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Jordanian Preservice Primary Teachers' Perceptions of Mentoring in Science Teaching

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Quality mentoring is fundamental to preservice teacher education because of its potential to help student and novice teachers develop the academic and pedagogical knowledge and skills germane to successful induction into the profession. This study focused on Jordanian preservice primary teachers' perceptions of their mentoring experiences as these pertain to science teaching. The Mentoring for Effective Primary Science Teaching instrument was administered to 147 senior preservice primary teachers in a university in Jordan. The results indicated that the greater majority of participants did not experience effective mentoring toward creating a supportive and reflexive environment that would bolster their confidence in teaching science; further their understanding of primary science curriculum, and associated aims and school policies; help with developing their pedagogical knowledge; and/or furnish them with specific and targeted feedback and guidance to help improve their science teaching. Substantially more participants indicated that their mentors modeled what they perceived to be effective science teaching. The study argues for the need for science-specific mentoring for preservice primary teachers, and suggests a possible pathway for achieving such a model starting with those in-service primary teachers—much like those identified by participants in the present study—who are already effective in their science teaching.

Keywords: *Perceptions; Preservice; Mentoring; Primary science*

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Introduction and Literature Review

The process of mentoring preservice teachers is crucial to any teacher education program. Albeit varied in terms of the degree of formality and structure of the mentoring relationship, in most cases, preservice teachers are mentored either by their assigned cooperating (i.e. in-service) classroom teacher—as was the case in the present study—or through the coordinated and joint efforts of their cooperating teacher and university supervisor (Ganser, 2006). Mentors can substantially impact the choices that individuals make, how much confidence they have in making such choices, and how likely they are to achieve their goals (Clutterbuck, 2004). The benefits of mentoring apply not only to teacher mentees, but also to mentors and schools (Hobson, Ashby, Malderez, & Tomlinson, 2009; Jarvis, McKeon, Coates, & Vause, 2001; Nilsson & Van Driel, 2010). Many researchers have focused on the benefits of effective mentoring practices. Harrison, Dymoke, and Pell (2006) argued that mentors bear some professional responsibility to induce particular changes in the professional beliefs, values, and behaviors of novice teachers. The modeling of effective teaching by mentors, and effective mentor–mentee communication enable preservice teachers to emulate effective teaching practices and provide them with emotional support and task assistance (Hennissen, Crasborn, Brouwer, Korthagen, & Bergen, 2011; Roehrig, Bohn, Turner, & Presselly, 2008). Clutterbuck (2004) clustered the benefits of mentoring in four outcome categories for mentees: development of knowledge, and technical and behavioral competence (development outcomes); achievement of career goals (career outcomes); planning for professional growth and learning resources (enabling outcomes); and increased confidence (emotional outcomes).

Similarly, in science education, mentors and quality mentoring programs can provide guidance and support that enable mentees to develop and support K-12 students' science learning. Furthermore, effective mentoring can help develop preservice teachers' personal knowledge of science and their pedagogical knowledge for science teaching (Parker, 2004; Schneider, 2008). Enabling preservice teachers to develop such knowledge and expertise is crucial to achieving contemporary goals of science education, which are focused on preparing a 'scientifically literate' citizenry, as well as students who are motivated and qualified for science-related college studies and careers. The *National Science Education Standards* (National Research Council [NRC], 1996, 2012) and *Next Generation Science Standards* (NGSS Lead States, 2013), for example, provide guidance toward achieving these goals. Briefly, recent science education reform efforts envision science classrooms that engage students with learning science as communities of practice where students inquire and learn collaboratively, while engaged with practices that simulate authentic scientific practices, such as argumentation, modeling, and communication. Needless to say, accomplishing such ambitious vision and goals requires highly qualified teachers of science—including elementary teachers—whose preparation is necessarily enhanced by capable and effective mentors (Hudson & McRobbie, 2003; Hudson & Skamp, 2002).

A number of research studies show that mentoring practices related to preservice elementary teachers in science do not live up to expectations (Bradbury & Koballa, 2007; Ekiz, 2006; Hudson, 2002, 2005; Hudson & Skamp, 2002; Hudson, Usak, & Savran-Gencer, 2009, 2010; Nilsson &Van Driel, 2010). For example, Hudson (2002) reported that mentors do not generally model science teaching practices, and most mentees do not have opportunities to observe experienced teachers in a primary science teaching setting. Hudson and Skamp (2002) revealed that a considerable number of preservice primary teachers received limited mentoring experience and limited assistance in teaching primary science. Hudson et al. (2009, 2010) found that the majority of mentors in their studies were not engaged with most of the effective mentoring practices assessed by the Mentoring for Effective Primary Science Teaching (MEPST) instrument (Hudson, Skamp, & Brooks, 2005), and that many mentees were not enabled to develop the sort of pedagogical knowledge needed for implementing successful science teaching practices. Indeed, in his survey of nine Australian universities, Hudson (2005) found that a majority of mentors did not provide mentees with the required mentoring in primary science teaching in relation to the educational system, pedagogical knowledge, and modeling components addressed in the MEPST instrument. Ekiz (2006) also documented a lack of mentor–mentee communication and mentor support. More importantly, Ekiz reported an absence of shared understandings about the mentoring process between school-based classroom mentors and institutions of teacher education. One manifestation of the absence of the latter understanding, Ekiz found, was that mentors tended to provide feedback to student teachers that was not grounded in actual classroom observation of their mentees. Instead, mentors often left the classrooms as their mentees enacted their lessons and, instead of firsthand observation, the mentors relied on self-report data and asked student teachers to tell them how their lesson unfolded after they had concluded their teaching.

The aforementioned research results suggest that, when it comes to science, much could not be expected from in-service primary teachers in terms of serving as mentors who would develop student teachers' practice in science instruction. This research-supported expectation can be categorized into two interconnected and interdependent limitation domains: limitations related to primary teachers' professional preparation and limitations related to mentoring programs. Regarding the first domain, research has long established that primary teachers often are certified with very limited content expertise in science, where their college preparation often amounts to a few credit hours of general science courses (Epstein & Miller, 2011; Lewis, Dema, & Harshbarger, 2014; Stake, Easley, & Anastasiou, 1978). As a result, preservice and in-service elementary teachers often have limited scientific knowledge, and many subscribe to alternative, naïve conceptions of the very scientific concepts they are expected to teach (Jale & Boone, 2002; Koc, 2006; Kruger & Summers, 1990; Sarikaya, 2004; Schoon & Boone, 1998). This pattern, Jarvis et al. (2001) noted, applied to the majority of elementary teachers in several nations, including the UK, the USA, Austria, South Africa, and Italy. These results also have been confirmed in Jordan (Abed 2009; Ibrahim, 2005).

This lack of content preparation has prompted calls for the dire need to engage elementary teachers with substantial professional development programs toward deepening their science content knowledge and understandings (Fulp, 2002).

Primary teachers, thus, often have relatively low self-efficacy related to, and are apprehensive toward, teaching science (Epstein & Miller, 2011; Lewis et al., 2014; Stake et al., 1978). When it comes to science, Allen (2006) noted, elementary school teachers have to negotiate three apprehensions: they do not like science, do not feel confident in their science knowledge, and do not know how to teach science effectively. For instance, Appleton and Kindt (1999) reported that the early childhood and elementary teachers in their study lacked self-confidence in teaching science and were hesitant to teach the subject. Because they lacked confidence, ability, and enthusiasm, elementary teachers often resort to didactic teaching methods and fail to meaningfully address questions from their students (also see, Dunlop & Fraser, 2007; Osborne & Simon, 1996). In other words, many in-service primary teachers lack pedagogical content knowledge (PCK) (Goodnough & Hung, 2009; Nilsson & Loughran, 2012), which would enable them to design and enact—and by extension to model for their mentees—effective science instruction (Jarvis et al., 2001). Clearly, many in-service elementary teachers share the same issues related to effective science teaching as their preservice counterparts.

The second domain of limitation is related to mentoring programs or, more accurately, the lack thereof. It goes without saying that effective mentoring requires well-prepared mentor teachers who are able to deliver on the roles and tasks entrusted to them. Effective mentors are able to address specific issues, which are pertinent to the specific attributes and practices of the target content area (Feiman-Nemser & Parker, 1990; Hudson & Skamp, 2002; Peterson & Williams, 1998). Unfortunately, the current prevailing modalities for the preparation of elementary teachers hinder such a possibility chiefly because programs are rather generic (as opposed to discipline specific) in their approach to preparing elementary teachers and, at best, incorporate informal opportunities for developing teacher mentors. Thus, as Hudson (2004, 2005) pointed out, primary teachers who mentor their preservice colleagues may not have had formal training in mentoring, relevant and content-specific mentoring expertise (as compared to knowledge of generic instructional methods), or personal experiences with successful models for mentoring to guide the growth of their mentees in primary science.

Theoretical Framework: Need for Effective, Science-Specific Mentoring in Elementary Teaching

There continues to be diverse perspectives on mentoring theory, the processes and attributes of mentoring relationships, and the roles of mentors and mentees in the context of the education of preservice teachers and the induction of beginning teachers, as well as other contexts for mentoring (Bozeman & Feeney, 2007; Chu, 2013; Rice, 2006; Roberts, 2000). For instance, Rice (2006) noted that the term mentoring often is used to refer to a combination of coaching, counseling, assessment, and career development, thus invoking several theories and processes associated with teaching, learning, and reflective practice (Chu, 2013), as well as varying degrees of structure or formalism. The present study draws on the theory and model for mentoring developed by Hudson (2004) and Hudson and McRobbie (2003), which are built on constructivist learning theory, and specifically speaks to mentoring in the context of elementary science teaching. The approach of Hudson and his colleagues is quite useful because it pays particular attention to a central dilemma in the mentoring of elementary teachers in science. This dilemma, as will become evident in the discussion in the following, derives from the fact that, unlike with most cases of mentoring relationships that pair a relative novice with a relative expert in a field, the mentor (in-service elementary teacher) and the mentee (preservice elementary teacher) in most cases share less-than-optimal preparation in science content, as well as poor attitudes toward science and low self-efficacy toward science teaching. In other words, the mentors in many cases hardly are 'experts' when it comes to supporting their preservice counterparts as they attempt to teach science to elementary students.

Science mentoring often seems marginalized and left more to chance, when it should be central to elementary teacher education, as well as carefully planned and delivered by qualified and trained mentors (Ganser, 1996). Mentors need to be aware of, and trained to undertake, their roles and responsibilities, rather than be assigned to conduct their positions without previous preparation (Holloway, 2001). Clutterbuck (2004) stressed the importance of formal mentoring, which explicates specific goals for the mentor–mentee relationship, clarifies their roles, and discourages inefficient and ineffective practices. After all, mentors need to enable mentees to think rigorously and reflectively (Roger & Barrie, 2008). Mentors are not only supervisors and evaluators, but also champions of novice teachers' success (Mullen, 2005). Excellent mentors need to exhibit skills in listening, caring, communicating openly, and giving constructive feedback (Johnson & Ridley, 2004). In this regard, Hobson et al. (2009) remarked that being an effective and experienced teacher is necessary but insufficient to make an effective mentor. The careful selection and preparation of mentors are a major factor, which can maximize the potential benefits of mentoring.

The research literature strongly supports the need and necessity for preparing and training mentor teachers. Evertson and Smithey (2000) reported that trained mentors were able to support teachers as they developed sophisticated teaching skills, organized and managed their instruction effectively, and established more workable classroom routines. Long (1997) and Hudson (2007) emphasized that helpful mentoring cannot be indiscriminate or handled haphazardly; rather, it must be intentional, planned, and sequentially organized. In this sense, mentoring is not a disposition or an instinctive activity, which can be carried out by good practitioners. Instead, mentoring consists of a set of skills that need to be learned (Edwards & Collison, 1996, as cited in Jarvis et al., 2001). Structured mentoring programs must be considered as a new approach for developing elementary science teaching (Hudson & Skamp, 2002; Hudson et al., 2005).

In response to the limitations of the generic mentoring of primary teachers, many researchers have called for the transition to subject-specific mentoring. Hudson and

McRobbie (2003) and Hudson (2004) put forth a theory and model which argued that content-specific mentoring interventions is central to enhancing the professional experiences of preservice elementary teachers. Hudson et al. (2010) suggested benchmarking mentoring practices, such as the set of dimensions and associated mentor actions outlined in the MEPST (Hudson et al., 2005) (see the discussion of the MEPST). Jarvis et al. (2001) found that support materials consisting of checklists focused on science mentoring (in relation to nature of science, science learning objectives, and addressing students' naïve conceptions), rather than generic mentoring, improved the practices of both mentors and mentees in science teaching. Drawing on constructivist theory, Hudson (2004) remarked that the effective mentor could build mentees' beginning knowledge of science teaching toward more complex and specific science teaching knowledge.

Currently, there is a dearth of systematic empirical studies in Jordan of mentoring elementary teachers in science teaching. We could identify a single published study, which examined the experiences of two preservice elementary science teachers and their mentors (Qabalan, Khasawneh, & Al-Momani, 2009). Consistent with the primary author's experiences in his capacity as a science teacher educator in Jordan, the little empirical evidence available (Qabalan et al., 2009) suggests a parallel need for effective, science-specific mentoring in the context of elementary teacher education programs. The primary author's informal discussions with both prospective teachers and their mentors repeatedly suggest that the latter mostly are interested in, and focus on, working with preservice elementary teachers in the areas of Arabic language and mathematics teaching. Only a minority of mentors would express a specific or serious interest in focusing on science teaching. Thus, toward establishing a baseline of, and characterizing, the sort of mentoring practices in elementary science teaching, the present study investigated a group of Jordanian preservice elementary teachers' perceptions of their mentoring experiences for teaching science. Before detailing the purpose and methods of the study, it should prove beneficial to discuss the educational system in Jordan and the characteristics of preservice primary teacher education programs in Jordanian universities.

Context of the Study: School and Teacher Education in Jordan

The Educational System in Jordan

School education in Jordan has two main stages: elementary and secondary. The elementary stage is compulsory and spans 10 years. All children at the age of 6 are required to attend elementary school. The secondary stage is optional and lasts for 2 additional years. Based on their cumulative grade point average during the last 3 years of the elementary stage, secondary students are tracked into multiple academic streams, including scientific, literary, industrial sciences, Islamic studies, and information technology streams. The elementary stage is further divided into two cycles: the lower elementary cycle, which is called the primary stage (grades 1–3), and upper elementary cycle (grades 4–10). One teacher (i.e. a homeroom teacher), who typically holds a bachelor degree in education with a major as 'Class Teacher', teaches all academic subjects (with the exception of English) to students in the lower elementary or primary cycle. These subjects include Arabic language, mathematics, science, vocational education, Islamic education, social studies, and art and physical education. In the upper elementary and secondary stages, specialized teachers teach the different academic subjects.

Primary School Teacher Education in Jordan

In Jordan, preservice primary (grades 1–3) school teachers enroll in 4-year teacher education programs. All faculties of education in Jordanian universities prepare preservice primary teachers in generic programs to teach primary students all the aforementioned academic subjects, with the exception of English language. These preparation programs require preservice primary teachers to take two to three 3-credit-hour science and science methods courses. The courses bear different names in different universities (e.g. Scientific Concepts and Their Teaching Methods I and II, Concepts in Natural Sciences, Science Teaching Methodologies, Science for Elementary School Teachers I and II, and Teaching Science for Beginners). Nevertheless, these courses have similar syllabi.

Mentoring Preservice Primary Teachers in Jordan

In its Educational Reform Plan of 1987, the Jordanian Ministry of Education took steps to improve educational supervision for both preservice and in-service teachers. This was done, on the one hand, by increasing the number of educational supervisors and, on the other hand, by introducing 'Practical Education' (i.e. supervised student teaching experiences) into preservice teacher education programs across Jordanian faculties of education. The Jordanian central educational authorities introduced the mentoring of preservice teachers 'for the first time in 1996 when the preservice teacher training courses in the State Universities were established' (Momany & Cullingford, 2006, p. 87). In their final or senior year in teacher education, all preservice primary teachers are assigned to approved schools, called 'cooperating school', to teach the primary stage (grades 1–3) students for a full, 4-month scholastic semester. Cooperating schools are selected on the basis of administrative criteria and practical considerations, such as being closest to the preservice teacher residence, and the number of available classrooms and placements.

Cooperating school principals serve as focal contacts for preservice primary teachers during their student teaching. Principals support student teachers, provide them with needed resources, and introduce them to school administrative rules and regulations (Momany & Cullingford, 2006). Principals also assign a mentor (a cooperating teacher) to each student teacher. Such assignment is not based on any criteria or stipulations articulated by the university. For instance, there are no criteria related to pertinent training in mentorship, years of teaching experience, or other qualifications to guide principals as they assign mentors to preservice teachers. Thus, every primary teacher in a cooperating school likely will be assigned a student teacher. Furthermore, selected mentor teachers have no option to decline participating in the mentoring process, even though they receive no additional compensation or other incentives for taking on the role of mentor.

Each student teacher is assigned a university tutor or supervisor who coordinates the relationship between cooperating schools and the university, and is the only university personnel to visit with student teachers during their internship (Momany & Cullingford, 2006). University supervisors and school mentors share similar duties. Working alongside a university supervisor, mentors participate in assessing student teachers' performance during their internship, familiarizing them with curricula and instructional resources, and managing their learning about teaching (Al-Sagarat, 1999, as cited in Momany & Cullingford, 2006). At the outset of student teaching, mentors maintain a substantial presence in a student teacher's classroom: they attend several sessions and observe student teachers as they enact their lessons. Mentors progressively reduce such classroom presence as preservice teachers advance through their student teaching (Momany & Cullingford, 2006; Owais, 1999, as cited in Momany & Cullingford, 2006). In comparison, university tutors are supposed to conduct a fixed number of—usually three—supervisory and evaluation visits for each student teacher during their internship.

Educators and researchers have noted that the afore-described mentoring model in Jordan has not fulfilled its objectives and seems to be less than ideal (Al-Hawamleh, 1999, as cited in Al-Jamal & Cullingford, 2006; Drummond, 1998, as cited in Al-Jamal & Cullingford, 2006). Al-Jamal and Cullingford (2006) attributed this state of affairs to a lack of clarity in conceptualizing and defining the role of mentor teachers, less-than-adequate implementation strategies for the Ministry of Education 1996 policies on mentoring, and the attachment of unrealistic expectations to these policies and implementation. The seeming lack of effective mentoring of preservice teachers in Jordan is especially critical given that systematic and sustained professional development for in-service Jordanian teachers is neither mandated nor encouraged or meaningfully enacted. Thus, as preservice teachers join the teaching profession, they do not necessarily expect to benefit from the positive impacts on their practice anticipated from engagement with professional development, such as nurturing their abilities and teaching competencies toward fostering students' motivation (Cherubini, Zambelli, & Boscolo, 2002; Vogt & Rogalla, 2009), implementing instructional innovations (Ermeling, 2010), and/or improving student learning outcomes (Lovett et al., 2008). In the absence of systematic professional development for in-service teachers in Jordan, it could be argued that, to a significant extent, the mentoring that preservice primary teachers receive in the context of their teacher education programs might as well—as least currently and in the foreseeable future—be one of the most significant factors impacting their practice.

As noted earlier, there currently are no national policies or common practice in Jordan for training mentor teachers. Mentors, thus, are not expected to have developed or to display shared understandings of, or sets of skills and practices specific to, effective mentorship of preservice or novice teachers. Additionally, the aforementioned absence of any formal criteria for the selection and assignment of mentor teachers to primary student teachers entails that all in-service teachers in a given school could potentially serve as mentors. It follows that mentors could span the spectrum in terms of their teaching experience and expertise, effectiveness and success in their own classroom teaching, and the specific practices and approaches they adopt to mentor their student teachers. It is safe to assume, then, that existing mentoring practices in Jordan are widely varied and potentially have differential impacts on the experiences and professional growth of student teachers, hence the focus of the present study on characterizing the sorts of mentoring practices experienced by Jordanian preservice primary teachers.

Purpose

The present study was descriptive in nature and aimed to establish a baseline of, and characterize, the sort of mentoring practices experienced by Jordanian preservice primary teachers in the context of teaching science. The following research question guided the study: What are the perceptions of Jordanian senior preservice primary teachers of the mentoring practices they experienced in the context of teaching science during their student teaching internship?

Method

As noted earlier, effective mentorship for preservice teachers in Jordan is, at best, poorly conceptualized, and there currently exists no explicit articulation of associated or espoused mentoring practices. Thus, there was a need to anchor the present survey of student teachers' experiences with mentoring in an articulate framework for mentorship and associated practices. Toward this end, the study used the MEPST instrument (Hudson et al., 2005), which was administered to a group of Jordanian senior preservice primary teachers toward the conclusion of their school practicum experiences. University tutors explained the aim of the study when they met with student teachers during supervisory visits, distributed the survey to participants, supervised its completion on site (i.e. at the student teachers' cooperating schools), and returned the completed surveys to the researchers.

Participants

Participants were 147 female preservice primary teachers (100% response rate) enrolled in the fourth and final year of their teacher education program at a university in Jordan. It is important to recall that the curricula, structure, and experiences in preservice primary teacher education are fairly standard across Jordanian faculties of education. All participants had completed two college-level science content courses and one science methods course during their years in teacher education. However, their secondary science content background knowledge differed substantially. Enrollment in primary (lower elementary cycle or grades 1–3) teacher education programs in

Jordan is limited to secondary school graduates who were tracked into three of the five aforementioned secondary streams; namely, the scientific, literary, and information technology streams. Only 32 of the 147 participants (22%) came from the secondary science stream, which entails having completed four courses in science: biology, chemistry, physics, and geology. In comparison, participants who came from the literary (64%) and information technology (14%) streams had not completed any of these secondary science courses.

At the time of completing the MEPST survey, the majority of participants (80%) reported having taught five or more science lesson during their student teaching internship. Another 15% reported having taught three or four lessons, and the remaining participants indicated that they only taught one or two lessons during their time at the cooperating schools.

All mentors who worked with participants in the study were female. The ages of 15% of the mentors ranged from 22 to 29 years, 49% from 30 to 39 years, and 36% of the mentors were 40 years or older. Participants reported that they had observed all the science lessons taught by their mentors, and indicated that 82% of mentors had taught more than three science lessons during the practicum period. Sixty-five percent of participants 'disagreed' and 'strongly disagreed' that science was one of their mentors' strongest subject areas.

The MEPST Instrument

The MEPST (see Table 1) was developed and validated by Hudson and his colleagues (Hudson, 2005, 2007; Hudson et al., 2005) specifically for use with mentoring in the context of primary science teaching. The authors reported a five-factor structure for the final, 34-item MEPST with fairly high Cronbach alpha coefficients of reliability as follows: personal attributes (.93), system requirements (.76), pedagogical knowledge (.94), modeling (.95), and feedback (.92), as well as strong model fit indices (e.g. $\chi^2 =$ 1,335, df = 513, and the RMSEA (Root Mean Square Error of Approximation) = .07, $p < .0001$) (see Hudson et al., 2005). The five factors or dimensions refer to clusters of mentor attributes and/or practices that typify effective mentoring in primary science teaching. Respondents specify their extent of agreement or disagreement on a 5-point Likert scale (strongly disagree = 1, disagree = 2, uncertain = 3, agree = 4, and strongly agree = 5) about whether 'during my final professional school experience (internship/practicum) in primary science teaching my *mentor*' (Hudson et al., 2005, p. 670, italics in original) exhibited or modeled the target set of attributes and practices.

The *personal attributes* dimension (six items) refers to a mentor's personal characteristics when dealing with mentees, such as being attentive to ('listened to me when discussing science teaching practices') and supportive of ('was supportive of me for teaching science') his/her mentee. *System requirements* (three items) refer to the mentor's understanding of the content of the primary science curriculum ('outlined state science curriculum documents to me'), and of relevant aims ('discussed with me the aims of science teaching') and policies ('discussed with me the school

Table 1. Means and SD for MEPST factors and mentoring attributes and practices ($N = 147$)

MEPST item[a] (showing target mentoring attribute or practice)	% A/SA[b]	*M*	SD
Personal attributes factor		2.90	0.64
Was supportive of me for teaching science	40	3.03	1.08
Seemed comfortable in talking with me about science teaching	40	3.01	1.05
Assisted me to reflect on improving my science teaching practices	32	3.01	0.98
Instilled positive attitudes in me toward teaching science	31	2.93	0.97
Listened to me when discussing science teaching practice	23	2.73	0.98
Made me feel more confident as a teacher of primary science	20	2.67	0.96
System requirements factor		2.67	0.70
Discussed with me the aims of science teaching	25	2.75	1.03
Outlined state science curriculum documents to me	20	2.55	1.04
Discussed with me the school policies used for science teaching	20	2.70	0.94
Pedagogical knowledge factor		2.83	0.60
Discussed with me questioning skills for effective science teaching	37	2.99	1.08
Assisted me with implementing science teaching strategies	35	3.07	1.07
Provided strategies for me to solve my science teaching problems	35	3.06	1.00
Guided me with science lesson preparation	35	2.89	1.25
Gave me clear guidance for planning my science teaching	33	2.93	1.03
Discussed with me the knowledge I needed for teaching science	33	2.92	1.02
Assisted me with classroom management strategies for science teaching	33	2.76	1.23
Assisted me with timetabling my science lessons	28	2.57	1.27
Gave me new viewpoints on teaching primary science	29	2.81	1.01
Showed me how to assess the students' learning of science	19	2.61	0.98
Developed my strategies for teaching science	18	2.55	0.93
Modeling factor		3.23	0.64
Was effective in teaching science	53	3.37	1.01
Modeled effective classroom management when teaching science	51	3.23	1.09
Used hands-on materials for teaching science	50	3.31	1.18
Had well-designed science activities for the students	50	3.22	1.14
Had a good rapport with primary students doing science	48	3.32	1.05
Displayed enthusiasm for teaching science	47	3.28	1.07
Modeled science teaching	46	3.29	0.93
Used science language from the current primary science syllabus	35	2.82	1.18
Feedback factor		2.77	0.53
Observed me teach science	41	3.10	1.22
Clearly articulated what I needed to do to improve my teaching of primary science	22	2.86	0.96
Discussed evaluation of my science teaching	22	2.61	1.09
Reviewed my science lesson plans	21	2.61	1.00
Provided oral feedback on my science teaching	19	2.56	0.99
Provided written feedback on my science teaching	16	2.87	0.77

[a]From Hudson et al. (2005, pp. 670–671). Note that the Arabic translation of some MEPST items feature slight changes to accommodate linguistic nuances and the context of the study.

[b]Percent of participants who 'agreed' or 'strongly agreed' that their mentor exhibited attribute or practice.

policies used for science teaching') requisite to the implementation of quality science education in primary classrooms. The *pedagogical knowledge* dimension (11 items) speaks to the mentor's knowledge and skills related to effective science teaching in primary classrooms, such as planning ('had well-designed science activities for the students'), scheduling ('assisted me with timetabling my science lessons'), teaching strategies ('was effective in teaching science'), and questioning ('discussed with me questioning skills for effective science teaching'). *Modeling* (eight items) refers to the extent to which a mentor exhibits in his or her own instruction effective science teaching behaviors, which could be internalized by a student teacher, such as modeling enthusiasm ('displayed enthusiasm for teaching science'), classroom management ('modeled effective classroom management when teaching science'), and active learning strategies ('used hand-on materials for teaching science'). The *feedback* dimension (six items) addresses the sorts and extent to which a mentor provides specific feedback to his/her mentee related to, among other things, planning ('reviewed my science lesson plans'), reflection on practice ('assisted me to reflect on improving my science teaching practices'), and teaching strategies ('clearly articulated what I needed to do to improve my teaching of primary science').

The MEPST was developed in English and used in countries such as Australia and Turkey (Hudson, 2005, 2007; Hudson et al., 2009). However, this would be the first use of the instrument in an Arab nation, where English is taught as a foreign language. To address the language barrier, the survey items were translated to Modern Standard Arabic. A panel of Jordanian linguistics fluent in both English and Arab carefully examined the accuracy of the translation. Next, a panel of experts in science education and teacher education programs at two Jordanian universities examined the translated instrument to establish its face validity, and provided comments and suggestions for minor edits related to the translation. Finally, the translated instrument was pilot-tested with 40 primary preservice teachers enrolled in the same program as the study's participants in the semester prior to formal data collection. The overall Cronbach's alpha coefficient of internal consistency for the translated questionnaire was high (.95), and the reliability coefficients for four factors were good to high: personal attributes (.74), pedagogical knowledge (.88), modeling (.88), and feedback (.71). As with the original MEPST, Cronbach's alpha for the system requirements factor was somewhat lower (see above), and stood at the moderate value of .61 for the translated instrument. These reliability measures support the applicability of the Arabic version of the MEPST for use in Arab countries.

Data Analysis

Descriptive statistics (frequencies, mean scores, and standard deviations (SD)) were generated for each MEPST item and factor. Analysis of variance (ANOVA) was used to examine the significance of differences among participant mean scores related to the MEPST main five factors. While a significant ANOVA indicates that mean scores across these factors differ, the test does not identify which pairs of mean scores among the five tested factors are significantly different. Thus, when significant, an ANOVA was followed with *post hoc*, pairwise comparisons using the Scheffe test to pinpoint pairwise differences among means.

Results

Table 1 presents the mean scores (M) and SD for the five MEPST factors, as well as for the individual items under each factor. Table 1 also presents the combined percentages across all 147 participants who 'agreed' or 'strongly agreed' that their mentor exhibited the attribute or practice targeted by each of the MEPST items. Overall, the results do not bode well for the mentorship experiences as perceived by participant preservice primary teachers during their practicum in cooperating schools. The mean scores for the personal attributes ($M = 2.90$, SD = 0.64), system requirements ($M = 2.67$, SD = 0.70), pedagogical knowledge ($M = 2.83$, SD = 0.60), and feedback ($M = 2.77$, SD = 0.53) factors ranged from 2.67 to 2.90 on the 5-point MEPST scale, where '3' indicates that a respondent was 'uncertain' as to whether his/her mentor engaged with the respective behavior. Additionally, a significant ANOVA for comparing the mean scores for the five MEPST factors ($F_{4,730} = 17{,}306$; $p < .0001$) followed by multiple comparisons using the Scheffe test indicated that the differences between the mean scores for the system requirements, pedagogical knowledge, and feedback factors were not statistically significant ($.27 < p < .94$). Table 1 also indicates that in the case of 23 of 27 items (85% of items) under the aforementioned four factors, only 35% or less of participants 'agreed' or 'strongly agreed' that their mentor enacted the respective practice. This percentage was 25% or less for 9 of these 23 items (see Table 1). Taken together, these findings indicate that the experiences of participants across the mentoring attributes and practices included under these four factors were relatively uniform and mostly less than positive.

On a relatively more positive note, the mean score for the modeling factor ($M = 3.23$, SD = 0.60) indicated that participants believed their mentors did, on average, a better job demonstrating effective science teaching. Indeed, for seven of eight items under the modeling factor, about half of the participants 'agreed' or 'strongly agreed' that their mentors demonstrated the sorts of strategies or behaviors that are characteristic of effective science instruction in primary grades (see Table 1). The Scheffe test, which was applied following a significant ANOVA for comparing the mean scores for the five MEPST factors ($F_{4,730} = 17{,}306$; $p < .0001$), confirmed that the mean score differences between the modeling factor and remaining four factors were statistically significant all in favor of the modeling dimension. The only other statistically significant difference pinpointed by the Scheffe test was the mean difference between the personal attributes and system requirements factors, in favor of the former factor. The latter finding indicates that, from the participants' perspective, mentors relatively were more salient in exhibiting caring and supportive behaviors of their mentees, than demonstrating knowledge of the primary science curriculum, its aims, and the policies associated with teaching primary science.

The aforementioned results suggest that roughly half of the participants perceived their mentors to be effective science teachers. However, for the larger majority of participants, the mentors did not explicitly or systematically engage in practices that would facilitate their growth and development in the area of teaching science to primary students. At this point, it should prove useful to further discuss the findings pertinent to each of the five MEPST factors, which speak to the attributes of effective mentoring for primary science teaching.

Personal Attributes

Mean scores for the six items under this factor, which range from 2.67 to 3.03, suggest that a substantial number of mentees did not experience the respective mentoring practices (see Table 1). For instance, 80% of the participants felt that their mentors did not enhance their confidence in teaching science, whereas 77% thought their mentors did not listen to them attentively on matters related to science teaching. Additionally, 60% of the participants perceived that their mentors were not supportive of their teaching of science and/or were uncomfortable talking to them about science teaching.

Elementary teachers' beliefs and attitudes play an important role in their perceptions and practices related to science teaching (Eshach, 2003; Milner, Sondergeld, Demir, Johnson, & Czerniak, 2012; Minogue, 2010). Several studies (Appleton & Kindt, 1999; Dunlop & Fraser, 2007; Fulp, 2002; Osborne & Simon, 1996) have indicated that elementary teachers lack positive attitudes toward science and confidence in their abilities to effectively teach science. Improved elementary teachers' attitudes toward, and greater confidence in, teaching science also have been linked to improvements in elementary students' science learning (Osborne, Simon & Collins, 2003; Osborne & Dillon, 2008). To the extent that mentors affect the attitudes, confidence, and choices of their mentees toward teaching for both the short and long terms (Clutterbuck, 2004), the present results indicate that participant preservice primary teachers likely were not recipients of the sort of support to help nurture their affect toward science and science teaching, or what Clutterbuck labeled as the emotional component of mentorship for teaching.

System Requirements

The overwhelming majority of participants indicated that their mentors did not explicitly discuss with them the aims of science teaching in primary grades (75%) or the school policies associated with implementing the primary science curriculum (80%) (see Table 1). Additionally, only 20% of the preservice primary teachers in this study 'agreed' or 'strongly agreed' that their mentors discussed with them documents that outline the science curriculum, which participants were expected to teach. Indeed, the mean score for this factor ($M = 2.67$, SD = 0.70) was lowest among the observed means for the five MEPST factors, despite the fact that, in Jordan, the aims and policies in question are outlined in formal curricular documents, such as the Science Curriculum Outlines and Science Teachers' Curriculum Guides.

Interestingly enough, unlike with the case of the other four MEPST factors, the relatively lower mean scores for the system requirement factor and associated items in the present study were consistent with those from other studies of the mentorship experiences of preservice elementary science teachers (Hudson, 2005; Hudson & McRobbie, 2003). The seeming lack of awareness or knowledge of curricular documents, and associated broader goals and policies in K-12 science education, often is explained by the overreliance of teachers on science textbooks (Chiappetta, Ganesh, Lee, & Phillips, 2006). Indeed, while science education researchers and science teacher educators conceive of science textbooks as one among several instructional materials and resources available to science teachers, these textbooks—more often than not—become *the* science curriculum and inordinately dictate the content and instructional activities that are enacted in the larger majority of science classrooms (Abd-El-Khalick, Waters, & Le, 2008; Chiappetta et al., 2006; Chiappetta, Sethna, & Fillman, 1991; Shiland, 1997; Valverde, Bianchi, Schmidt, McKnight, & Wolfe, 2002). This state of affairs likely is more prevalent in the case of elementary teachers because research indicates that the overreliance on science textbooks is particularly pronounced for teachers who lack deep understandings of the science content knowledge they are expected to teach (Hashweh, 1987; Shiland, 1997). As explained in the preceding text, most primary teachers in Jordan would have acquired minimal and variable preparation in science content before they start their teaching profession.

Pedagogical Knowledge

A majority of participants (between 63% and 82%) indicated that they did not receive mentoring that helped them to develop their pedagogical knowledge for teaching science across the dimensions addressed in the MEPST. As evident in Table 1, the means for 9 of 11 individual items under this factor were less than 3.00 points and ranged from 2.55 to 2.99. The remaining two item mean scores were slightly larger than 3.00, with SD larger than one point. For instance, slightly more than 80% of participants indicated that their mentors did not provide guidance related to assessing student science learning or discuss strategies related to effective science teaching. Also, close to 70% indicated that their mentors did not provide assistance with scheduling science instruction or novel ideas for teaching science to primary students. Clearly, participants perceived that they were underserved in the domain of mentorship related to Clutterbuck's (2004) development outcomes, that is, pedagogical knowledge, and technical and behavioral competence.

These findings are *partially* explicable on the well-documented difficulties that in-service primary teachers—who might serve as mentors—face with implementing effective science instruction because they have not developed the requisite pedagogical and PCK (Fulp, 2002; Sarikaya, 2004). Ibrahim (2005) and Abed (2009) have documented a similar pattern in Jordan. These findings support the conclusion of

Hudson et al. (2009) that many preservice primary teachers are not provided with adequate support and opportunities to develop their pedagogical knowledge and technical skills for science teaching during their practicum experiences in light of the fact that their mentor teachers are not highly developed in these very areas.

The aforementioned explanation, nonetheless, can only partially account for the present results, because as will become evident in the next section, close to half of the participants indicated that their mentors modeled what they perceived to be effective science teaching practices. When compared to the finding that roughly 70–80% of the participants reported not having been effectively mentored in terms their of pedagogical knowledge for science teaching, it could be inferred that, at least, some of the mentors in the present study were effective in teaching science; however, those mentors were not equally successful in drawing on such expertise to guide the development of their mentees' pedagogical knowledge. We will return to this important point in the discussion section.

Modeling

The mean score for the modeling factor ($M = 3.23$, SD $= 0.64$) was larger than the means for the other four factors. As noted earlier, the respective differences between these means were statistically significant in favor of the modeling factor. Table 1 indicates that, with one exception related to the use of science language ($M = 2.82$, SD $=$ 1.18), the means for the eight items under this factor were greater than 3.00, and ranged from 3.22 to 3.37. Close to 50% of the participants 'agreed' or 'strongly agreed' that their mentors used carefully designed, hands-on activities when teaching science; modeled effective classroom management and established rapport with primary students; and were enthusiastic about, and effective in, teaching science. To be sure, these results need to be interpreted with caution because they build on participant preservice teachers' perceptions of what they considered to be effective science teaching in primary grades. Hudson (2002) clearly differentiated between modeling science teaching and modeling *effective* science teaching, where the latter provides mentees with a fuller understanding of how to improve their own teaching. Obviously, about half the participants did not experience such modeling by their mentor teachers.

Participants perceived that their mentors did substantially better in terms of modeling effective science teaching strategies relative to the mentoring practices addressed by the other four MEPST factors. What is more, these findings are statistically significant: they could not be dismissed as due to chance associated with the sample of mentors at hand and, more importantly, the differences gain special significance in the context of the present study. These findings suggest that some in-service primary teachers among the participants' cadre of mentors have managed to develop the sorts of knowledge and skills requisite to effective science teaching and, thus, could potentially serve as a core group that would benefit from professional development specifically targeted toward improving their mentoring practices.

Feedback

Mentors did not fare well with the feedback factor, with an overall mean score of 2.77 (SD = 0.53). As evident in Table 1, a sizable majority of participants indicated that their mentors did not review their lesson plans (79%), provide oral (81%) or written (84%) feedback on their science teaching, or help the participants understand what they needed to do in order to improve their science teaching (78%). About 40% of participants reported that mentors observed their science teaching, which indicates that about 20% of the mentors might as well have observed their mentees while teaching science without having examined their lesson plans. Again, mentors in the present study seemed to have fallen short in terms of developing among their preservice primary teachers what Clutterbuck (2004) referred to as enabling outcomes, that is, outcomes related to providing mentees with the resources and information needed for self-development and learning how to process feedback and refine their instructional strategies and practices.

Discussion, Conclusions, and Implications

As is the case with any complex professional practice, preservice and novice teachers require careful mentoring and induction into the profession (Clutterbuck, 2004; Harrison et al., 2006). Such mentoring is particularly crucial for preservice and novice teachers teaching science to elementary students. This latter crucial need stems from two intertwined issues related to science teaching in elementary schools around the globe. First, in general, by the time they start their careers, elementary teachers would have attained minimal preparation in science content and processes (Allen, 2006; Jale & Boone, 2002; Stake et al., 1978). This issue is associated with the nature, requirements, and structure of elementary teacher education across many nations (Jarvis et al., 2001). Jordan is no exception (Ibrahim, 2005). As is the case with this study, only a minority of Jordanian secondary school graduates who enroll in a primary teacher education program (22% in the present case) come from the 'scientific stream' and have had some exposure to science content courses. Additionally, during their college education, elementary teachers typically enroll in one or two college science courses (Abd-El-Khalick & Akerson, 2009), which are not likely to substantially improve their limited preparation in the sciences. As a result, a majority of elementary 'class' or 'homeroom' teachers lack the content knowledge understandings, positive attitudes toward science, and confidence in their abilities to teach science, which are requisite for effective science teaching (Appleton & Kindt, 1999; Milner et al., 2012; Minogue, 2010) and, eventually, for effective mentoring (Hudson et al., 2005).

Second, a consequence or equally likely an antecedent of this first issue, science is accorded minimal attention and assigned very limited instructional time in elementary classrooms (Allen, 2006). Again, Jordan is no exception: science takes a back seat compared to the priority assigned to teaching mathematics and the Arabic and English languages. Science instruction in Jordanian primary schools is limited to three 40-minute sessions per week in grades 1 and 2, and four 40-minute sessions per week in grade 3. Mathematics and language instruction is accorded, at least, twice as much instructional time. Thus, not only are preservice elementary teachers ill-prepared to teach science, but their potential school mentors likely are also as ill-prepared, and harbor similar negative attitudes toward science, as well as have low confidence in their ability to teach science. Potential mentors, thus, likely are not able to model effective science teaching practices to their mentees or create an environment conducive to their professional growth. What is more, given the low priority assigned to science, elementary school teachers do not have strong incentives to engage with efforts to improve their teaching of science.

The aforementioned difficulties with elementary science teaching makes high-quality mentoring of student teachers all the more important; hence, the significance of this study. To the best of our knowledge, the present study is the first quantitative investigation in Jordan, probably across Arab nations, to systematically map mentoring practices in elementary teacher education by examining preservice primary teachers' perceptions of their mentoring experience in science teaching. To the extent that these experiences are similar to those in other primary teacher education programs in Jordan and similarly structured programs in other nations, the present results speak to rather poor mentoring practices in science teaching as perceived by primary student teachers. As detailed earlier, the MEPST mean factor and item scores indicated that the greater majority of participant preservice teachers (from 65% to 85%) did not experience effective scaffolding toward creating a supportive and reflexive environment that would bolster their confidence in teaching science; further their understanding of primary science curriculum, and associated aims and school policies; help with developing their pedagogical knowledge; and/or furnish them with specific and targeted feedback and guidance to help improve their teaching of science. In comparison, substantially more participants (around 50%) indicated that their mentors modeled what they perceived to be effective science teaching.

While the overall pattern observed in the present study is consistent with findings from other studies (Hudson, 2005; Hudson et al., 2009, 2010; Osborne & Simon, 1996), mean scores for the five MEPST factors in this study were generally lower than the means reported in those studies. In a way, primary student teachers in Jordan might be somewhat worse off than their counterparts in other countries (Jarvis et al., 2001). Such mentoring is not likely to achieve the much desired mentoring outcomes articulated by Clutterbuck (2004), including emotional outcomes (e.g. confidence in, and positive attitudes toward, science teaching), development outcomes (e.g. curricular knowledge, and pedagogical knowledge and technical competence related to teaching science), and enabling outcomes (e.g. specific feedback and guidance for planning professional growth).

As noted earlier, an interesting finding of the present study is that the mean score for the MEPST modeling factor was larger than those for the other four factors. The mean differences also were statistically significant. About half of the participants perceived that their mentors did substantially better in terms of modeling effective science teaching than engaging with the mentoring practices assessed by the other

MEPST factors. Thus, it could be inferred that some in-service primary teachers among the participants' cadre of mentors have managed to develop the sorts of knowledge and skills requisite to effective science teaching. This finding is anchored in participants' perspectives of what counts as effective science teaching and, thus, should be considered as tentative. It should prove very useful, nonetheless, for researchers to examine firsthand—e.g. through classroom observations—the instructional practices of Jordanian in-service primary teachers to ascertain whether some actually engage in science teaching that demonstrates effective and best practices. This finding, if established, has two important implications for the development of mentoring for science teaching in primary Jordanian schools.

First, identifying a group of in-service primary teachers who are effective in teaching science—no matter how small in number—can provide a first practical measure toward breaking the current vicious cycle, that is, the cycle of ill-prepared preservice primary teachers who most likely would be mentored by equally ill-prepared in-service teachers when it comes to science teaching. Second, while roughly half of the mentors in the present study were perceived to be effective in teaching science, the overwhelming majority did not engage with effective mentoring practices. It follows that while being able to teach science effectively is necessary for effective mentoring, it surely is not sufficient. Thus, there is need in Jordan—as is the case with mentoring elementary school teachers in science teaching in several nations across the globe—to offer in-service primary teachers professional training in mentoring student and novice teachers. Mentoring is not a disposition: mentors need specific training and professional development, which will enable them to articulate for themselves and their mentees the attributes of effective science teaching, and then build an environment and scaffolds to ensure that their mentees would internalize and implement effective science teaching practices, and then process critical feedback toward the continual improvement of their teaching (Feiman-Nemser & Parker, 1990; Holloway, 2001; Peterson & Williams, 1998). Obviously, what we are advocating here is a model that subscribes to content-specific versus generic mentoring for teaching science in primary grades (Hudson, 2004, 2005). We recommend that the professional development of primary teacher mentors starts with those who are identified by researchers and/or teacher educators as effective in science teaching, which the present study suggests are already among the ranks of the current teaching force in Jordan and, indeed, in every similar context across the globe.

In this context, it is important to note that most of the voluminous literature on mentoring preservice and beginning school teachers has been dedicated to examining the impacts and benefits for the mentees who are engaged in these relationships (Ehrich, Hansford, & Tennent, 2004; Ingersoll & Strong, 2011). Indeed, the aforementioned multiple positive impacts and tangible benefits that mentees derive from their engagement in effective mentoring relationships are now very well established (Ingersoll & Strong, 2011). In some cases, albeit peripherally, this body of literature also speaks to the benefits—mostly affective—that mentors derive from their engagement with novices, such as the personal satisfaction that mentors derive from helping and supporting others (Coates, 2012). Nonetheless, there is an emergent and rapidly expanding body of literature that is starting to primarily examine and document the benefits of mentoring on outcomes related to the professional development and growth of the *mentors* (Coates, 2012; Jarvis et al., 2001; Martin, 2013; Nilsson & Van Driel, 2010). For instance, Coates (2012) reported that teachers who mentor novices 'are more likely to remain in the classroom or advance to an administrative role' (p. 92). To be sure, more systematic empirical research is needed to further bolster and delineate these findings. Nonetheless, what is currently known about the mutual benefits for *both* mentors and mentees is fairly robust and needs to become central to the discourse and advocacy aimed at engaging effective in-service teachers with mentoring, and incentivizing them to dedicate the time and energy needed to develop and hone the skills needed to successfully mentor preservice and beginning teachers.

Currently there are no explicit policies or criteria in Jordan for the training, selection, and assignment of mentor teachers. Attributes of effective mentoring in elementary science teaching, such as those underlying the MEPST, could provide a point of departure for outlining such policies and criteria. The latter is crucial for the development and enactment of professional training for in-service teachers in the area of mentoring, as well as for the selection and assignment of mentors to student teachers. If the present results are any indication, the subset of primary teachers who are good candidates for becoming effective mentors in science (e.g. have positive attitudes toward science and are effective in teaching science) is likely a small minority among practicing teachers. Thus, there is need to create school-level policies to enable those teachers who can potentially be developed into effective mentors to serve as 'science specialists' or 'science teacher mentors' who would float across the primary grades within a school to offer support and guidance to student teachers (as well as regular classroom teachers) in science teaching (see for, e.g. Schwartz, Abd-El-Khalick, & Lederman, 2000).

Obviously, to have any chance of becoming systemic, the aforementioned measures toward improving mentorship for preservice primary teachers in science will need to be embedded in commensurate changes in policy and practice at the levels of primary teacher education programs in Jordan and, eventually, at the national level. For example, in the absence of resources for mentorship training for all teachers, primary teacher education programs could focus on preservice and in-service primary teachers who had completed the secondary scientific stream, as they would have had more training in science content and more positive inclinations toward science compared to their counterparts in the literary and information technology streams. In a sense, teacher education programs could build a pipeline from secondary education, to teacher preparation, and finally to primary classrooms where those teacher candidates who have better science content knowledge, more positive attitudes toward science, and confidence in teaching science would populate the positions of 'primary science mentor' in Jordanian primary schools. The latter model might as well be practicable and effective in other nations with similar difficulties prompting effective science teaching in elementary schools.

Disclosure statement

No potential conflict of interest was reported by the authors.

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