Identifying mentoring practices for developing effective primary mathematics teaching  
Peter Hudson and Robert Peard, Queensland University of Technology

Mentoring and the development of teaching mathematics

It is well established that mentoring can assist in the development of teaching practices particularly when mentors and mentees engage in pedagogical discourse and reflective thinking (e.g., Power, Clarke, & Hine, 2002; Sinclair, 1997). Mentoring is now a prominent practice in teacher education and has implications for “generalist” primary teachers who take on mentoring roles.

Just as educators and teachers can improve their teaching practices, so too can mentors (supervising teachers) improve their mentoring practices (Hudson & Skamp, 2003). Although education departments have provided professional development for teachers in mentoring positions (NSW DET, 2003), Hulshof and Verloop’s study (1994) reports that 74% of mentors felt that education in mentoring was necessary but mainly for new mentors. As curricula continually changes, primary mathematics teachers are required to develop further understandings and skills; similarly, mentors involved in mathematics education also need to ensure that their understandings and skills are aligned with current mathematics teaching practices.

A major part of the mentor’s role is to develop the mentee’s overall teaching ability, yet each mentor has individual beliefs on what is and what is not important. These individual mentor views will vary on all aspects of teaching and mentoring. Although some mentoring can emerge naturally, educators need to ensure that mentoring is not left to chance; hence mentors “need explicit training in the stimulation of novice teachers to reflect on their actions in order to move them to higher levels of professional thinking” (Veenman, de Laat, & Staring, 1998, p. 6).

A five-factor model for mentoring in primary mathematics teaching

Five factors for mentoring have previously been identified, namely, Personal Attributes, System Requirements, Pedagogical Knowledge, Modelling, and Feedback, and items associated with each factor have also been identified and justified with the literature (Hudson, Skamp, & Brooks, 2005). The following explains the five factors and associated attributes and practices in relation to mentoring in primary mathematics teaching.

Factor 1: Personal Attributes

Mentors need to exhibit a number of personal attributes to develop mentees’ teaching of primary education. The mentoring process may be strengthened with the inclusion of the Personal Attributes factor, particularly as learning takes place within a social context and a mentor’s personal attributes aim to facilitate such learning. In relation to Personal Attributes and mentoring in mathematics education, mentors need to be: (1) supportive, (2) attentive, and (3) comfortable with talking about specific teaching practices. Mentors also need to: (4) instill positive attitudes in their mentees for teaching primary key learning areas (5) instill confidence in their mentees for teaching, and (6) assist the mentee to reflect constructively on improving teaching practices (Abell & Bryan, 1999).

Factor 2: System Requirements

System requirements present quality control directions by providing a curriculum that focuses on achieving specific aims for teaching. System requirements are an essential aspect for reforming primary education. Three key mentoring practices may be associated with the factor, System Requirements, which focus on: (1) aims for teaching mathematics (2) the primary mathematics curriculum and (3) school policies related to mathematics education (e.g., Bybee, 1997; Riggs & Sandlin, 2002).

Factor 3: Pedagogical Knowledge

Pedagogical knowledge is developed within the school setting and is essential for supporting effective primary teaching. Mentors need to have pedagogical knowledge to guide their mentees in specific teaching practices. Eleven mentoring attributes and practices may be associated with Pedagogical Knowledge for developing specific teaching practices: (1) planning for teaching (2) timetabling (3) preparation (4) teaching
strategies (5) classroom management (6) questioning skills (7) assisting with problem solving (8) content knowledge (9) implementation (10) assessment, and (11) providing viewpoints (Breeding & Whitworth, 1999; Fleer & Hardy, 2001)

Factor 4: Modelling

The mentees’ skills for teaching are learned more effectively by observing their mentors’ modelling of teaching practices. Modelling teaching practices may be linked to implementing primary education reform, particularly as beginning teachers can introduce change into the education system. Eight attributes and practices may be associated with modelling primary mathematics teaching, that is, modelling: (1) enthusiasm (2) teaching (3) effective teaching (4) a rapport with students (5) hands-on lessons (6) well-designed lessons (7) classroom management and (8) syllabus language (See for example, Briscoe & Peters, 1997; Little, 1990)

Factor 5: Feedback

Finally, providing feedback allows for preservice teachers to reflect and improve teaching practices, and this includes primary teaching practices in specific subject areas. Six attributes and practices that may be associated with the Feedback factor for developing mentees’ primary mathematics teaching, require a mentor to: (1) articulate expectations (2) review lesson plans (3) observe practice (4) provide oral feedback (5) provide written feedback and (6) assist the mentee to evaluate teaching practices (See for example, Long, 2002).

Aim of the study

The aim of the study is to identify the current practices of mentoring for the development of mathematics teaching and to identify how current practices may be improved through a specific mentoring intervention that focuses on effective reference to the attributes and practices associated with the five factors: Personal Attributes, System Requirements, Pedagogical Knowledge, Modelling, and Feedback.

Methodology

The “Mentoring for Effective Mathematics Teaching” (MEMT) survey instrument in this study evolved through a series of preliminary investigations on Mentoring for Effective Primary Science Teaching. Steps for developing and validating the survey instrument included small-scale interviews with mentors and mentees (n=10) on their perceptions of mentoring preservice primary science teaching at the conclusion of a three-week professional experience (Hudson & Scamp, 2003). The literature-based survey instrument was pilot tested on 21 first-year preservice teachers and later with 59 final-year preservice teachers at the conclusion of their professional experiences. Analysis of these pilot tests provided data for refining the instrument to be administered to final-year preservice teachers from nine Australian universities (Hudson et al., 2005). Responses to these items were on a five-part Likert scale (i.e., strongly disagree=1, disagree=2, uncertain=3, agree=4, strongly agree=5).

For this study, the primary science instrument was altered to reflect primary mathematics teaching and data were analysed within each of the five factors and descriptive statistics were derived using SPSS12 for each variable.

Results and discussions

The 29 responses (26 female; 3 male) from final-year preservice teachers received from one Australian university provided descriptors of the participants (mentors and mentees) and data on each of the five factors and associated attributes and practices. Responses were gathered at the conclusion of their final professional experience (i.e., practicum/field experience).

Five factors

The five factors were analysed through confirmatory factor analysis with acceptable Cronbach alphas for four of the five factors, that is, Personal Attributes (mean score = 4.01, SD [standard deviation] =0.92), System Requirements (mean score = 2.99, SD = 1.00), Pedagogical Knowledge (mean score = 3.70, SD = 1.01), Modelling (mean score = 3.97, SD = 0.86), and Feedback (mean = 3.84, SD = 0.92)
were .92, .68, .95, .89, and .87 respectively. Cronbach alpha for System Requirements falls below the recommended .70 indicator. Nevertheless, the following provides further insight into specific data on the attributes and practices associated with each factor.

**Personal Attributes**

When analysing the mentees’ responses on their mentors’ Personal Attributes (mean item score range: 3.66 to 4.31; SD range: 0.90 to 1.15), a majority of mentors (90%) were supportive towards their mentees’ primary mathematics teaching. Eighty-three percent of mentors appeared comfortable in talking about mathematics teaching and listened attentively to their mentees. However, less than 80% of mentees believed that the mentor instilled confidence (69%) and positive attitudes (76%) for teaching primary mathematics. Aiding the mentee’s reflection on teaching practices is considered a key element in the mentoring processes but 21% of mentors did not display this characteristic.

**System Requirements**

Items displayed under the factor System Requirements presented a vastly different picture from the previous factor (mean item score range: 2.79 to 3.28; SD range: 1.21 to 1.32). The primary mathematics mentoring practices associated with System Requirements were all below 60%. To illustrate, 55% of mentors discussed the aims of mathematics teaching, 41% outlined mathematics curriculum documents, and only 38% of mentors discussed the school’s mathematics policies with the mentee. Most mentees “strongly disagreed” that the mentor discussed with them “System Requirements” for primary mathematics teaching.

**Pedagogical Knowledge**

Mean item scores (3.17 to 4.14; SD range: 0.88 to 1.40) indicated that the majority of mentees “agreed” or “strongly agreed” that the mentor displayed Pedagogical Knowledge for mathematics teaching. In this study, 90% of mentors assisted their mentees to develop their pedagogical knowledge of mathematics teaching strategies. However, more than 20% of mentors may not have mentored the other pedagogical knowledge practices. For example, in the planning stages before teaching mathematics 69% of mentors assisted in planning, and 79% discussed the timetabling of the mentee’s teaching and assisted with mathematics teaching preparation. Furthermore, teaching strategies need to be associated with the assessment of students’ prior knowledge, yet nearly half the mentors were perceived not to discuss assessment for teaching mathematics (52%). In addition, problem-solving strategies for teaching mathematics (66%) and providing viewpoints on teaching mathematics was not a high priority with mentors (62%). This implies that many final-year preservice teachers may not be provided with adequate Pedagogical Knowledge to develop successful mathematics teaching practices.

**Modelling**

Modelling teaching provides mentees with visual and aural demonstrations of how to teach. Mean item scores (3.59 to 4.28; SD range: 0.84 to 1.37) indicated that the majority of mentors were perceived to model mathematics teaching practices. Even though more than 75% mentees perceived they received modelled practices for teaching mathematics including modelling a rapport with their students (93%), displaying enthusiasm for teaching mathematics (86%), modelling the teaching of primary mathematics (86%), and using language from the mathematics syllabus (76%), more than 25% of mentees indicated their mentors had not modelled classroom management (73%), hands-on mathematics lessons (72%), effective mathematics teaching (69%) or well-designed lessons (66%). It may also be that 17% of mentees who perceived they received the modelling of teaching mathematics considered this modelling not to be effective. Mentees may perceive some association between modelling effective teaching practices and hands-on lessons, well-designed lessons, and classroom management.

**Feedback**
Mean item scores (2.95 to 3.72; SD range: 1.21 to 1.44) indicated that the majority of mentees “agreed” or “strongly agreed” that their mentors provided Feedback as part of their mentoring practices in mathematics teaching. Indeed, 90% of mentors observed their mentees teach mathematics and provided oral feedback on this teaching. However, only 55% of mentors were perceived to review lesson plans, which is necessary in order to provide feedback before teaching commences for enhancing teaching prospects. In addition, written feedback formalises the mentoring process and allows mentees to reflect after leaving the school environment; yet 41% of mentors did not provide written feedback. Many mentors (34%) were not forthcoming with articulating their expectations for teaching mathematics.

**Summary and conclusions**

Mentees claim that the in-school context is pivotal to their development as teachers (Jasman, 2002). Indisputably, “generalist” primary teachers will not be experts in all subjects in primary school, and some may not have adequate knowledge, skills, or confidence in teaching mathematics. Mathematics education is considered a priority by education departments yet there are mentors who may either not have the skills in mathematics education to mentor effectively or lack knowledge of effective mentoring strategies. Indeed, there should be more emphasis on the mentoring of mathematics if more importance is placed on this key learning area. This study argues that for mentees to receive equitable mentoring in primary mathematics teaching requires specific mentoring attributes and practices to be learned by mentors. The form this education takes will require rethinking, as “experienced” mentors may be reluctant to be educated on their mentoring practices (Hulshof & Verloop, 1994).

This is a small-scale study, and utilises mentoring practices and attributes associated with primary science education, therefore, further research would be needed to verify these findings in relation to primary mathematics education. Nevertheless, the inadequate mentoring outlined in this study may be initially addressed through a specific mentoring intervention that focuses on effective mentoring (i.e., attributes and practices associated with the five factors: Personal Attributes, System Requirements, Pedagogical Knowledge, Modelling, and Feedback). As each item associated with the MEMT instrument is linked to the literature, a mentoring intervention may be based around these items. A well-constructed mentoring intervention may then provide professional development for mentors for enhancing not only their own mentoring practices but also their teaching practices. Additionally, the MEMT instrument may be used (by tertiary institutions or departments of education) to gauge the degree and quality of mentoring in primary mathematics and, as a result of diagnostic analysis, plan and implement mentoring programs that aim to address the specific needs of mentors in order to enhance the mentoring process.

Utilising the mentor’s time efficiently is crucial for developing the mentee’s practices in primary mathematics, and this is further justification for educating mentors. The mentor’s involvement in facilitating the mentee’s learning for more effective primary mathematics teaching cannot be indiscriminate; instead it must be predetermined and sequentially organised so that the mentor’s objectives are focused, specific, clear, and obtainable, which means educating mentors. Effective mentoring requires mentors to: display personal attributes, provide guidance on system requirements, model effective mentoring (which also requires modelling effective teaching practices), and provide pedagogical knowledge and feedback towards enhancing teaching practices. Educating mentors aims at ultimately targeting the development of more effective mathematics teaching practices, and hence a way to enhance primary students’ learning experiences and opportunities towards developing higher standards of mathematics education.

**References**


