended outcomes for my students. I feel really empowered to have such a positive feeling about the children’s learning and the activities I designed ... (Renee, journal entry)

Learning to teach is a complex process. To understand that process better we need to examine the impact of teacher education programs and courses on prospective and beginning teachers. Previous research has shown that alternating theory and practice-based contexts in teacher education programs can assist the translation of theory-based knowledge into the practice of beginning teachers. This study sought further understanding of why and how a practice-based component of a teacher education program might achieve this. It also sought to explore prospective teachers’ perceptions of their own learning and teaching during this component in an effort to highlight strengths and weaknesses of the methods course. Results confirm that prospective teachers were able to use theoretical-based knowledge to interpret, analyse, reflect on and improve their teaching of mathematics in practice. Evidence indicated that particular elements of the component – the situated learning context, co-teaching, and embedded formative assessment – empowered them to do this. As a result of undertaking the practice-based component, an overall shift in teaching towards the use of higher order questions, the increased use of “scripting” explanations, the use of tasks explicitly designed to enhance the conceptual development of children and to address perceived misconceptions in their mathematical understanding were among the most notable shifts in practice. Such teaching strategies are consistent with current visions of teaching mathematics (Australian Association of Mathematics Teachers (AAMT), 2002; NCTM, 2000; NSWDET, 2003). Importantly, “context” plays a major role in the success of this component and the mathematics methods

course in which it is nested. As mentioned earlier, the component has evolved over many years and is based on what works in this situation for the type of student teachers attracted to this institution and primary education program. Although aspects can be adapted, the simple transfer of some or all elements to another context may not yield the same successes.

Practical Implications for Teacher Education

Informed by a growing body of research literature, current views of quality teaching reflected in policy documents and key professional literature from around the world emphasise the importance of teachers' professional knowledge and their knowledge of practice (AAMT, 2002; NCTM, 2000; NSW Institute of Teachers, 2006). For instance, the *Standards for Excellence in Teaching Mathematics in Australian Schools* (AAMT, 2002) recognises the importance of teachers possessing professional knowledge of “current theories relevant to the learning of mathematics”, of content, of students and of how students learn mathematics best (p. 2). It also states that excellent teachers of mathematics possess strong practical knowledge so they can carefully plan learning experiences that “enable students to develop new mathematical understandings ... engage them actively in learning” and allow teachers to plan appropriate future learning (AAMT, 2002, p. 4). Besides conforming to research findings of quality teaching, such views also form the basis for teacher accreditation criteria (e.g., NSW Institute of Teachers, 2006). Hence, it is imperative that teacher preparation programs include such outcomes for their graduate teachers, and for the sake of their credibility, should provide research-based evidence to verify their effectiveness in achieving them and in the ability of their graduates to translate such knowledge to their teaching. Importantly, although these documents suggest or even “mandate” outcomes for graduating teacher education students, *how* they are achieved is rightly left to individual teacher education programs to determine.

The results of this study illustrate how one teacher education program is addressing this challenge by providing practical suggestions for reshaping traditionally-structured teacher education courses, especially those attached to field experiences. In particular, the following elements have greatest implications for assisting the translation of theory to practice.

- Alternating the learning context from university-based tutorials to one situated in a school provides prospective teachers with rich opportunities to examine and reflect on their practice in terms of the theories behind their pedagogical decisions and vice versa;
- The situated learning context removes the power of the mentor teacher often noted in traditional field experiences and provides a secure environment in which prospective teachers can rehearse teaching (pedagogical) strategies and develop heuristics or “scripts” (e.g., explanations for complex mathematical concepts) that can be used in whole-class field experiences and eventually in their own classrooms;
- Co-teaching provides prospective teachers opportunities to learn from each other and encourages them to “take risks” and experiment with novel teaching strategies;
- Co-teaching enables prospective teachers explore what to teach, how to teach it and how students learn best before being placed in the added stress of a whole class situation; and
- Embedded formative assessment allows shortcomings in planning and teaching to be addressed immediately. Hence, it can refocus prospective teachers' attentions on more pressing concerns of teacher quality such as higher order thinking and conceptual understanding rather than allow them to become preoccupied with more overt lower order and procedural concerns.

In summary, the findings suggest a change in thinking about structure and focus of teacher education courses by looking for opportunities for prospective teachers to discuss, interpret and reflect on the relationship between theory and practice. Teacher education

programs are regularly criticised for the inability of their graduates to cope with the realities of the classroom. At times they have been criticised for teaching too much theory at the expense of practical experience, for not incorporating effective mechanisms that encourage the transfer of theory to practice, and for even teaching the *wrong* theory (Wilson et al., 2006). Perhaps the most important practical implication of this research is the need to provide an evidence-base to redress such unsubstantiated criticisms.

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