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ORIGINAL PAPER

Online Collaborative Mentoring for Technology Integration in Pre-Service Teacher Education

Helga Dorner[1] · **Swapna Kumar**[2]

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Abstract The Mentored Innovation Model is an online collaborative mentoring model developed in Hungary to help teachers integrate technology in their classrooms in meaningful ways. It combines an online modular approach of formal pedagogical ICT training with an informal online community experience of sharing, developing and critiquing of shared learning resources during teacher education coursework. In this article we describe its implementation with pre-service teachers to support them with technology integration in their teaching. We then discuss the usefulness of the model for teacher education based on the results of a technology self-efficacy and mentoring satisfaction survey with 116 pre-service teachers.

Keywords Collaborative mentoring · Pre-service teacher education · Technology integration

Introduction

Mentoring in teacher education is "one of the most important strategies to support novices learning to teach" (Wang 2001, p. 52) and helps to improve confidence, self-esteem, and the ability to problem-solve (Hobson et al. 2009; Mathur et al. 2013). Technology integration by individual teachers in their classrooms can be an isolating and challenging endeavor in which professional development in the form of mentoring can be invaluable. However, mentors who are experts in technology integration are not always available in every school or district where pre-service teachers complete their practica or where in-service teachers are employed. In this context, Internet and Communication Technologies (ICT) present tremendous potential for online mentoring and for collaborative models of online mentoring where both the pre-service or in-service teachers and the mentors can benefit from interactions. Online collaborative mentoring is thus anchored in the notion that mentoring processes that are successfully aligned with the dynamics of (online) learning communities, and characterized by supportive interpersonal relationships, collegiality, constructive feedback and authentic learning can enhance teachers' professional growth (Mullen 2009).

The Mentored Innovation Model (MIM) (Dorner and Karpati 2010; Dorner 2012a) is an online collaborative mentoring model developed in Hungary that was designed to help teachers with their efforts to integrate technology in their classrooms in meaningful ways. The methodological precedent of the MIM was piloted in the European Pedagogical ICT License (EPICT) project (which Hungary joined in 2004) and in the Calibrate project (2005–2008), a European Union-funded international research-and-development project that involved schools, educational organizations and ministries of education from eight member countries. The MIM operates on principles of collaborative learning in online communities and focuses on authentic, problem-based classroom application of technology integration. In this paper we present the implementation of the model for mentoring pre-service teacher technology integration and the research results from that implementation. We then discuss the value of this model for others wishing to implement it in teacher education.

✉ Helga Dorner
dornerh@ceu.edu

[1] Centre for Teaching and Learning, Central European University, Budapest, Hungary

[2] School of Teaching and Learning, University of Florida, Gainesville, FL, USA

Literature Review

Despite the ubiquity of technology in today's society, teachers often lack confidence and preparation in its use for teaching and learning (Kay 2006; Polly et al. 2010). The obstacles to teacher use of technology mentioned in the literature are lack of time (Wepner et al. 2003), lack of technology skills (Teo 2009; Thomson et al. 2003), teacher beliefs and technology self-efficacy (Abbitt 2011; Bai and Ertmer 2008; Liu 2012), and lack of clarity about strategies of meaningful technology integration (Cuban 2001). The development of teachers' technology skills through a single course or a series of courses focused on educational technology can overcome these barriers (Hargrave and Hsu 2000; Polly et al. 2010). This approach has, however, been criticized for teaching technology use isolated from pedagogical content knowledge (Shulman 1986) and for not providing participants with a clear understanding about pedagogically meaningful technology integration (Kay 2006; Liu 2012; Singer and Maher 2007; Tondeur et al. 2012).

Curriculum-wide integration of technology (Kay 2006; Ottenbreit-Leftwich et al. 2010; Tondeur et al. 2012), content-specific technology integration based on the Technological Pedagogical Content Knowledge (TPACK) model (Koehler and Mishra 2009), role modeling with concrete examples of how technology can be used in the classroom and finally, collaboration with mentor teachers on the integrative use of technology in teaching and learning processes (Aust et al. 2005; Bullock 2004) have been found to be successful in helping pre-service teachers integrate technology in their teaching. While one-on-one mentoring and group mentoring with an experienced teacher are valuable forms of mentoring in teacher education, a collaborative approach where novices and experts work together and a combination of technical, instructional and emotional support is provided has been found to be effective for mentee learning (Feiman-Nemser 1998).

The mentoring of pre-service teachers has typically been studied during the practicum phase of teacher education programs, when pre-service teachers apply their knowledge and skills in school classrooms (Grove et al. 2004; Liu 2012). Interactions between pre-service teachers and mentors, levels of guidance by mentors, modeling by mentors, observations by pre-service teachers, discussions about teaching with technology with mentors, and the beliefs of mentors as well as those of teacher educators have been found to influence pre-service teacher integration of technology during their practicum (Bai and Ertmer 2008; Grove et al. 2004; Haydn and Barton 2007; Judge and O'Bannon 2007; Nilsson and Driel 2010; Sahin 2008). While acknowledging the value of mentoring relationships during the practicum phase, the model presented in this paper emphasizes the use of collaborative mentoring by subject-specific in-service teachers, teacher educators and educational researchers in a structured manner throughout a teacher education program – during coursework as well as the practicum.

The Mentored Innovation Model

The MIM (Dorner and Karpati 2010; Dorner 2012a) is an online collaborative mentoring approach that systematically combines multiple strategies for scaffolding mentees' technology integration in the teaching and learning process. It involves collaboration between pre-service or in-service teachers, teacher mentors who are experienced in technology integration, educational researchers, and teacher educators. Collaborative mentoring integrates the formal mentoring primarily orchestrated by teacher educators as well as the community-driven processes of peer mentoring through online co-construction of teaching materials embedded in authentic, problem-based pedagogical situations, that is, classroom experiences where technology integration should occur. Pre-service teachers, teacher educators, and mentor teachers are all members of a democratic community and leadership roles are interchangeable, depending on the purposes of the actual problem-solving situation. According to this approach, learning happens when (pre-service) teacher mentees and teacher mentor(s) are involved in the reciprocal processes of negotiating understandings of how technology is related to the process (pedagogy) and the content of teaching, and how the use of technology is interconnected with their teaching conceptions (Kember and Kwan 2000). The MIM does not exclusively propose any single pedagogical approach or orientation for meaningful technology integration, but, rather, participants engage with a range of approaches and select strategies that best match their existing teaching philosophies and beliefs.

The MIM explicitly focuses on collaborative mentoring for pre-service teacher technology integration during teacher education coursework, while providing a comprehensive model of collaborative mentoring during coursework as well as the practicum, not just during the practicum. The model is grounded in processes where individual cognition is supported by peer interaction (Dorner 2012b). Teacher mentees learn from each other while they critically engage, adapt or adopt technology integration strategies and resources in online collaborative mentoring scenarios during their coursework in order to apply these during the practicum. Over multiple semesters, pre-service teachers solve problems and design materials collaboratively with teacher educators, teacher mentors and educational researchers while simultaneously reflecting on how technology can support their pedagogy.

Implementing the MIM in Pre-Service Teacher Education

Collaborative mentoring focused on technology integration in the MIM consists of three phases (Dorner and Karpati 2010; Dorner 2012a) that are sequential but can also occur multiple times in a loop. In this section we describe the three phases of the MIM based on an implementation of this model with 116 pre-service teachers in Hungary who worked in small groups for semester-long periods. These pre-service teachers were first- or second-year students in a two-year-Master's program in the Bologna system, and who were supposed to teach at secondary schools after graduation. Teacher education in Hungary has gone through various cycles of reforms, with the latest one in 2011. Currently, secondary school teacher education is a six-year-long single-cycle process. The pre-service teachers involved in this project were trained in the previous structure, that is, in the Bologna system. In both the present and previous structure, pre-service teachers do a mandatory teaching practicum at schools (currently two semesters long) and both teacher educators (university faculty) and subject specialist senior teachers are assigned an important role in scaffolding processes in the practicum.

Technology integration is regarded as part of the general coursework that also includes pedagogy and psychology modules (Csordas et al. 2013). However, technology integration is not represented in a unified manner in the teacher training curricula and is not taught systematically in preparation for the practicum, i.e., technology integration content during the coursework is not connected explicitly to the practicum. The teaching practicum, ideally, gives pre-service teachers the opportunity to experiment with ICT tools in their teaching. In this context, the pilot initiative of the MIM was unique in two ways. Firstly, it had the potential to focus on technology integration as part of the compulsory pre-service teacher training courses in a sustained and structured manner and second, it strived to do this through creating an online community of pre-service teachers, teacher educators, subject-specific teacher mentors and educational researchers during both the coursework and the practicum. The following three phases of the MIM occurred during teacher education coursework:

- In the initial phase of the model implementation, the pre-service teachers identified pedagogical and methodological problems of technology integration in collaboration with teacher educators, a subject-specific mentor and educational researchers. For example, what are authentic tasks for English as a Foreign Language (EFL) students to engage in online communication? What are strategies that EFL teachers could use in designing and facilitating these authentic tasks? How does that contribute to EFL students' digital literacy?
- Once pre-service teachers had identified a problem that involved technology integration, they created a development project plan (for materials, resources or lesson plans) and a joint research agenda about the targeted content areas together with their mentors and peers. For example, a concrete session plan that focused on the establishment of rules of online communication in the 'virtual' EFL classroom, that included activities for EFL students to engage in exploring, critiquing and creating netiquette for the whole class together. The accompanying research agenda, in this example, included perspectives on digital literacy, consultations with the educational researcher about potential research literature, research questions and ICT tools, and eventually the design of an action research project.

  Throughout this second phase, the pre-service teachers were provided sustained and on-going professional support from their mentors. This collaboration provided opportunities to discuss and engage with complex technical, pedagogical, hands-on issues of applying technology to specific content areas. Technical concerns and skills are considered important areas to reflect on and develop during the mentored collaboration since computer self-efficacy and technology acceptance are crucial conditions for technology integration. This also helps teachers to make design decisions about the tools they identify as best representing their teaching approach and content (Koh and Divaharan 2011; Koh and Frick 2009).
- In the third phase, existing learning objects, activities, lesson plans etc. were identified and adapted or further developed in collaboration with peers, the teacher educator and eventually, the subject-specific mentor. Alternatively, if new materials were needed for the problem and context, the pre-service teachers created these from scratch with input from their peers and teacher educators. The process of pedagogical innovation, that is, the design and application of technology-integration strategies, which is likely to happen at the individual teacher's level, was documented by the pre-service teachers and co-researched with an educational researcher.

Throughout the three phases, computer-supported collaborative learning (CSCL) environments such as Moodle and LeMill were used for online collaborative mentoring processes. The environments were chosen to facilitate theories of social learning and constructivist philosophy as operationalized by Rice (2007): (1) learners acquire new knowledge as they interact with their environment, (2) students learn more when they construct learning experiences for others, (3) when becoming part of a culture, students are constantly learning, and (4) freedom of choice as regards constructed behavior (e.g., objective and factual, or more subjective approaches). Accordingly, the most frequently used applications (besides

the more static functions such as upload and download) were the asynchronous forum and the collaborative wiki. Students uploaded and downloaded a variety of documents, from word documents to video files.

The educational researcher(s) worked with the mentees exclusively online, however, the teacher educator(s) had regular face-to-face consultations with the pre-service teachers beyond their ongoing and sustained online work. During the implementation of the MIM with pre-service teachers, the actual teaching plans and activities were to be implemented during the mandatory teaching practicum period that varies across time as defined by the host institutions. The actual 'content' for the collaborative mentoring processes was provided through the integration and adjustment of principles and procedures found in the European Pedagogical ICT License (EPICT) framework as well as in the collaborative use and exchange of resources in the European Learning Resources Exchange (LRE) program. Through the integrated combination of the online modular approach of formal pedagogical ICT training and the informal online community experience of sharing, developing and critiquing of shared learning resources; mentees thus practiced technology adoption and application strategies.

Research on the MIM Implementation

The three MIM phases were implemented with a group of 116 Hungarian pre-service teachers (Female = 88; Male = 28; $Age_{20–25}$=96; $Age_{26–33}$=20) over four years. Data was collected using surveys and this paper reports the results of research conducted with this group of teachers. The surveys were used to answer the following research questions:

Question 1: How do pre-service teachers perceive their level of comfort with technology (computer use and Internet abilities)?

Question 2: What are critical conditions that influence pre-service teachers' satisfaction with this mentoring experience?

The pre-service teachers were sent two online questionnaires – one explored their self-efficacy with technology before the mentoring began and the other surveyed their satisfaction with the mentoring experience once it was over. The self-efficacy survey was an essential tool to estimate their level of technology literacy at the beginning of the mentoring process, especially because online collaborative mentoring necessitates comfort level with technology, influences participants' ability and persistence to acquire skills and predicts participants' satisfaction (Liaw and Huang 2013). Items on the self-efficacy survey required the teachers to rate their computer use and Internet abilities, in alignment with technology literacy standards for teachers from the United Nations Educational, Scientific and Cultural Organization (UNESCO) ICT Competence Framework for Teachers (UNESCO 2008, 2011) which also incorporates key principles articulated by the International Society for Technology in Education (ISTE). The instrument itself was developed and validated in the European Calibrate project (Karpati and Blamire 2008). In terms of the actual analyses, we applied statistical means on a 1–5 scale in order to yield a single index for the two separate variables. The mentoring satisfaction survey was a Likert-type questionnaire surveying satisfaction with the online mentoring experience. The items included four aspects of the online collaborative mentoring process: (a) teachers' overall satisfaction, (b) satisfaction with the mentor's activity, (c) communication in online collaborative mentoring, and (d) teachers' perceived social presence. We computed regression analyses and created importance values. *Contribution* or *overall importance* relates to the effective importance (impact) of any independent variable on the dependent variable. We thus used the importance value to calculate satisfaction indices that measure the quality of the online learning experience and the mentoring process by incorporating the participants' judgment in a weighted form. The effect of variables with significant impact on satisfaction is assumed to be proportionate to their importance.

Findings

The self-efficacy survey was used to map pre-service teachers' self-rated computer use and Internet abilities. The self-rated values for the two areas, computer use (M = 3.46, SD = .51) and Internet abilities (M = 3.68, SD = .44) as a whole suggested appropriate level of comfort with technology, that is, appropriate for the types of online activities in which pre-service teachers would be expected to engage. The percentages that refer to those skills or areas that were crucial in order to be able to participate in the online mentoring are presented here. In terms of computer use, almost all pre-service teachers' (94.6 %) reported that they could use word processing programs in general without help, could prepare presentations without any help (55.4 %) or with some help (24.3 %) and the majority of them could do photo editing without any help (62.2 %) or with some help (14.9). In terms of their Internet abilities, pre-service teachers (more than 80 %) expressed confidence and efficacy in all the areas (downloading and saving texts, pictures, and documents, using search engines, navigation, saving websites, using email communication) with the exception of creating websites, which only 17.6 % of them could do without any help.

The self-efficacy survey served as a diagnostic tool to estimate pre-service teachers' preparedness for online mentoring and the basic ICT skills they would need before they learned further skills during the mentoring stage of the practicum. The

aim of online collaborative mentoring was not just technology literacy or technology skill development but competencies surrounding the pedagogical integration of technology. This research and the results presented in this paper focus on the implementation of the three-phased MIM and mentoring satisfaction during those phases. The teaching practicum that followed was supposed to give pre-service teachers the opportunity to implement their designed materials and experiment with technology integration in their teaching. Their ability to integrate technology will be assessed during the actual implementation phase of the practicum.

When pre-service teachers were asked to rate their satisfaction with the various elements of the MIM, online communication processes turned out to be the condition with the strongest impact on pre-service teachers' overall satisfaction ($N_{pre\text{-}service}$ $p<.001$; imp. = .40). Hence, online communication that was described by variables such as joint work in the online environment, participation in on- and off-topic discussions, acknowledgment of each other's points of view, and convenient conversation through the online platform emerged as a critical condition. Mentor activity significantly influenced pre-service teachers' overall satisfaction ($p<.001$; imp. = .02). It also significantly influenced pre-service teachers' satisfaction with online communication ($p=.001$; imp. = .12) and perceived social presence in the mentored collaborations ($p=.009$; imp. = .08). We extrapolate that pre-service teachers perceived each other as 'present' and 'socially visible' in the online collaborations, but importantly, these dynamics were considerably orchestrated through their mentor's activity and communications.

Discussion

The structure of teacher education in Hungary, where pre-service teachers work with teacher educators who are university faculty and senior teachers during their practicum, is a little different but not uncommon in other countries where teacher educators and practicum teachers in schools work with pre-service teachers. However, the MIM is unique in that the teacher educator, the subject-specific teacher mentor and the educational researcher are involved in online collaborative mentoring during teacher education coursework. During their coursework pre-service teachers identify a pedagogical problem, discuss technology integration issues and develop materials or adapt materials. The teacher educator and the school-based mentor teacher then continue to be present when those materials are implemented by the pre-service teachers during the teaching practicum. The subject-specific mentor is an expert who is also involved in the process and not necessarily the teacher in whose class pre-service teachers complete their practicum. This ensures coherence and connection between teacher education coursework and the practicum, and ensures that technology implementation is taught in a sustained way over multiple semesters.

In addition to being implemented during the formal coursework phase of the teacher education program, this model involves online mentoring and computer-supported collaborative learning. It capitalizes on the capabilities of ICT available today by bringing together various stakeholders in teacher education and facilitating the sharing of knowledge and experiences. The results of the mentoring satisfaction survey indicate that the mentor's activity and the quality of online communication were key to teachers' overall satisfaction in the MIM. This is similar to previous studies about instructor communications in online environments (Bolliger 2004; Johnson et al. 2008), although those studies did not deal with teacher mentoring during teacher education coursework.

The model of online collaborative mentoring implemented during teacher education courses presented in this paper was characterized by curriculum and pedagogy-driven technology integration, pre-service teachers' learning with technology to teach with technology and pre-service teachers' learning in a collegial community. We elaborate further on these areas in the sections below.

Curriculum and Pedagogy-Driven Technology Integration

The involvement of the teacher educator, the subject-specific mentor and the educational researcher throughout the process in the MIM provides multiple perspectives and a curriculum and pedagogy-integrated teaching of technology integration as opposed to stand-alone technology training. Pre-service teachers begin by identifying an authentic pedagogical problem that is subject-specific and integrating technology to solve the problem instead of beginning by learning a technology and attempting to use it in a simulated teaching situation. Further, discussions during the second step of planning and the third of designing materials center on a solution appropriate to the learners, pedagogical strategies and beliefs. The acquisition and modeling of such strategies will help the pre-service teachers to integrate technology into their pedagogy in their future classrooms and solve similar pedagogical problems in their daily practice.

Learning with Technology to Teach with Technology

Pre-service teachers in this implementation learned to integrate technology into their teaching while learning with technology in an online environment. The online collaborative mentoring experience acts as a loop input whereby pre-service teachers, through their own technology-supported learning, experience the multiple ways in which technology can be integrated in teaching. Role-modeling by mentor teachers helps them become more confident about using

technology in their own teaching (Koh and Divaharan 2011), although pre-service teachers might tend to apply technology in a similar way as observed in their mentor teachers (Doering et al. 2003). Nevertheless, pre-service teachers' firsthand experience of being mentored in online collaborations provides them with opportunities to learn about pedagogical technology application, experience it themselves as mentees, and later on implement it in their own practice.

These experiences with online mentoring and computer-supported collaborative learning involve online communication strategies, peer mentoring and online learning for pre-service teachers that will be valuable to them later in their teaching careers. Teachers, especially beginning teachers, often feel isolated teaching in their classrooms unless their schools have professional learning communities or opportunities for collaboration. In such a context, these pre-service teachers will be able to draw on their online experiences to find mentors or other teachers who teach similar subjects and can share resources.

Learning in a Collegial Community

Online mentoring in the MIM integrates an online modular approach of formal pedagogical ICT education in teacher education with an informal online learning community experience. Teacher educators and subject-specific mentors collaborate to mentor pre-service teachers online on a set of formal and structured tasks. Simultaneously and at every stage, the pre-service teachers discuss, share and critique their resources, plans and beliefs about teaching with technology grounded in a pedagogical problem with the teacher educator, the educational researcher, the subject-specific mentor and peers in an online environment. The inclusion of multiple perspectives and engagement from practicing expert teachers, teacher educators and their peers with the common goals of student learning and technology integration to enhance teaching can lead to the formation of a collegial community around the pedagogical integration of technology.

Ideally, it is expected that teacher educators and mentors will also share problems of practice and experiences where they integrated technology, and share their materials and lesson plans with pre-service teachers who adapt them or improve them using new technological solutions. This ensures that mentoring processes in the MIM do not just reinforce the one-directional flow of expert knowledge that is often the case in higher education but involve true collaboration and the generation of new ideas and ways of teaching with technology. Such processes would reflect a collegial community in which there are shifting roles and redefined positions as well as a dynamic distribution of and changing levels of expertise, which actually characterize collaborative learning (Strijbos and Weinberger 2010; Wenger 1998). Further, such a community can last beyond the teacher education program if hosted in a non-institution-specific learning environment, so that a true two-way process of sharing can be sustained. Pre-service teachers who graduate can share their initial teaching experiences with technology in their classrooms and teacher mentors and teacher educators can provide advice, but also learn about current classrooms and the implementation of new technologies.

Limitations

The main limitation of this study is that we studied the implementation of the MIM during teacher education coursework but we were unable to study the implementation of the teaching projects during the practicum. We recognize the need to conduct in situ research in schools on technology integration in the classrooms during the practicum, and that such research would emphasize the value of the MIM beyond pre-service teachers' perceptions and self-reported satisfaction with the mentoring experience. In terms of the model presented in this study, it was designed within the context of teacher education in Hungary. We believe that it has application in other countries and contexts but acknowledge that teacher educators would have to tailor it to their own context and needs, their students' needs, and the policy and standards for ICT competencies and technology integration. We also realize that the time, effort and coordination involved in collaborative mentoring by expert teachers, teacher educators and educational researchers during teacher education courses is not always possible or easy, despite the opportunities afforded by online technologies and computer-supported collaborative environments.

Conclusion

In this article, we described the use of the Mentored Innovation Model in a teacher education program where pre-service teachers learned to integrate technology in pedagogy with subject-specific teachers and teacher educators. In the Hungarian context this model will be of value in the newly created institutional teacher training centers, a recently launched new initiative, whose role is to coordinate and oversee all aspects of teacher training, which includes the theoretical and practical training of pre-service teachers. Online mentoring models such as the MIM that integrate the online modular approach of formal pedagogical ICT training and the informal online community experience of sharing and critiquing resources could serve as a platform to leverage expertise with the active online collaboration of teacher trainers, educational researchers, subject-specific mentors, mentor teachers at the host schools, pre-service teachers and also interested in-service teachers.

The teaching practices experienced by pre-service teachers in formal higher education often reflect a one-directional flow of knowledge, that of teacher educators to pre-service teachers. Notwithstanding the value of those experiences, including opportunities for discourse and reflection on pedagogy, technologies and technology integration in an approach such as the MIM facilitates the building of a community of pre-service teachers, in-service teachers, teacher educators and educational researchers where all participants could learn from the experiences of others. The involvement of multiple stakeholders and perspectives, exposure to online discourse, collaboration and teaching practices in online environments, and the focus on pedagogy and subject-matter while teaching with technology are valuable aspects of this approach for pre-service teachers that can be adapted based on the context-specific needs of other teacher education programs.

References

Abbitt, J. T. (2011). An investigation of the relationship between self-efficacy beliefs about technology integration and technological pedagogical content knowledge (TPACK) among pre-service teachers. *Journal of Digital Learning, 27*(4), 134–142.

Aust, R., Newberry, B., O'Brien, J., & Thomas, J. (2005). Learning generation: Fostering innovation with tomorrow's teachers and technology. *Journal of Technology and Teacher Education, 13*(2), 167–195.

Bai, H., & Ertmer, P. A. (2008). Teacher educators' beliefs and technology uses as predictors of pre-service teachers' beliefs and technology attitudes. *Journal of Technology and Teacher Education, 16*(1), 93–112.

Bolliger, D. U. (2004). Key factors for determining student satisfaction in online courses. *International Journal on E-Learning, 3*(1), 61. ERIC Document Reproduction Service ID EJ723807.

Bullock, D. (2004). Moving from theory to practice; An examination of the factors that preservice teachers encounter as the attempt to gain experience teaching with technology during field placement experiences. *Journal of Technology and Teacher Education, 12*(2), 211–237.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge: Harvard University Press.

Csordas, I., Fozo, A., Levaine-Muller, K., Toth-Mozer, Sz., & Viniczai, V. (2013). *Country Report on ICT in Education*. Brussels: European Schoolnet. Retrieved March 13, 2015 from http://www.eun.org/c/document_library/get_file?uuid=f8ff53ba-37a8-41fe-b6c3-adb59f4760c8&groupId=43887.

Doering, A., Hughes, J., & Huffman, D. (2003). Preservice teachers: Are we thinking with technology? *Journal of Research on Technology in Education, 35*(3), 342–361.

Dorner, H., & Karpati, A. (2010). Mentoring for innovation: Key factors affecting participant satisfaction in the process of collaborative knowledge construction in teacher training. *Journal of Asynchronous Learning Networks, 14*(3), 63–77.

Dorner, H. (2012a). Mentoring innovation through online communications in a digital culture. In S. Fletcher & C. Mullen (Eds.), *Handbook of mentoring and coaching in education* (pp. 169–183). London: Sage.

Dorner, H. (2012b). Effects with online mentoring in CSCL environments: mentor presence and cognitive engagement. *American Journal of Distance Education, 26*(3), 157–171.

Feiman-Nemser, S. (1998). Teachers as teacher educators. *European Journal of Teacher Education, 21*(1), 63–74.

Grove, K., Strudler, N., & Odell, S. (2004). Mentoring toward technology use: Cooperating teacher practice in supporting student teachers. *Journal of Research on Technology in Education, 37*(1), 85–110.

Hargrave, D., & Hsu, Y. (2000). Survey of instructional courses for pre-service teachers. *Journal of Technology and Teacher Education, 8*(4), 3030–3314.

Haydn, T. A., & Barton, R. (2007). Common needs and different agendas: How trainee teachers make progress in their ability to use ICT in subject teaching. Some lessons from the UK. *Computers & Education, 49*(4), 1018–1036.

Hobson, A. J., Ashby, P., Malderez, A., & Tomlinson, P. D. (2009). Mentoring beginning teachers: What we know and what we don't. *Teaching and Teacher Education, 25*, 207–216.

Johnson, R. D., Hornik, S., & Salas, E. (2008). An empirical investigation of factors contributing to the creation of successful e-learning environments. *International Journal of Human-Computer Studies, 66*, 356–369.

Judge, S., & O'Bannon, B. (2007). Integrating technology into field-based experiences: A model that fosters change. *Computers in Human Behavior, 23*(1), 286–302.

Karpati A., & Blamire R. (2008). *Evaluation and validation of the first European Learning Resource Exchange.* (Final Validation Report of the CALIBRATE project) Retrieved July 25, 2014 from http://calibrate.eun.org/shared/data/calibrate/deliverables/D4_2_Final_Validation_ReportFinal.pdf.

Kay, R. H. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education, 38*(4), 383–408.

Kember, D., & Kwan, K. P. (2000). Lecturers' approaches to teaching and their relationship to conceptions of good teaching. *Instructional Science, 28*, 469–490.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60–70.

Koh, J. H. L., & Divaharan, S. (2011). Developing pre-service teachers' technology integration expertise through the TPACK-developing instructional model. *Journal of Educational Computing Research, 44*(1), 35–58.

Koh, J. H. L., & Frick, T. W. (2009). Instructor and student classroom interactions during technology skills instruction for facilitating pre-service teachers' computer self-efficacy. *Journal of Educational Computing Research, 40*(2), 207–224.

Liaw, S.-S., & Huang, H.-M. (2013). Perceived satisfaction, perceived usefulness and interactive learning environments as predictors to self-regulation in e-learning environments. *Computers & Education, 60*, 14–24.

Liu, S. H. (2012). A multivariate model of factors influencing technology use by pre-service teachers during practice teaching. *Educational Technology & Society, 15*(4), 137–149.

Mathur, S. R., Gehrke, R., & Kim, S. H. (2013). Impact of a teacher mentorship program on mentors' and mentees' perceptions of classroom practices and the mentoring experience. *Assessment for Effective Intervention, 38*(3), 154–162.

Mullen, C. A. (Ed.). (2009). *The handbook of leadership and professional learning communities*. New York: Palgrave Macmillan.

Nilsson, P., & Driel, J. (2010). Teaching together and learning together: Primary science student teachers' and their mentors' joint teaching and learning in the primary classroom. *Teaching and Teacher Education, 26*(6), 1309–1318.

Ottenbreit-Leftwich, A., Glazewski, K., Newby, T., & Ertmer, P. (2010). Teacher value beliefs associated with using technology: addressing professional and student needs. *Computers & Education, 55*, 1321–1335.

Polly, D., Mims, C., Shepherd, C., & Inan, F. (2010). Evidence of impact: Transforming teacher education with preparing tomorrow's teachers to teach with technology (PT3) grants. *Teaching and Teacher Education, 26*, 863–870.

Rice, W. H. (2007). *Moodle teaching techniques*. Birmingham: Packt Publishing.

Sahin, M. (2008). Cross-cultural experience in pre-service teacher education. *Teaching and Teacher Education, 24*(7), 1777–1790.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4–14.

Singer, J., & Maher, M. A. (2007). Pre-service teachers and technology integration: Rethinking traditional roles. *Journal of Science Teacher Education, 18*(6), 955–984.

Strijbos, J. W., & Weinberger, A. (2010). Emerging and scripted roles in computer-supported collaborative learning. *Computers in Human Behavior, 26*, 491–494.

Teo, T. (2009). Modelling technology acceptance in education: A study of pre-service teachers. *Computers & Education, 52*, 302–312.

Thomson, A. D., Schmidt, D. A., & Davis, N. E. (2003). Technology collaboratives for simultaneous renewal in teacher education. *Educational Technology Research and Developments, 51*(1), 73–89.

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education, 59*, 134–144.

United Nations Educational, Scientific and Cultural Organization (2008). *ICT competency standards for teachers. Competency standards modules.* Paris: UNESCO. Retrieved July 6, 2014, from http://cst.unesco-ci.org/sites/projects/cst/The%20Standards/ICT-CST-Competency%20Standards%20Modules.pdf.

United Nations Educational, Scientific and Cultural Organization (2011). UNESCO ICT competency framework for teachers. Paris: UNESCO. Retrieved July 6, 2014, from http://unesdoc.unesco.org/images/0021/002134/213475e.pdf.

Wang, J. (2001). Contexts of mentoring and opportunities for learning to teach: A comparative study of mentoring practice. *Teaching and Teacher Education, 17*, 51–73.

Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.

Wepner, S. B., Ziomek, N., & Tao, L. (2003). Three teacher educators' perspectives about the shifting responsibilities of infusing technology into the curriculum. *Action in Teacher Education, 24*(4), 53–63.