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Specific mentoring: a theory and model for developing primary science teaching practices

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The transition from generic mentoring to specific mentoring practices can provide a stronger focus for developing preservice primary teachers (mentees) in subject-specific areas. Constructivist theory and a five-factor model towards specific subject mentoring are proposed as ways to develop mentees' teaching practices. Firstly, constructivist theory complements mentoring within field experiences (practicum/internship), as it can be used to build upon prior understandings towards developing the mentee's knowledge and skills for teaching. Secondly, the picture that emerges from the literature shows five factors for mentoring, namely: (i) personal attributes that the mentor needs to exhibit for constructive dialogue; (ii) system requirements that focus on curriculum directives and policies; (iii) pedagogical knowledge for articulating effective teaching practices; (iv) modelling of efficient and effective practice; and (v) feedback for the purposes of reflection for improving practice. It is argued that 'generalist' primary teachers in their roles as mentors will require specific mentoring strategies linked to these five factors to enable effective mentoring in specific subject areas.

Introduction

Educators (Mullen *et al.*, 1997) have pushed for new mentoring approaches within teacher education. A review on Australian education (Ramsey, 2000) finds that teacher quality may not be a priority for universities and employers, and teacher education should 'expand, as a priority, current professional development initiatives which equip educational leaders and mentors with the knowledge and skills to fulfil their roles in the induction of new members' (p. 208). Such mentoring, which generally occurs within field experience programs, will require a new approach that takes mentoring to a more specific level of operation. For mentors to be effective, mentoring programs need to focus on specific objectives for developing primary science teaching practices. Mentoring can be a change agent but will require a new readiness from mentors to more effectively guide mentees in this specific subject area.

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From general to specific mentoring

Generic mentoring knowledge has grown considerably over the last decade (see, for example, McIntyre *et al.*, 1993; Tomlinson, 1995; Edwards & Collison, 1996; Reiman & Thies-Sprinthall, 1998) and has articulated essential elements for effective mentoring, particularly in the method and manner of mentoring. However, generic mentoring will limit the mentee's experiences for specific teaching practices, which is even more pertinent for primary education as it covers several key learning areas.

It was found in England that nearly all mentoring in primary teaching was generic (Jarvis *et al.*, 2001). Although there are generic mentoring approaches, specific mentoring can differ considerably from subject to subject. Enhancing primary science teaching practices will require the mentor to have specific pedagogical knowledge appropriate to the subject. Feiman-Nemser and Parker (1990, p. 42) have shown that pedagogical knowledge can have differences from one subject to the next and, therefore, mentoring must 'address content-related issues in content-specific terms'. Peterson and Williams (1998) also claim that unique mentoring processes are required for specific subject teachers. Yet mentors in primary education may not be confident to mentor in specific subject areas (see Jarvis *et al.*, 2001).

A theory for mentoring

A new approach to mentoring will require a rethinking of theories for mentoring. A theory for mentoring must have embedded in its principles a provision for constructing knowledge from prior experiences and develop the potential of the mentee by moving from the general to the specific, and it must also complement field experience models currently operating in schools.

Constructivism

According to constructivist theory, learning is most effective when new knowledge and skills will be used and individuals construct meaning for themselves (Bickhard, 1998). Shank (1993, p. 7) explains that constructivism holds that learning is a process of building up structures of experience where prior knowledge and experiences scaffold new understandings. 'We do not create meaning. We construct meaning', bringing together objectivity and subjectivity. In this way, constructivists move from 'simplicity and generality to relative complexity and specificity' (Crotty, 1998, p. 44). This theory may also have applications for guiding mentees' learning of teaching practices, particularly as teaching is a complex process with specific knowledge required for developing effective teaching.

The 'constructivist mentor'

Constructivism also has the potential to be employed in mentoring programs that focus on specific subjects such as primary science; for example, mentors can progressively build mentees' beginning knowledge of science teaching towards more complex and specific science teaching knowledge. The 'constructivist mentor' may have an impact on the mentee's development and create sequential changes in primary science teaching practices. As von Glasersfeld (1998, p. 28) purports 'constructivism may provide the thousands of less intuitive educators an accessible way to improve their methods of instruction', which also has implications for mentoring. Constructivism may develop mentors in their specific mentoring roles, which in turn can assist in the development of mentees' primary science teaching, but this will require a model for mentoring that complements constructivism.

A five-factor model for mentoring

Constructivist mentoring in teacher education may be characterized by a model defined by five factors, namely: personal attributes, system requirements, pedagogical knowledge, modelling, and feedback (Hudson & Skamp, 2001, 2003; see Figure 1). Moreover, a study of 331 final-year preservice teachers from nine Australian universities provided data that statistically and educationally confirmed these factors (Hudson *et al.*, 2004). The mentoring roles within these factors can frame the mentee's teaching experiences in a constructivist way. Within this model, the mentor scaffolds, facilitates and coaches the mentee towards a level of proficiency in science teaching. Indeed, mentors may become agents of systemic change with a model that encapsulates the mentoring process and provides a context for mentoring. The inclusion of system requirements aids in ensuring that mentors use current teaching practices, which is essential for systemic reform (Bybee, 1997). The ultimate goal should be one of explicit mentoring that develops pedagogical self-efficacy in the mentee, and consequently, autonomy in teaching practice.

Experienced teachers in their roles as mentors can play a significant part in educating preservice teachers, but this will require mentors to be more critical of

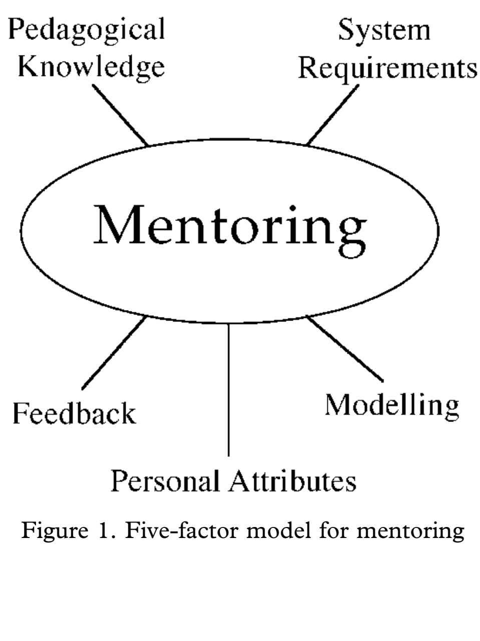

Figure 1. Five-factor model for mentoring

their mentoring practices. Mentoring practices in primary schools are generally generic in nature and need to develop subject-specificity in order to focus on the unique qualities of each subject. For example, pedagogical knowledge for a gymnastics lesson will differ from the knowledge required for teaching a science lesson. Subject-specific mentoring within each of the five factors may aid in developing mentees' pedagogical knowledge and act as a vehicle for education reform in such subjects; however mentors need to conceptualize such practices. The following section outlines each of these five factors and how the five-factor model may be utilized for specific mentoring in primary science teaching.

Mentor's personal attributes for developing primary science teaching

Attributes to instil positive attitudes and confidence for teaching primary science and to assist mentees to reflect on their primary science teaching practices require mentors to be encouraging, affable, attentive and supportive (Peterson & Williams, 1998; Ganser, 2002; Kennedy & Dorman, 2002). Therefore, a significant part of the mentor's role is exhibiting such personal attributes that would best facilitate the mentee's development of primary science teaching practices. For example, if the mentor takes a keen interest in the mentee's discussion of lesson plans and the mentee is supported with positive comments and constructive advice, then the mentee may gain more confidence in teaching the lesson. Conversely, mentors who do not display supportive and positive personal attributes may limit, or even reduce, the mentee's confidence to teach.

System requirements for primary science teaching

Most education systems have curriculum requirements for each school subject, including primary science (Bybee, 1997). The primary science curriculum, its aims, and the related school policies for implementing system requirements are fundamental to any educational system, as they provide uniformity and direction for implementing primary science education. Mentors need to be familiar with the content of current system primary science curricula and how it can be implemented in the school. The mentor's role must include addressing system requirements so that mentees can be more focused on planning and implementing quality educational practices in primary science. This requires mentors to outline the school's science education policy and curriculum so that mentees may note how system requirements are implemented within the school setting.

Mentor's pedagogical knowledge of primary science

The mentor's pedagogical knowledge is a key reason for providing field experiences (practicum/internship) within preservice teacher education programs (Briscoe & Peters, 1997; Kesselheim, 1998). Indeed, the mentor's knowledge of how to teach in the classroom context can provide mentees with a deeper understanding of teaching practice (Shulman, 1986). Pedagogical knowledge can differ from subject to subject and lesson to lesson; hence mentors need to conceptualize what constitutes subject-specific pedagogical knowledge in order to articulate this clearly to their mentees. In primary science, the mentor's pedagogical knowledge needs to focus on planning, timetabling, preparation, implementation, classroom management strategies, teaching strategies, science teaching knowledge, questioning skills, problem solving strategies and assessment techniques in a primary science education context. The mentor with specific pedagogical knowledge can more effectively assist the mentee to improve specific science teaching practices. Expressing various viewpoints on teaching primary science (e.g. inquiry approach, constructivism) may also assist the mentee to formulate a pedagogical philosophy of science teaching.

Mentor's modelling of primary science teaching practices

Similarly to pedagogical knowledge, modelling of teaching practices has consider able effect on a mentee's development if included in authentic classroom experiences. Indeed, mentors are defined as experts who can model effective teaching practice (Galvez-Hjornevik, 1986; Barab & Hay, 2001). Subject-specific mentoring allows mentors to focus on modelling the particular unique aspects of that subject. Modelling of primary science teaching practices by the mentor need to be consistent with current educational system requirements. To do this in the classroom, mentors need to display enthusiasm for science and involve mentees, not only in teaching science, but also teaching it effectively with well-designed, hands-on lessons that display classroom management strategies and exemplify a rapport with students. The discourse used by the mentor when modelling science teaching needs to be consistent with the current science syllabus, which will aid in scaffolding the mentee's understanding of teaching primary science and includes current education reform policies. Such modelling allows mentees to conceptualize effective teaching practices towards developing their own knowledge and skills.

Mentor's provision of feedback on primary science teaching practices

Feedback is an essential ingredient in the mentoring process, as this allows mentors to articulate, in a constructive manner, expert opinions on the mentee's development towards becoming a teacher (Bellm *et al.*, 1997; Haney, 1997; Bishop, 2001). In a previous study (Hudson & Skamp, 2001) it was noted that no feedback from mentors may have a similar impact to negative feedback. Therefore, the mentor's willingness to provide constructive feedback can contribute to instilling confidence in the mentee. In the classroom context this requires mentors to review the mentee's primary science lesson plans and programs in order to provide more comprehensive and specific feedback. Observing the mentee's primary science teaching provides content for the mentor to express oral and written feedback on the mentee's science teaching. The mentor also needs to show the mentee how to evaluate primary science teaching, so that the mentee can more readily reflect upon practices.

Educating mentors in specific mentoring

Mentors need to collaborate with the mentee for establishing primary science teaching goals and facilitate the mentee's self-reflection towards a higher level of expertise. It is the mentor who can more readily shape, through holistic immersion, a mentee's professional and personal skills in teaching primary science. However, the mentor's availability during the mentee's field experience can be a limiting factor in the mentoring process (Ganser, 2002). The mentor's time may be utilized more effectively by focusing on specific mentoring within the five-factor model and articulating successful teaching practices in the specific subject area.

A major part of the mentor's role in primary education 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, from the planning through to the choice of classroom procedures for implementing a specific teaching strategy (see, for example, Coates *et al.*, 1998). Mentor education is currently inadequate for developing such specialist skills required for mentoring in specific subject areas. For mentees to receive equitable mentoring in specific subject areas would require mentors to be educated on mentoring skills for specific subjects.

It is also 'important to find effective and economic strategies for training teacher-mentors' to improve their specific mentoring (Jarvis *et al.*, 2001, p. 3). Field experiences are generally available to preservice teachers, who are usually assigned mentors. In the primary school, mentors are generalist primary teachers and may not be experts in all subject areas. Nevertheless, by drawing on generic sources for mentoring and teaching, and combining this with specific subject pedagogy, 'non-specialist' primary teaching mentors may mentor more effectively, particularly if such skills are subsumed within the mentor's role. That is, mentors need to be provided with subject-specific guidelines that present effective mentoring practices, which will then allow mentors to develop their mentoring skills in an economically viable way.

Conclusion

Constructivist theory and the five-factor model for specific mentoring may assist the development of mentees' primary science teaching. Firstly, constructivist theory complements field experience models, as it allows mentors to build upon the mentee's prior understandings towards developing knowledge and skills for science teaching. Secondly, the picture that emerges from the literature shows five factors for effective mentoring that may be used as a model for specific subject areas, namely: personal attributes that the mentor needs to exhibit for constructive dialogue; system requirements that focus on curriculum directives; competent pedagogical knowledge for articulating best practices; modelling of efficient and effective practice; and feedback for the purposes of reflection to improve practices. Specific mentoring strategies associated with each factor need to be designed to adequately guide mentoring in specific subject areas such as primary science, which may also be used as a form of professional development for the mentor in the dual roles as teacher and mentor.

Notes on contributor

Peter Hudson was a principal of a New South Wales school and is now a science education lecturer. He has just submitted his Ph.D. in mentoring and preservice teacher education.

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