

Employing the five-factor mentoring instrument: analysing mentoring practices for teaching primary science

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Primary science education is a concern around the world and quality mentoring within schools can develop pre-service teachers' practices. A five-factor model for mentoring has been identified, namely, personal attributes, system requirements, pedagogical knowledge, modelling, and feedback. Final-year pre-service teachers (mentees, $n=211$) from three Turkish universities were administered a previously validated instrument to gather perceptions of their mentoring in primary science teaching. ANOVA indicated that each of these five factors was statistically significant ($p<.001$) with mean scale scores ranging from 3.36 to 4.12. Although mentees perceived their mentors to provide evaluation feedback (95%), model classroom management (88%), guide their preparation (96%), and outline the science curriculum (92%), the majority of mentors were perceived not to assist their mentees in 10 of the 34 survey items. Professional development programmes that target the specific needs of these mentors may further enhance mentoring practices for advancing primary science teaching.

Keywords: mentoring; pre-service teachers; science education; mentors

Mentoring has been viewed as a valuable construct in fostering pre-service teachers' personal and professional development (Okan and Yildirim 2004; Norman and Feiman-Nemser 2005; Sundli 2007; Schmidt 2008). Pre-service teachers in their roles as mentees require experienced guidance when in the school setting. Mentors can develop strong connections with mentees and a sense of esteem from the mutual efforts and satisfaction in what they create together (Bainer 1997). Yet, Harrison, Dymoke and Pell (2006) assert that mentors have a responsibility to make changes in the professional beliefs, values and behaviours of their mentees (e.g., pre-service teachers) as an educational goal. Mentoring has many aspects in approaching pre-service teachers' challenging on the process of learning to teach. Amongst them, mentors' personal attributes, which include their dispositions and interpersonal skills, are paramount for advancing the mentees' development (Galbraith and Cohen 1995; Ganser 1996, 2002). Schmidt (2008) emphasises the importance of the mentor's approach with the mentee. Mentees need assistance to overcome the challenges during the process of learning to teach, which requires mentors' sustained guidance and support in a collaborative nature (Freese 1999; Okan and Yidirim 2004; Norman and Feiman-Nemser 2005; Schneider 2008). Harrison, Dymoke, and Pell (2006) reveal that mentor's attributes include: being a good listener; being flexible; an ability to focus on issues, to enable discussion and reflection on practice; an ability to open up opportunities for them and broaden their experiences; and an awareness or

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foresight to recognize pressure points, which may require further collaboration between the mentor and mentee.

In pre-service teacher education, mentors (i.e., supervising teachers) can provide pedagogical advice and guidance for developing the mentee's practices and to support students' learning (Schneider 2008). The mentor's practical knowledge includes pedagogical knowledge in science education research. Usak's (2005) study shows that particular knowledge is needed by pre-service teachers such as content knowledge, preparation for teaching, classroom management, student assessment and evaluation. Indeed, many researchers have focused on pre-service teachers' development through effective mentoring practices. The research indicates that mentors need to provide pedagogical knowledge about planning (Jarvis et al. 2001; Schmidt 2008), timetabling (Williams 1993), teaching strategies (Fleer, Jane, and Hardy 2007; Hudson 2007; Schmidt 2008), problem solving (Breeding and Whitworth 1999), content knowledge (Lenton and Turner 1999), and implementation (Beck, Czerniak and Lumpe 2000).

Pre-service teachers learn through observation of their mentor's modelling of teaching practices; indeed these mentors become their role models (Dinkelman 2003; Okan and Yildirim 2004). Schmidt (2008) outlines the crucial role of modelling teaching strategies and ideas suggested by mentors in facilitating the mentee's professional growth. Pre-service teachers accept their mentors as models in terms of developing technical aspects of teaching such as instructional and classroom management skills or developing a teacher-student rapport (Loughran 1997). For example, Harrison, Dymoke, and Pell (2006) reveal the perceived role model of mentors for the planning, organization and delivery of instruction in the classroom. Schmidt highlights that the mentee can develop self-confidence by observing the mentor's practices and incorporating the mentor's feedback. A mentor's intervention that offers support can assist the mentee's development into the teaching profession (e.g., see Day 1999). The mentor's sustained feedback can be a critical factor for the mentee to meet the challenges of teaching (Schmidt 2008). Similarly, Rich and Hannafin (in press) reveal that pre-service teachers valued feedback from mentors as a way to monitor their teaching practices.

There are aspects that impede mentoring pre-service teachers in professional experience programmes with negative experiences that can affect the mentoring process (Sudzina and Coolican 1994). For example, McLaughlin (1993), Fullan and Hargreaves (1996), and Long (1997) have found collaborative environments that stifle innovation and reinforce traditional practice, even though this appears not to be the norm (Little 1993). Campbell and Kovar (1994) claim that typical mentoring problems occur in these four main areas: mentee's academic preparation, mentee's accountability, mentor's skills, and appropriateness of the professional experience site. Another pitfall to mentoring includes an over-dependence on the part of the mentee that may hinder the mentor (Heller and Sindelar 1991). Conversely, a mentee who excels may receive positive affirmations from others and even comparisons with the mentor's teaching ability which may 'show up' the mentor and, hence, create ego problems on the part of the mentor. The mentor's dual role as confidant and assessor may also create dilemmas. Benton (1990) claims that assessment procedures for determining the mentee's ability and application to teaching, and the whole process of assessment can be very stressful, which may lead to negative experiences if not managed successfully.

Broader concerns of mentees range from poor planning of the mentoring process to a lack of understanding of the mentoring process (Long 1997), and that mentors may concentrate more on training pre-service teachers to deliver the curriculum, rather than developing them as teachers (Edwards and Protheroe 2004). More specific concerns of mentees include: classroom management/discipline, student motivation, teaching techniques and catering for individual differences (Ellis 2001). These concerns are the reasons why there must be sound, sequential planning and an understanding of the mentoring process, which requires mentors to have knowledge of effective mentoring practices (Hudson 2007). Managing time is constantly a consideration for the mentor, including time to: interact with the mentee; discuss curriculum issues and lesson preparation/planning; debrief lesson observations; and, discuss future planning, which makes time efficiency an essential aspect for mentoring (Adams and Krockover 1997; Ganser 2002). Scott and Compton (1996) also claim that difficulties can exist regarding the time needed to develop a collegial mentor–mentee relationship. The time commitment required of mentors is high, especially for those mentees who require more assistance than others, which can be an additional burden to the mentor (Long 1997). This is a further reason for planning mentor–mentee interactions, so that the mentor’s time is focused, specific, and productive.

A mentoring theory and model for developing primary science teaching practices have been articulated in the *European Journal of Teacher Education* (Hudson 2004). This study explores and describes final-year pre-service teachers’ perceptions of their mentoring in primary science education within this theoretical mentoring model. This study employs an empirically-based instrument that focuses on the mentoring model to investigate mentees’ perceptions of their mentoring in primary science teaching.

Data collection method and analysis

The Mentoring for Effective Primary Science Teaching instrument (MEPST; Hudson 2007) focused on five factors for mentoring (i.e., Personal Attributes, System Requirements, Pedagogical Knowledge, Modelling, and Feedback). Items on the MEPST instrument have been empirically justified (Hudson, Skamp, and Brooks 2005). For example, statistical analysis of pre-service teachers’ responses ($n=331$) across the five-factor model indicated acceptable Cronbach alphas for each key factor, namely, Personal Attributes (mean scale score=2.86, $SD=1.08$), System Requirements (mean scale score=3.44, $SD=.93$), Pedagogical Knowledge (mean scale score=3.24, $SD=1.01$), Modelling (mean scale score=2.91, $SD=1.07$), and Feedback (mean scale score=2.86, $SD=1.11$) were .93, .76, .94, .95, and .92, respectively. Correlations and co-variances of the five factors were statistically significant ($p<.001$). Regression weights, which provided an indication of the relative contribution each variable makes to the specified factor were also statistically significant (range: .80 to 1.13; $p<.001$). Standardised regression weights ranged from .67 to .89 ($p<.001$), and all standard errors, which are a measure of how much the value of a test statistic varies from sample to sample, were minimal for all items ($\leq .01$; see Hudson, Skamp, and Brooks 2005). The five factors are articulated well in the literature for which this survey provides a direct link. Even though this instrument has been used in Australia for analysing mentoring practices in primary

science teaching, no data are available on the use of this instrument in other countries, particularly countries such as Turkey where English is taught as a Foreign Language (EFL).

Teacher education programmes in Turkey use a centralised curriculum, which is a result of reform efforts since 1998. In addition to the re-organisation of teacher education programmes, teacher training reforms placed strong emphasis on advancing field experiences in a more collaborative nature of university-school partnership, technology literacy, and special subject teaching courses. Primary science teachers are then educated through four-year undergraduate programmes that follow very similar coursework suggested by the Higher Education Council. These pre-service science teachers are required to undertake a number of courses (units) in the domains of general culture, science content, science teaching methods, and pedagogy (YOK 1998; Simsek and Yildirim 2001; Asan 2003; Cakiroglu and Cakiroglu 2003; Saban 2004; Savran-Gencer and Cakiroglu 2007). Four years of coursework in science education involves a total of 148 credit hours. Under the pedagogical domain, courses related to teaching in the school setting (including *School Experience and Practice Teaching*) constitute a total number of 11 credits (7.4% of the whole curriculum). The Higher Education Council has continued to implement further changes in teacher training content in the light of emerging needs of contemporary education. Furthermore, the Turkish Ministry of Education has promoted reforms that require changes to the pedagogical approaches offered in elementary and secondary education to incorporate constructivist and inquiry-based paradigms (Savran-Gencer and Cakiroglu 2007). Turkish universities conduct four-year courses (eight semesters) for educating primary science teachers. Each semester consists of 14 weeks with a total of 148 credits. Approximately six subjects have 18.5 credits in each semester though this can vary over the four years; nevertheless it averages as 18.5 credits x 8 semesters = 148 credit points for the course.

This study aims to articulate mentees' perceptions of existing mentoring practices linked to this instrument for mentoring in primary science teaching in Turkey. For this study, 211 mentees' perceptions of their mentoring were obtained from the MEPST instrument's five-part Likert scale (i.e., strongly disagree=1, disagree=2, uncertain=3, agree=4, strongly agree=5). Incomplete responses were discarded (Hittleman and Simon 2006). Data were subjected to an ANOVA (Hair et al. 1995; Kline 1998), and mean scale scores and descriptive statistics were derived through SPSS16. These pre-service teachers' responses represented 75% of the total cohort.

Results and discussions

The 211 completed pre-service teacher responses (117 female; 94 male) from three Turkish universities 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 or field experience). Thirty-two percent of these mentees ($n=211$) entered teacher education straight from high school, with 100% completing science units in their final two years of high school (i.e., Years 11 and 12). Seventy-five percent of mentees had completed six science methodology units at university, and 85% had completed three or more block field experiences (practicum) with 75% completing four professional experiences. There were no professional experiences under three

weeks. Mentees were required to teach at least 16 science lessons during their last practicum. All the mentees taught in city classrooms with 65% located in city centre districts.

Mentees indicated that most mentors (male=99, female=112) were over 40 years of age (42%) with 30% between 30 to 39 years of age, and 28% under 30. Mentees also claimed that 65% modelled five or more lessons during their mentees' practicum, however, 25% of mentors were perceived not to model a science lesson.

Five factors for effective mentoring in science

An ANOVA was conducted on the five factors using SPSS16. Mean scale scores on mentees' perceptions ($n=211$) of their mentors' practices fell within a 0.76 range (i.e., 3.36 to 4.12). ANOVA indicated that each of these five factors was highly significant ($p<.001$). Mentees perceived the mentoring factor, Feedback, as the most used practice of these mentors. Modelling science teaching practices and addressing System Requirements about science education were also perceived to be employed by these mentors. Yet, these mentees pointed out that their mentors' Pedagogical Knowledge and Personal Attributes were not as apparent as the previously mentioned factors (see Table 1).

The following provides further insight into specific data on the attributes and practices associated with each factor.

Personal attributes

Mentees recorded their responses about their mentors' personal attributes on the MEPST instrument. (Mean item score range: 2.07 to 4.43; *SD* range: 0.76 to 1.29; see Table 2 for percentage rank order). They indicated that 90% of their mentors were supportive towards their mentoring in primary science teaching with about two-thirds claiming that their mentors instilled confidence and positive attitudes for teaching primary science. Surprisingly, only 17% perceived that their mentors listened to them and aided them to reflect on their science teaching practices (see Table 2). Indeed, aiding mentees to reflect on their practices would require mentors to not only feel comfortable in talking about science (53%) with questions that elicit reflective pedagogical improvements but also listening attentively to their mentees in order to determine the quality of their mentees' reflections.

Table 1. Mean scale scores and ANOVAs for each of the five factors ($n=211$).

Factor	Mean scale score*	Range	Sum of Squares (items)	<i>df</i>	F ratio*
Personal Attributes	3.36	2.36	1118.80	5	205.37
System Requirements	3.75	1.97	417.98	2	191.37
Pedagogical Knowledge	3.46	3.01	1573.78	10	138.80
Modelling	3.83	1.99	604.51	7	75.26
Feedback	4.12	0.76	100.04	5	32.53

* All factors were statistically significant $p<.001$

Table 2. 'Personal attributes' for mentoring primary science teaching.

Mentoring practices	%*	Mean score	<i>SD</i>
Supportive	90	4.43	0.79
Instilled positive attitudes	69	4.05	1.09
Instilled confidence	67	3.91	1.00
Comfortable in talking	53	3.62	0.96
Assisted in reflecting	17	2.07	1.28
Listened attentively	17	2.08	1.29

* %, Percentage of mentees who either 'agreed' or 'strongly agreed' their mentor provided that specific mentoring practice.

System requirements

Items displayed under the factor, System Requirements, varied considerably. Mentees indicated strong support from their mentors for outlining science curriculum documents (92%), which was well above indications from other studies using the same MEPST instrument (e.g., Hudson 2007). Although 71% of mentees claimed that their mentors discussed aims for teaching science, only 26% discussed policies related to science teaching (Mean item score range: 2.68 to 4.65; *SD* range: 0.82 to 1.32, see Table 3). Policies guide the school's practices and need to be aligned with the science curriculum and related aims. Indeed, in some education systems (e.g., Australia, UK, US) policies are legal documents mandatory to a school's operations. Although data showed that policies may not be included in most mentors' practices, implementing departmental curriculum documents and discussing the aims of science education appeared on the agenda. These fundamental system requirements can provide pre-service teachers with knowledge about the education system related to the school setting. Hence, these mentees may only be given a partial picture of their education system requirements.

Pedagogical knowledge

Ninety-six percent of mentees claimed their mentors guided their preparation for teaching primary science with a majority indicating they also assisted in planning (76%), assessment (70%), articulating viewpoints about science teaching (69%), discussing questioning techniques (67%) and assisting with teaching strategies (57%). Nevertheless, the majority of mentors were perceived not to have mentored five of the 11 items associated with pedagogical knowledge, particularly science content

Table 3. 'System requirements' for mentoring primary science teaching.

Mentoring practices	%*	Mean score	<i>SD</i>
Outlined curriculum	92	4.65	0.82
Discussed aims	71	3.91	0.89
Discussed policies	26	2.68	1.32

* %, Percentage of mentees who either 'agreed' or 'strongly agreed' their mentor provided that specific mentoring practice.

Table 4. 'Pedagogical knowledge' for mentoring primary science teaching.

Mentoring practices	%*	Mean score	SD
Guided preparation	96	4.60	0.60
Assisted in planning	76	4.07	0.91
Discussed assessment	70	4.07	0.91
Provided viewpoints	69	4.05	1.09
Discussed questioning techniques	67	3.83	1.10
Assisted with teaching strategies	57	3.79	1.16
Assisted with classroom management	48	3.03	1.29
Discussed problem solving	45	3.60	1.02
Discussed implementation	37	2.91	1.37
Discussed content knowledge	25	2.55	1.30
Assisted with timetabling	6	1.58	1.00

* %, Percentage of mentees who either 'agreed' or 'strongly agreed' their mentor provided that specific mentoring practice.

knowledge and timetabling science lessons (mean item score range: 1.58 to 4.60; *SD* range: 0.60 to 1.37, see Table 4). Indeed, pedagogical knowledge about classroom management and implementing a science lesson was perceived to be provided by less than half these mentors. Pre-service teachers are involved in university studies about pedagogical knowledge and have more than one opportunity to be mentored in field experiences (practicum). However, these mentoring practices may be representative across field experiences as many of the same mentors are engaged in these field experiences regardless of the practicum level. This implies that many final-year pre-service teachers may not be provided with adequate pedagogical knowledge in the school setting to develop successful science teaching practices.

Modelling

Mean item scores (2.52 to 4.51; *SD* range: 0.81 to 1.33, see Table 5) indicated that the majority of mentors were perceived to model science teaching practices. Modelling classroom management (88%), primary science teaching (83%), and enthusiasm for

Table 5. 'Modelling' primary science teaching.

Mentoring practices	%*	<i>M</i>	<i>SD</i>
Modelled classroom management	88	4.51	1.12
Modelled teaching	83	4.32	0.81
Displayed enthusiasm	82	4.36	0.93
Modelled rapport with students	66	3.92	1.33
Used syllabus language	63	3.92	1.01
Modelled effective teaching	54	3.50	1.12
Demonstrated hands-on	45	3.60	1.01
Modelled a well-designed lesson	25	2.52	1.31

* %, Percentage of mentees who either 'agreed' or 'strongly agreed' their mentor provided that specific mentoring practice.

teaching science (82%) were perceived to be the most representative practices of these mentors. Yet, modelling effective teaching (54%), hands-on science activities (45%), and well-designed science lessons (25%) rated much lower on the mentees' responses (see Table 5). Although mentors were rated very high for articulating curriculum documents to their mentees (Table 3), this did not appear to match consistently with the mentors' use of syllabus language (Table 5).

Feedback

Mean item scores (3.95 to 4.66; *SD* range: 0.67 to 1.01, see Table 6) indicated that the majority of mentees 'agreed' or 'strongly agreed' that their mentors provided 'Feedback' as part of their mentoring practices in science teaching. As consistent with other studies (Hudson 2004, 2005, 2007), oral feedback on the mentees' teaching of science (84%) was rated much higher than written feedback (65%). The written feedback coincides with mentors' reviewing of their mentees' science lesson plans.

Summary and conclusion

ANOVA indicated that each of these five factors was statistically significant. Descriptive statistics further showed that the majority of mentors were perceived to assist their mentees in 24 of the 34 survey items. However, mentees claimed that nearly a third of the empirically-based mentoring practices outlined in this paper were not provided by their mentors. Despite very positive perceptions of mentoring in science education such as providing evaluation feedback, guiding their preparation, and being supportive for teaching science, mentees signalled mentors' practices that required improvement. Although the practices indicated in this study have been derived from the mentoring literature, cultural considerations may need to be explored to determine the applicability of these practices in English as Foreign Language countries. Yet, it appears that strategies such as 'assisting a mentee to reflect', 'listening attentively to the mentee' and 'assisting the mentee with timetabling' have been determined as effective mentoring practices that could be adopted in other countries. A limitation of this study involves the mentee's interpretation of the survey items, for example, it may be difficult for a mentee to determine if a mentor has listened attentively. Nevertheless, this survey is from the mentee's perspective, hence, from a two-way dialogue perspective, the mentee may

Table 6. Providing 'feedback' on primary science teaching.

Mentoring practices	%*	Mean score	<i>SD</i>
Provided evaluation on teaching	95	4.66	0.67
Provided oral feedback	84	4.32	0.90
Articulated expectations	70	3.89	0.92
Observed teaching for feedback	67	3.91	1.01
Provided written feedback	65	3.95	0.93
Reviewed lesson plans	65	3.95	0.93

* %, Percentage of mentees who either 'agreed' or 'strongly agreed' their mentor provided that specific mentoring practice.

have some indication on a five-part scale about a mentor's listening to the mentee. Although tertiary institutions facilitate an understanding about what may constitute 'classroom management', as an example, pre-service teachers' understandings of mentors' modelling of classroom management may require further clarification.

Mentees are in unique positions from an observational point of view. They are well placed to respond to their mentoring of primary science teaching as they are the recipients of such practices. Indeed, students who are recipients of teaching practices may have opportunities to evaluate their teachers. If students can evaluate their teachers on teaching performance or pre-service teachers can evaluate lecturers on tutoring practices, then mentees can equally evaluate their mentors' practices. However, it may be necessary for observational participants such as mentees to develop skills in evaluation, observation and giving feedback to reduce uncontrolled variables. The MEPST instrument provides a way to evaluate these practices in line with empirical evidence about mentoring. Moreover, these specific mentoring practices extracted from the research literature on generic mentoring can have applications to other subject areas such as mathematics (Hudson 2007) and English (Hudson and Millwater 2007).

The mentor's personal attributes, facilitating pedagogical knowledge, modelling practices, and providing constructive feedback should link with current literature if practices are to advance with the world's knowledge about teaching or conversely provide research evidence that may re-direct the mentoring process. The strong positive responses indicated that these mentors were prepared to assist their mentees' develop science teaching knowledge and skills; yet they may require further direction on specific-subject mentoring such as discussing content knowledge, timetabling, and other negatively-perceived items. These results affirm findings in other studies that also show areas of perceived strengths and weaknesses in mentoring. Mentoring may need to be more explicit for mentees to notice such practices or mentors may not exhibit these particular practices; either way this necessitates further education on mentoring practices that may not be apparent to the mentees. Importantly, mentees' perceptions of their mentors' practices may aid in determining mentoring needs. Hence, professional development programmes for mentors and mentees can target specific mentoring practices for advancing primary science teaching.

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References

- Adams, P., and G. Krockover. 1997. Concerns and perceptions of beginning secondary science and mathematics teachers. *Science Education* 81: 29–50.
- Asan, A. 2003. School experience course with multimedia in teacher education. *Journal of Computer Assisted Learning* 19: 21–34.
- Bainer, D.L. 1997. With a new lens: How partnering impacts teachers' views of and approaches to teaching science. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL. (March 1997).
- Beck, J., C.M. Czerniak, and A.T. Lumpe. 2000. An exploratory study of teachers' beliefs regarding the implementation of constructivism in their classrooms. *Journal of Science Teacher Education* 11, no. 4: 323–43.
- Benton, P., ed. 1990. *The Oxford internship scheme: Integration and participation in initial teacher education*. London: Calouste Gulbenkian Foundation.
- Breeding, M., and J. Whitworth. 1999. Increasing the success of first- year teachers: A synthesis of three studies. Paper presented at the annual meeting of the American Association of Colleges for Teacher Education, Washington, DC. (February 1999).
- Cakiroglu, E., and J. Cakiroglu. 2003. Reflections on teacher education in Turkey. *European Journal of Teacher Education* 26: 253–64.
- Campbell, K., and S.K. Kovar. 1994. Fitness/Exercise science internships: How to ensure success. *Journal of Physical Education, Recreation and Dance* 65, no. 2: 69–72.
- Day, C. 1999. Professional development and reflective practice: Purposes, processes and partnerships. *Pedagogy, Culture & Society* 7, no. 2: 221–33.
- Dinkelman, T. 2003. Self-study in teacher education a means and ends tool for promoting reflective teaching. *Journal of Teacher Education* 54, no. 1: 6–18.
- Edwards, A., and L. Protheroe. 2004. Teaching by proxy: Understanding how mentors are positioned in partnerships. *Oxford Review of Education* 30, no. 2: 183–97.
- Ellis, J.A. 2001. A dilemma in reforming science teacher education: Responding to students' concerns or striving for higher standards. *Journal of Science Teacher Education* 12, no. 3: 253–76.
- Fleer, M., T. Hardy, and B. Jane. 2007. *Science for children*. Sydney, Australia: Prentice Hall.
- Freese, A.R. 1999. The role of reflection on pre-service teachers' development in the context of a professional development school. *Teaching and Teacher Education* 15: 895–909.
- Fullan, M., and A. Hargreaves. 1996. *What's worth fighting for in your school?* New York: Teachers College Press.
- Galbraith, M.W., and N.H. Cohen, eds. 1995. *Mentoring: New strategies and challenges*. San Francisco, CA: Jossey-Bass.
- Ganser, T. 1996. Preparing mentors of beginning teachers: An overview for staff developers. *Journal of Staff Development* 17, no. 4: 8–11.
- Ganser, T. 2002. How teachers compare the roles of cooperating teacher and mentor. *Educational Forum* 66, no. 4: 380–85.
- Hair, J.F., R.E. Anderson, W.C. Black, and R.L. Tatham. 1995. *Multivariate data analysis with readings*. 4th ed. New York: Prentice-Hall.
- Harrison, J., S. Dymoke, and T. Pell. 2006. Mentoring beginning teachers in secondary schools: An analysis of practice. *Teaching and Teacher Education* 22: 1055–67.
- Heller, M.P., and N.W. Sindelar. 1991. Developing an effective teacher mentor program. Fastback 319. *Phi delta kappa*. Bloomington, IN: Educational Foundation.
- Hittleman, D.R., and A.J. Simon. 2006. *Interpreting educational research: An introduction for consumers of research*. Upper Saddle River, NJ: Prentice-Hall.
- Hudson, P. 2004. Specific mentoring: A theory and model for developing primary science teaching practices. *European Journal of Teacher Education* 27, no. 2: 139–46.

- Hudson, P. 2007. Examining mentors' practices for enhancing pre-service teachers' pedagogical development in mathematics and science. *Mentoring & Tutoring: Partnership in Learning* 15, no. 2: 201–17.
- Hudson, P., L. Brooks, and K. Skamp. 2005. Development of an instrument: Mentoring for effective primary science teaching. *Science Education* 89, no. 4: 657–74.
- Hudson, P., and J. Millwater. 2007. Mentoring for effective teaching of writing in the primary school. Paper presented at Australian Teachers Education Association (ATEA) Conference, Wollongong, NSW. (July 2007).
- Jarvis, T., D. Coates, F. McKeon, and J. Vause. 2001. Beyond generic mentoring: Helping trainee teachers to teach primary science. *Research in Science and Technological Education* 19, no. 1: 5–23.
- Kline, R.B. 1998. *Principles and practices of structural equation modeling*. New York: The Guildford Press.
- Lenton, G., and G. Turner. 1999. Student-teachers' grasp of science concepts. *The Journal for Science Education* 81, no. 295: 67–72.
- Little, J.W. 1993. Teacher's professional development in a climate of educational reform. *Educational Evaluation and Policy Analysis* 15, no. 2: 129–51.
- Long, J. 1997. The dark side of mentoring. *The Australian Educational Researcher* 24, no. 2: 115–33.
- Loughran, J.J. 1997. Learning through modeling: Developing pre-service teachers' understanding of reflection. *Teaching Education* 8: 23–8.
- McLaughlin, M.W. 1993. What matters most in teachers' workplace context? In: J.W. Little and M.W. McLaughlin, eds. *Teachers' work: Individuals, colleagues, and contexts* 79–103. New York: Teachers' College Press.
- Norman, P.J., and S. Feiman-Nemser. 2005. Mind activity in teaching and mentoring. *Teaching and Teacher Education* 21: 679–97.
- Okan, Z., and R. Yildirim. 2004. Some reflections on learning from early school experience. *International Journal of Educational Development* 24: 603–16.
- Rich, P., and M. Hannafin. Forthcoming. Capturing and assessing evidence of student teacher inquiry: A case study. *Teaching and Teacher Education*.
- Saban, A. 2004. Prospective classroom teachers' metaphorical images of selves and comparing them to those they have of their elementary and cooperating teachers. *International Journal of Educational Development* 24: 617–35.
- Savran-Gencer, A., and J. Cakiroglu. 2007. Turkish pre-service science teachers' efficacy beliefs regarding science teaching and their beliefs about classroom management. *Teaching and Teacher Education* 23: 664–75.
- Schmidt, M. 2008. Mentoring and being mentored: The story of a novice music teacher's success. *Teaching and Teacher Education* 24: 635–48.
- Schneider, R. 2008. Mentoring new mentors: Learning to mentor pre-service science teachers. *Journal of Science Teacher Education* 19, no. 2: 113–16.
- Scott, N.H., and E. Compton. 1996. *Report on the 1995–1996 beginning teacher induction program in New Brunswick*. New Brunswick, Canada. (ERIC Document Reproduction Service No. ED403246).
- Simsek, H., and A. Yildirim. 2001. *The reform of pre-service teacher education in Turkey*. In: R.G. Sultana, ed. *Challenge and change in the Euro-Mediterranean region*, 411–30. New York: Peter Lang.
- Sudzina, M.R., and M.J. Coolican. 1994. Mentor or tormentor: The role of the cooperating teacher in student teacher success. Paper presented at the annual meeting of the Association of Teacher Educators, Atlanta, Georgia.
- Sundli, L. 2007. Mentoring—A new mantra for education? *Teaching and Teacher Education* 23, no. 2: 201–14.
- Usak, M. 2005. Prospective elementary science teachers' pedagogical content knowledge about flowering plants. Doctoral Thesis, Ankara.

- Williams, A. 1993. Teacher perceptions of the needs as mentors in the context of developing school-based initial teacher education. *British Educational Research Journal* 19, no. 4: 407–20.
- YOK. 1998. *Egitim fakultesi ogretmen yetistirme lisans programlari* (Undergraduate teacher education programs of the faculties of education). Ankara: YOK.