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Learning to teach online: a systematic review of the literature on K-12 teacher preparation for teaching online

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ABSTRACT

There is a growing need for qualified online instructors to teach the expanding population of online K-12 students. To meet this need, teachers must be provided learning opportunities to acquire the specific types of knowledge and skills necessary to teach online. In this systematic review of the literature, we utilize the TPACK framework to aggregate the types of knowledge and skills required to teach online and examine both the extent to which these elements are addressed in existing programs and are based on empirical research. Findings suggest that the types of knowledge and skills based on empirical research originate from few studies and that most programs address only a small subset of knowledge and skills, varying greatly without uniformity in content or learning experiences.

Online learning opportunities for K-12 students have steadily increased over the last 20 years (Kennedy & Archambault, 2012; Watson, Murin, Vashaw, Gemin, & Rapp, 2013), and currently every state in the United States has some form of state-level program offering online courses (Watson et al., 2013). As well, K-12 students are increasingly being required to successfully complete an online course in order to fulfill graduation requirements (Watson, Gemin, Ryan, & Wicks, 2009). To meet the needs of online learners, high quality online teachers are required, but often teachers are placed in these roles without formal training in online teaching and are expected to learn on the job, through brief professional development sessions, or short workshops (Rice & Dawley, 2009). Not surprisingly, these learning experiences have not been sufficient for developing effective online teachers (Archambault, 2011; Rice & Dawley, 2009). Additionally, preservice teacher education programs have been slow to implement courses and fieldwork pertaining to online instruction. Currently no national or state standards exist for such training with most recommendations coming from teacher professional organizations with little or no basis in empirical research (Compton & Davis, 2010; Kennedy & Archambault, 2012).

Research on teacher preparation for online teaching is developing, and best practices are beginning to emerge (e.g., Compton, 2009; Davis & Rose, 2007; DiPietro, Ferdig, Black, & Preston, 2008; Ferdig, Cavanaugh, DiPietro, Black, & Dawson, 2009; Harms, Niederhauser, Davis, Roblyer, & Gilbert, 2006; Kennedy & Archambault, 2012; Rice & Dawley, 2009). However,

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the recommended types of knowledge and skills are typically derived from case studies of individual programs and/or their development (e.g., Ahn, 2011; Bose, 2013; Compton & Davis, 2010; Compton, Davis, & Mackey, 2009; Dabner, Davis, & Zaka, 2012; Macdonald & Poniatowska, 2011), exploration of programs particular to content areas (e.g., Covington, Petherbridge, & Warren, 2005; Karlsson, 2004), expert editorials (e.g., Davis & Ferdig, 2009; Davis & Rose, 2007; Harms et al., 2006), or self-reported survey research from surveys of online instructors (e.g., Archambault, 2011; Black, DiPietro, Ferdig, & Polling, 2009; Dawley, Rice, & Hinck, 2010; Kennedy & Archambault, 2012; Rice & Dawley, 2009).

Although previous research (Ferdig et al., 2009) has aggregated best practices for online teaching, a systematic examination of the types of knowledge and skills required by online teachers and the extent to which these elements are addressed in online teacher preparation programs has not been conducted. This study aims to fill this important gap and to provide recommendations to programs tasked with preparing teachers to teach online. By aggregating the types of knowledge and skills required to teach online and examining existing programs for evidence that they address these elements, this study ties together theory and practice and provides both a theoretical and practical foundation upon which future programs can build. This work is guided by the following research questions:

(1)   What are the types of knowledge and skills teachers require to effectively teach online?

(2)   To what extent are the types of knowledge and skills required by teachers to teach online suggested by the literature based on empirical research?

(3)   To what extent are the identified types of knowledge and skills required by teachers to teach online addressed in teacher learning programs?

Conceptual framework

Online instruction differentiates itself from face-to-face instruction in that it is based within a virtual environment. Communication between instructor and student, and among students, is solely facilitated through the use of technological tools. This particular context requires teachers to understand how to effectively utilize technology for instruction, as opposed to in a face-to-face setting, in which the use of technology in instruction can be nonessential. Teachers must have specific knowledge of pedagogy, content, and technology, as well as an understanding of how these elements interact to teach in virtual environments. Therefore, the technological pedagogical content knowledge (TPACK) framework (Mishra & Koehler, 2006) is utilized in this study as a lens for examining teacher knowledge.

The use of the TPACK framework is aligned with research on teacher preparation for online teaching (Archambault, 2011) and incorporates technological, pedagogical, and content knowledge (CK) as three interconnected knowledge domains that should be considered together when designing and facilitating instructional activities. This framework differs from traditional views of technology integration where technology is often considered as a stand-alone component. The TPACK framework is appropriate to consider teacher knowledge in terms of virtual teaching as the use of technology in this context is ubiquitous. The tripartite integrated nature of TPACK provides teachers a framework for understanding how to use technology to create more authentic and relevant virtual learning experiences, as opposed to simply learning about the technology and how to use it for more general purposes (Mishra & Koehler, 2006).
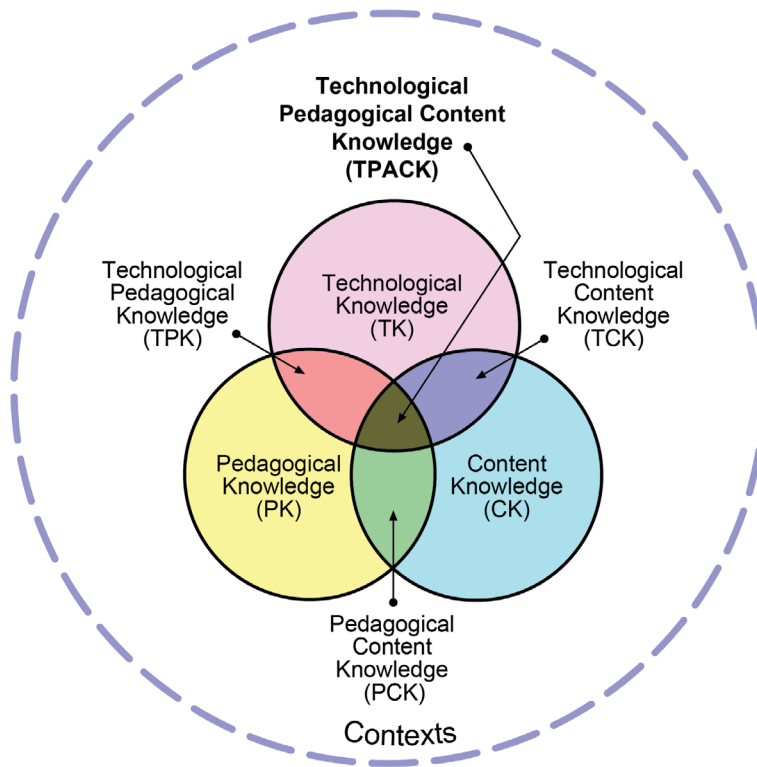
Figure 1. The TPACK framework. Reproduced by permission of the publisher, © 2012 by tpack.org.

The TPACK framework is comprised not only of the three core domains (CK, pedagogical knowledge (PK), and technology knowledge), but also of knowledge domains that exist in the intersections of these three (pedagogical content knowledge (PCK), technological content knowledge (TCK), and technological pedagogical knowledge (TPK)), and the knowledge domain that lies in the intersection of all three domains (TPACK) (Mishra & Koehler, 2006). Figure 1 illustrates the domains of the TPACK framework.

CK is knowledge about the subject matter being taught, PK is knowledge concerning the methods of teaching, and technological knowledge (TK) is knowledge regarding the use of technological tools. PCK is consistent with Shulman's (1986) theory that knowledge of pedagogy should be specific to a given content area. TCK is the understanding of the reciprocal relationship between a content area and technology. TPK is comprehension of how technology is used in the service of teaching and learning. Finally, TPACK is the culminating knowledge of all single and combined knowledge domains considered together as interrelated parts (Mishra & Koehler, 2006).

Method

Data collection

The literature was searched using the EbscoHost Web online search tool. The databases chosen for the search were Academic Search Complete, Computers & Applied Sciences

Complete, Education Research Complete and Teacher Reference Center. Within these databases, we applied the following abstract Boolean search criteria:

> (AB 'cyber school' OR AB 'online' OR AB 'virtual school' OR AN 'online learning' OR AB 'virtual learning' OR AB 'distance learning') AND (AB 'K12' OR AB 'K-12' OR AB 'secondary' OR AB 'high school') AND (AB 'teacher preparation' OR AB 'teacher education').

The terms chosen in the first set of parentheses (cyber school, online, virtual school, online learning, virtual learning, distance learning) narrowed the search to fully online programs. The second set of terms (K12, K-12, secondary, high school) limited results to K-12 institutions, while the third set of search terms (teacher preparation, teacher education) limited the results to studies examining teacher education in these areas. The Boolean search terms AND and OR were included to allow for as many results as possible, given that there were a variety of terms applied to online learning. The search was limited to articles published in or after 2004, a timespan reflective of the current state of online learning and teacher preparation in this area. Only peer-reviewed journals were included. The search yielded 99 results, of which 36 were repeat entries, leaving 63 articles to be reviewed.

In the second phase of the review, the first author read each article and applied the inclusion criteria that each article explicitly considers teacher education for online teaching, including both preservice and inservice teacher programs, which narrowed our sources to 15. From these 15 sources, a legacy search was conducted that yielded nine additional sources. To conduct this legacy search, the first author examined the references cited by these 15 sources, looking for articles that met the inclusion criterion. Although some of these sources predated the 2004 criterion from the original search, they were deemed relevant by the first two authors and were included.

In the third phase of the review, authors who had written extensively on this topic were identified. Using the bibliographies of their personal websites, Google Scholar and the EbscoHost Web online search tool, we identified two additional sources to be included in the review, for a total of 26 studies to be reviewed.

Data analysis

Studies were first categorized into four types (see Table 1) to allow for a differentiated analysis according to the nature of the study: editorials and conceptual papers, examination of existing programs, (review of literature, and online teacher self-report data.

Second, types of knowledge and skills required to teach online were extracted from each of the studies. Several types of knowledge and skills were reported in multiple studies, and often were simply described in different ways. For clarity, duplicate types of knowledge and skills were removed, leaving 116. Of those 116 types of knowledge and skills, only the types of knowledge and skills from two studies (DiPietro et al., 2008; Rice & Dawley, 2009) were derived from empirical research, and are noted with italics in Table 2.

Lastly, to contextualize these types of knowledge and skills in terms of teacher knowledge domains, all 116 were then categorized into the seven knowledge domains of the TPACK framework (see Table 2). The first two authors categorized types of knowledge and skills individually and then compared the results. In case of disagreement, the authors discussed the categorization process until agreement was reached. Types of knowledge and skills, as

Table 1. Articles by type.

Type	Author(s)
Editorials/conceptual papers	Davis and Ferdig (2009)
	Davis and Rose (2007)
	Ferdig et al. (2009)
	Harms et al. (2006)
Examination of existing program	Ahn (2011)
	Bose (2013)
	Compton and Davis (2010)
	Compton et al. (2010)
	Compton et al. (2009)
	Covington et al. (2005)
	Dabner et al. (2012)
	Davis and Roblyer (2005)
	Davis et al. (2007)
	DiPietro et al. (2008)
	Duncan and Barnett (2009)
	Karlsson (2004)
	Macdonald and Poniatowska (2011)
	Townsend and Nail (2011)
	Turvey (2008)
Review of literature	Cavanaugh, Barbour, and Clark (2009)
	Compton (2009)
Online teacher self-report data	Archambault (2011)
	Black et al. (2009)
	Dawley et al. (2010), Kennedy and Archambault (2012)
	Rice and Dawley (2009)

identified in the literature, could also span one or more TPACK knowledge domains. For example, previous experience as a learner in an online environment could contribute to teacher knowledge in terms of TK (knowing how to use different platforms or technologies) and TPK (knowing pedagogical strategies specific to online teaching) and would therefore be listed under both knowledge domains.

TK includes items related to a teacher's knowledge of the technologies used for virtual instruction, such as the platform or learning management system being utilized, outside technology tools such as social media, and different media such as digital images and video. CK focuses on the teacher's knowledge of the subject matter itself (Mishra & Koehler, 2006). Therefore, the knowledge and skills listed under this domain were not technology specific, as online teachers must attain the same level of CK as their face-to-face counterparts. PK includes knowledge of methods for teaching and learning (Mishra & Koehler, 2006). Online teachers use foundational knowledge derived from face-to-face teaching and extend this knowledge into an online environment.

The intersections of the three primary knowledge domains in the TPACK framework were also evident in the literature. In an online environment, teachers must effectively convey content-specific ideas and concepts without face-to-face interaction, but rather, through text, synchronous and asynchronous video, or digital audio. The knowledge and skills required to do this were categorized under the TCK domain. TPK, the understanding of how technologies are used for instruction, includes the ability of an online teacher to apply his or her PK to the virtual platform. The knowledge and skills categorized under this domain include an online teacher's capacity for selecting the appropriate media to enhance interaction and learning among students. PCK is the unique knowledge required by teachers to transform specific content into attainable knowledge for students. PCK in the online

Table 2. Types of knowledge and skills by TPACK knowledge domain.

TPACK knowledge domain	Knowledge and skills extracted from the literature
Technological knowledge (TK)	*Skilled with basic uses of technology*
	Ability to use a range of software
	Ability to identify features of different software
	Understanding of constraints and possibilities of different software
	Ability to deal with constraints and possibilities of different software
	Ability to create basic web pages
	Ability to construct interactive web pages
	Teacher has the prerequisite technology skills to teach online
	Master the interfaces in which instruction will be delivered
	Continually extend their content and technological knowledge
	Uses technology to deliver content
	Require technical knowledge to be able to function in the online environment
	Understand impact of course pacing on course design and the pedagogical strategies they use
	Build in course components to reflect the interests of students enrolled in the course
	Knowledge of curriculum design and frameworks for online learning
	Basic knowledge of course evaluation
	Ability to apply curriculum design and frameworks for online (language) learning
	Ability to evaluate online (language) learning course based on one or more frameworks and to modify components accordingly
	Intuitive and integrated evaluation of online (language) learning tasks based on one or more frameworks
	Intuitive and integrated formative evaluations of online (language) course
	Produces course requirements and timetable
	Provides a comprehensive set of informational materials
	Motivate students by clearly organizing and structuring content
	Teacher arranges media and content to help students and teachers transfer knowledge most effectively in the online environment
	Develop and deliver activities that are collaborative, highly interactive, and motivating, while encouraging engagement with the content
	Know when to develop resources to service specific purposes
	Seek out and make available a variety of supplemental support tools to meet the diverse needs of students
	Ability to choose suitable technology to match online (language) learning task
	Creativity in using and adapting technology for online (language) learning tasks
	Creativity in using and adapting materials to create new online (language) materials and tasks to facilitate communicative competence and online interaction
	Understands how to use and select appropriate resources
	Knowledge of basic programming language
	Ability to troubleshoot basic browser problems
	Communicates available tech support
	Communicates abilities to provide tech support
	Teacher has experienced online learning from the perspective of a student
Content knowledge (CK)	*Have extensive knowledge of an appreciation for the content area they teach*
	Shared knowledge of content standards and curriculum resources
	Has content and pedagogy knowledge
	Continually extend their content and technological knowledge
Pedagogical knowledge (PK)	*Use student and course data to self-evaluate pedagogical strategies they use*
	Use multiple strategies to assess student learning
	Use alternative assessment strategies that allow students the opportunity to represent their knowledge in ways that are personally meaningful
	Use multiple strategies to form relationships that support rich interactions with students
	Use strategies to connect with students
	Engage students in conversation about content and non-content related topics to form a relationship with each student
	Basic knowledge of task evaluations
	Has content and pedagogy knowledge
	Develop and deliver activities that are collaborative, highly interactive, and motivating, while encouraging engagement with the content
	Understand how and when to provide appropriate supports
	Use strategies to address inappropriate or abusive behaviors of the students in public forums of the course

(Continued)

Table 2. (*Continued*)

TPACK knowledge domain	Knowledge and skills extracted from the literature
	Monitor venues of public communications in their course to identify students in personal crisis
	Outlines materials and notifies students of changes
	Supports time management skills
	Observes conduct and academic honesty policies
	Monitors student interactions and communication
	Balances structure and flexibility
	Promote full participation
	Establish a presence on the course to motivate students
	Interact with students with quick feedback to maintain their motivation for completing the course
	Model what 'formal' online communication looks like in discussion board and emails
	Effectively monitor the tone and emotion of their communications with students
	Provides multiple opportunities for communication
	Provides quick responses, meaningful feedback
	Models and participates in student discussions
	Facilitate discussion in a way that keeps students on task
	Develop co-presence in VS classroom
	Create a supportive and interactive environment with mutual support and respect
	Teacher provides online leadership in a manner that promotes student success through regular feedback, prompt response and clear expectations
	Understand how to provide opportunities for students to interact with one another and the instructor
	Encourage and support communication between students
	Facilitate the formation of community by encouraging content and non-content related conversations among students
	Knowledge of strategies to facilitate communicative competence and online interaction
	Ability to facilitate communicative competence and online interaction
	Fosters participation and collaborations
	Fosters a sense of community and interaction
	Manage student communication
	Active teacher involvement in monitoring and engaging student discussion
	Become a master of written communication
	Develops critical thinking skills
	Can make modifications to content and delivery
	Accommodates student differences
	Teacher understands and is responsive to students with special needs in the online classroom
	Know when to develop resources to service specific purposes
	Can team teach
	Ability to apply (language) learning theories for online (language) learning
	Knowledge of strategies for online (language) assessment
	Ability to assess (language) learning using different assessment methods
	Intuitive and integrated assessment of (language) learning
	Evaluate and assesses students, including student self-assessment
	Teacher demonstrates competencies in creating and implementing assessment in online learning environments in ways that assure validity and reliability of instruments and procedures
	Teachers develops and delivers assessments, projects, assignments that meet standards-based learning goals and assesses learning progress by measuring student achievement of learning goals
	Teacher demonstrates competencies in using data and findings from assessments and other data sources to modify instructional methods and content and to guide student learning
	Teacher demonstrates frequent and effective strategies that enable both teacher and students to complete self- and pre-assessments
	Knowledge of strategies for online community building and socialization
	Ability to foster online community and socialization
	Creativity in facilitating online socialization and community building
	Becomes a part of the learning communities
	Teacher models, guides, and encourages legal, ethical, safe and healthy behavior related to technology use
	Use Ability to assess (language) learning using different assessment methods
	Teacher has experienced online learning from the perspective of a student

Table 2. (*Continued*)

TPACK knowledge domain	Knowledge and skills extracted from the literature
Technological content knowledge (TCK)	*Use their content knowledge and knowledge of students to drive the integration of technology*
	Teacher arranges media and content to help students and teachers transfer knowledge most effectively in the online environment
	Develop and deliver activities that are collaborative, highly interactive, and motivating, while encouraging engagement with the content
	Know when to develop resources to service specific purposes
Technological pedagogical knowledge (TPK)	Teacher arranges media and content to help students and teachers transfer knowledge most effectively in the online environment
	Develop and deliver activities that are collaborative, highly interactive, and motivating, while encouraging engagement with the content
	Knowledge of language learning theories for online (language) learning
	Provides multiple opportunities for communication
	Providing multiple opportunities for interaction through various media
	Consider issues of student access to technology when integrating web based components into their course
	Teacher models, guides, and encourages legal, ethical, safe and healthy behavior related to technology use
	Understand how to provide opportunities for students to interact with one another and the instructor
	Teacher has experienced online learning from the perspective of a student
	Use strategies to address inappropriate or abusive behaviors of the students in public forums of the course
Pedagogical content knowledge (PCK)	*Monitor venues of public communications in their course to identify students in personal crisis*
	Outlines materials and notifies students of changes
	Supports time management skills
	Observes conduct and academic honesty policies
	Monitors student interactions and communication
	Balances structure and flexibility
	Promote full participation
	Outlines materials and notifies students of changes
	Provides multiple opportunities for communication
	Understand how to provide opportunities for students to interact with one another and the instructor
Technological pedagogical content knowledge (TPACK)	Supports time management skills
	Observes conduct and academic honesty policies
	Monitors student interactions and communication
	Balances structure and flexibility
	Promote full participation
	Teacher provides online leadership in a manner that promotes student success through regular feedback, prompt response and clear expectations
	Master of written communication
	Participate in a field experience for online K12 learning

Note. Types of knowledge and skills that are italicized are derived from empirical studies.

environment includes the knowledge and skills for creating opportunities for students to interact with the content. The intersection of all core and intersection knowledge domains results in a teacher's TPACK, of which the types of knowledge and skills are listed in the last section of the table.

To reconcile theory with existing practice, the final step of the analysis was to identify the extent to which these types of knowledge and skills were addressed in existing programs. In alignment with our conceptual framework, studies categorized as examinations of existing programs were analyzed for evidence that they addressed these types of knowledge and skills within the TPACK knowledge domains.

Results

Three key findings emerged from our review of the literature. First, the knowledge and skills based on empirical research came from only two studies: DiPietro et al. (2008) and Rice and Dawley (2009). Second, of the nine programs examined that were designed to prepare teachers to teach online, only one addressed at least six of the seven knowledge domains of TPACK. Third, programs to prepare teachers to teach online varied greatly, without uniformity in content or learning experience.

Research-based types of knowledge and skills

Of the 26 studies examined in this review of literature, six presented types of knowledge and skills necessary for an online instructor. Of those six, only two identified empirical research as the basis for the practices (DiPietro et al., 2008; Rice & Dawley, 2009). DiPietro et al. present a table of best practices for online teaching utilizing data from both observations and interviews of 16 virtual teachers at the Michigan Virtual School. These practices were consolidated in a table along with the description of the particular practice, a direct quote from a study participant concerning how they incorporated this into their virtual classroom, and a reference to past research on best practices for teachers in the face-to-face setting. DiPietro et al. reported that references used in their study did not necessarily pertain to virtual learning, but rather to teaching theory as a whole. Rice and Dawley (2009) gleaned their list of suggested practices for online teacher professional development from a national survey of various stakeholders in the field of online education, such as teachers and administrators.

The remaining studies providing knowledge and skills aggregated in this review rely heavily on recommendations for face-to-face instruction, an issue also noted by DiPietro et al. (2008). In another review of literature, Compton (2009) examined programs to prepare teachers to teach world languages online. Compton concluded that few studies have been conducted identifying the skills needed for online teachers and that most recommendations in this area come from existing knowledge on face-to-face instruction.

Additionally, it is worth noting that the literature on the creation of the Iowa State University program Teacher Education Goes Into Virtual Schooling (TEGIVS) provided many of the recommendations listed in Table 2 (Ferdig et al., 2009; Harms et al., 2006). Compton et al. (2009) discuss how the TEGIVS program was originally created to help meet the needs of online teachers who were required to rapidly shift from years of teaching in the face-to-face setting to successful instruction in the virtual classroom. For this program, a model curriculum was designed to educate teachers in online teaching and virtual learning communities (Harms et al., 2006). This instruction included the incorporation of certain types of knowledge and skills adapted from teacher education for face-to-face instruction (Davis & Rose, 2007).

The programs we identified in the literature designed to prepare teachers to teach online varied greatly, in particular when examining which TPACK domains were addressed. Figure 2 shows that only the TPK domain was addressed in all programs and the CK domain was absent in all programs. Aside from these consistencies among programs, the remaining knowledge domains were variably addressed in programs, with some programs focusing more on technological domains and others focusing on more pedagogical domains. Of the nine programs, only the TEGIVS program was found to incorporate nearly all of the domains of TPACK, lacking only the CK domain of the framework. Table 3 provides an illustration of
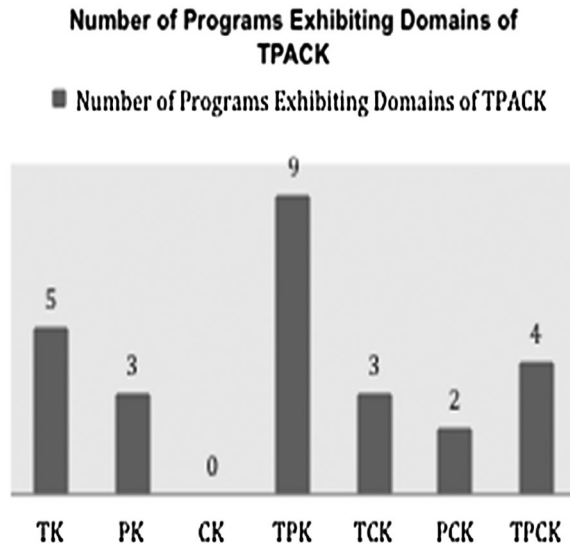
Number of Programs Exhibiting Domains of TPACK

■ Number of Programs Exhibiting Domains of TPACK

Figure 2. Number of programs exhibiting domains of TPACK.

Table 3. Individual programs (by author when program name was not given) inclusion of TPACK domains.

	TEGIVS (Compton et al., 2010; David & Roblyer, 2005; Davis et al., 2007)	Turvey, 2008	The Online Writing Partner-ship (Townsend & Nail, 2011)	Distance Teacher Education with PBL (Karlsson, 2004)	Dabner et al., 2012	Bose, 2013	Compton & Davis, 2010	Compton et al., 2009	Duncan & Barnett, 2009
TK	♦		♦	♦	♦				
CK									
PK	♦	♦				♦			
TCK	♦		♦		♦	♦			
TPK	♦	♦	♦	♦	♦	♦	♦	♦	♦
PCK	♦					♦			
TPCK	♦						♦	♦	♦

the TPACK knowledge domains that were addressed in each of the nine programs examined in this review.

As illustrated in Table 3, most programs focused on one or more specific areas rather than incorporate all of the elements of TPACK. Even in the one program that cited TPACK as their model (Bose, 2013), the creators conceded that they were unsuccessful in their attempt to include all knowledge domains. Five programs focused primarily on technological aspects of online teaching. Townsend and Nail (2011) discussed a program in which technology (e.g., email, discussion boards) was used to connect pre-service teachers with high school students to enhance the writing skills of the students with which they were working. Pre-service teachers were instructed on how to use the technology to present their writing critiques, and no other domains of TPACK were incorporated into the program. Program developers, however, noted this, and planned to include more pedagogical elements as well as learning activities for developing virtual social presence and learning community. Dabner et al. (2012),

examined a professional development program designed to instruct teachers in the use of technology specific to their content areas, aligning with the TK and TCK domains.

Variance in examined programs

Three of the programs we examined in this study included a field experience (Compton, Davis, & Correia, 2010; Compton et al., 2009). Compton and Davis (2010) examined a field experience in which participants were introduced to the online course through a series of instructional modules that addressed the TCK and TPK knowledge domains. A study of a similar field experience (Compton et al., 2009), addressed the TPK and PK domains, but did not address many of the types of knowledge or skills within the domain of TK.

With one exception, the studies detailing professional development programs for teachers were designed to teach the skills needed for online teaching, not for teachers to meet licensing requirements (Bose, 2013; Dabner et al., 2012). The exception, Kennedy and Archambault (2012), explored a program that would make online teaching an additional endorsement. According to the authors, the inclusion of endorsement requirements is a necessary consideration for future programs to prepare online teachers, especially given the numbers of states considering requiring an online teaching endorsement. So, while many study authors note this requirement, most studies assumed that online teachers were already endorsed in their subject area. As such, they varied on how rules regarding an online teaching endorsement would affect individual programs.

Programs also varied in their overall structure. Some programs were individual courses designed to introduce the participants to the concepts behind online learning (Bose, 2013; Compton & Davis, 2010; Compton et al., 2009; Dabner et al., 2012; Duncan & Barnett, 2009), while other programs were courses specifically designed to instruct potential online teachers to teach a certain subject (i.e., English composition, engineering, elementary enrichment) (Karlsson, 2004; Townsend & Nail, 2011; Turvey, 2008). The length of programs also varied. Some were as short as a single course (Compton et al., 2009; Dabner et al., 2012; Duncan & Barnett, 2009; Karlsson, 2004). Others, such as TEGIVS, were comprehensive programs designed to complement the teacher education experience. Still others were programs not affiliated with a particular subject area and varied in length from a month-long session or workshop to a small collection of courses (Bose, 2013; Compton & Davis, 2010; Townsend & Nail, 2011; Turvey, 2008).

Discussion and implications

This review of the literature revealed that of the 26 studies examined, only six provided a list of types of knowledge and skills reported as necessary for effective online teaching. Of those six studies, only two were based on empirical research, while the remaining four studies from which types of knowledge and skills were extracted were mostly adaptations of the skill sets required for face-to-face teaching. This finding indicates a clear need for further empirical research on teacher preparation for teaching online and also suggests an examination of how best practices for traditional teacher preparation may inform best practices for preparing teachers for virtual teaching. With decades of research on preparing teachers for face-to-face instruction, it seems fruitful to examine how these practices may transfer to online teaching. Moreover, an analysis of this type would illustrate the differences between

teaching in these two environments and allow programs to focus on the differences in courses for inservice teachers who already possess the required skills in face-to-face teaching. Additionally, identification of the similarities and differences between what teachers need to know for effective virtual teaching and face-to-face teaching should inform teacher preparation programs in both areas. This seems especially relevant as many school districts are now implementing one-to-one device programs, which transforms a traditional classroom into a hybrid-teaching environment. Although states and other educational organizations are currently considering additional licensure and add-on endorsements for online teaching, it seems likely that, in the near future, all teachers will be required to teach in both environments, and be able to seamlessly switch between environments to maximize the affordances of each. This type of knowledge is effectively articulated in the TPACK framework.

The TPACK framework possesses several benefits for examining teacher preparation for online teaching. The framework can provide a common language to examine the use of technological tools that greatly differ in purpose and design, such as massively open online courses, open educational resources, social media, digital fabrication, as well as the use of tools that fundamentally change the relationships between teachers and students, among students, and between students and content. The framework is also useful for examining programs that aim to assist teachers in teaching with these new technologies. By considering programs' learning activities through the knowledge domains of the TPACK framework, we can better understand how these experiences contribute to effective teaching with technology.

Our examination of programs described in the literature through the lens of the TPACK framework generated several themes. First, only the TPK domain was present in every program examined. This suggests that programs typically consider the relationship between the technologies used and the strategies and methods for virtual teaching as fundamental in online teaching. That this was the only domain evident in all of the programs examined warrants concern, as effective online teaching requires knowledge above and beyond the TPK domain. Second, TK was absent from five programs but was a primary focus of the other four. This sharp dichotomy may illustrate fundamental differences across programs or more nuanced differences in how these programs address the need for training on the use of technological tools and their expectations of requisite knowledge of their participants. Considering these two themes together suggests that some programs address TK through TPK, while others make an additional consideration of providing teachers with learning experiences solely about different technologies. The third theme is the absence in all programs of elements to address CK. This was likely due in part to some programs requiring a certain level of CK as a prerequisite to participation. For example, many programs were single course offerings or professional development for in-service teachers who, it is assumed, already possess sufficient CK. The TEGIVS program was incorporated into an existing teacher preparation program, which required prior CK (Davis & Roblyer, 2005). Therefore, indirectly, the CK domain may be addressed by the placement of programs within larger programs or the pre-requisite skills required of their participants. Similarly, few programs addressed PCK, which may also be due to the same reasons, as PCK is generally considered a domain of knowledge required by teachers for effective face-to-face teaching.

A final variation across programs was the inclusion or absence of a field experience. Three programs contained field experiences, and the studies examining these programs reported that participants felt the experience was an important part of their understanding

of the expectations and responsibilities of an online teacher. There is general agreement on the benefits of a field experience in preparing teachers for face-to-face teaching (Huling, 1998; Knowles & Cole, 1996), and several of the studies in this review suggest these same benefits may apply in preparing teachers for online teaching (Compton & Davis, 2010; Compton et al., 2009; Compton et al., 2010; Kennedy & Archambault, 2012). Field experiences not only address misconceptions in online learning (Compton & Davis, 2010; Compton et al., 2009; 2010), but also prepare teachers to use the required technology in a non-threatening environment (Archambault, 2011). Field experiences have also been shown to improve participants' development of virtual community and social presence, a primary challenge in online teaching (Compton & Davis, 2010; Compton et al., 2009; Kennedy & Archambault, 2012).

In addition to incorporating a field experience, organizations can also utilize the TPACK framework as a foundation on which to design effective learning experiences to improve teachers' knowledge and skills in virtual teaching. Addressing each of the domains in the framework and considering how each domain relates to the others may provide a program with a common language to discuss technology-rich instruction, the foundation of online teaching. It may also serve to uncover gaps, such as the absence of elements addressing TK in many of the programs reviewed in this study. Programs should also consider how PK and PCK should be accounted for in these types of programs. As all three core domains (CK, PK, TK) work together to facilitate learning in a technology-rich environment, teacher learning activities should be informed by these principles as well.

Efforts to design programs to improve teachers' knowledge and skills in virtual teaching will be bolstered through additional empirical research in this area. Such research should examine the connections between teacher preparation for face-to-face teaching and virtual teaching, effective use of hybrid teaching environments, emerging technologies for virtual teaching, and effective teaching and learning experiences in this area. Of the studies examined in this review, most reported on the development and initial implementation of professional development and teacher preparation programs. As there is little research on programs to prepare teachers to teach online, we only have knowledge of programs that have been a part of empirical research. Furthermore, future research should examine the effects of such programs on both teachers and their students. Research of this kind would continue to inform state and federal guidelines in terms of teacher credentials, teacher professional development, and pre-service teacher preparation.

Conclusion

This systematic review of the literature aggregates the types of knowledge and skills essential to effectively teach online and critically examines how these elements are operationalized in current programs for training teachers to teach online. In doing so, this research addresses both theory and practice, and provides recommendations for developing teacher learning programs as well as an illustration of the extent to which these recommendations are being operationalized in practice. The findings indicate that many of the reported skills and types of knowledge required for effective online teaching are not based on empirical evidence and are often adaptations of face-to-face teaching practices. In addition, few programs address the range of skills and knowledge required by teachers to effectively teach online. As the number of online learning opportunities increase for K-12 students, both in the form

of completely online and as hybrid learning experiences, these findings are important as the need for highly effective online teachers increases as well.

Implications of the findings are not limited to teacher preparation for online teaching, but for teacher preparation more broadly as more schools are adopting one-to-one device initiatives that transform a traditional classroom into a hybrid-learning environment. While educational leaders consider new accreditations for online teachers, a holistic re-evaluation of teacher preparation may be in order to account for the rise in digital technologies that are present in many classrooms. By considering virtual teaching best practices alongside of face-to-face instruction, affordances of both should become evident.

As evidenced by this review, there is a need for further empirical research on the skills and knowledge required to effectively teach online. Findings from such studies will significantly inform the development and implementation of teacher preparation programs in this area. Developing best practices for teacher education in online instruction will also inform evolving best practices for teacher preparation more broadly. Currently, practices in this area vary greatly, with programs often focusing on specific sub-components. The fragmented landscape of teacher preparation practices in this area is not conducive to producing consistently effective online teachers, which may result in diminished student learning in this emerging field. Through use of the TPACK framework, this review provides a theoretical foundation for programs to use in developing effective teacher preparation programs for online learning, and adds to the literature base on both required skills and knowledge for effective online teaching as well as teacher preparation in this area.

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No potential conflict of interest was reported by the authors.

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References

Ahn, J. (2011). Policy, technology, and practice in cyber charter schools: Framing the issues. *Teachers College Record, 113*, 1–26. doi:10.1080/294.2416

Archambault, L. (2011). The practitioner's perspective on teacher education: Preparing for the K-12 online classroom. *Journal of Technology and Teacher Education, 19*, 73–91. Retrieved from http://site.aace.org/pubs/jtate/

Black, E., DiPietro, M., Ferdig, R., & Polling, N. (2009). Developing a survey to measure best practices of K-12 online instructors. *Online Journal of Distance Learning Administration, 12*(1). Retrieved from http://www.westga.edu/~distance/ojdla

Bose, S. (2013). Integrated teacher education programme for open distance learning: A model for development and implementation. *Open Learning: The Journal of Open, Distance and e-Learning, 28*, 120–134. doi:10.1080/02680513.814534

Cavanaugh, C. S., Barbour, M. K., & Clark, T. (2009). Research and practice in K-12 online learning: A review of open access literature. *The International Review of Research in Open and Distributed Learning, 10*. Retrieved from http://www.irrodl.org/index.php/irrodl

Compton, L. K. (2009). Preparing language teachers to teach language online: A look at skills, roles, and responsibilities. *Computer Assisted Language Learning, 22*, 73–99. doi:10.1080/09588220802613831

Compton, L., & Davis, N. (2010). The impact of and the key elements for a successful virtual early field experience: Lessons learned from a case study. *Contemporary Issues in Technology and Teacher Education, 10*, 309–337. Retrieved from http://www.citejournal.org/

Compton, L., Davis, N., & Correia, A. P. (2010). Preservice teachers' preconceptions, misconceptions, and concerns about virtual schooling. *Distance Education, 31*, 37–54. doi:10.1080/01587911003725006

Compton, L. K. L., Davis, N., & Mackey, J. (2009). Field experience in virtual schools – to be there virtually. *Journal of Technology and Teacher Education, 17*, 459–477. Retrieved from http://site.aace.org/pubs/jtate/

Covington, D., Petherbridge, D., & Warren, S. E. (2005). Best practices: A triangulated support approach in transitioning faculty to online teaching. *Online Journal of Distance Learning Administration, 8*(1). Retrieved from http://www.westga.edu/~distance/ojdla

Dabner, N., Davis, N., & Zaka, P. (2012). Authentic project-based design of professional development for teachers studying online and blended teaching. *Contemporary Issues in Technology and Teacher Education, 12*, 71–114. Retrieved from http://www.citejournal.org/

Davis, N., & Ferdig, R. E. (2009). Editorial: What is special about teacher education for virtual schooling? *Journal of Technology and Teacher Education, 17*, 425–435. Retrieved from http://site.aace.org/pubs/jtate/

Davis, N. E., & Roblyer, M. D. (2005). Preparing teachers for the "Schools that Technology built": Evaluation of a program to train teachers for virtual schooling. *Journal of Research on Technology in Education, 37*, 399–409. doi:10.1080/15391523.2005.10782445

Davis, N., Roblyer, M. P., Charania, A., Ferdig, R., Harms, C., Compton, L. K. L., & Cho, M. O. (2007). Illustrating the "virtual" in virtual schooling: Challenges and strategies for creating real tools to prepare virtual teachers. *The Internet and Higher Education, 10*, 27–39. doi:10.1016/j.iheduc.2006.11.001

Davis, N., & Rose, R. (2007). *Research committee issues brief: Professional development for virtual schooling and online learning*. Vienna, VA: North American Council for Online Learning. Retrieved from http://www.inacol.org/resource/professional-development-for-virtual-schooling-and-online-learning/

Dawley, L., Rice, K., & Hinck, G. (2010). *Going virtual! 2010: The status of professional development and unique needs of K-12 online teachers*. Retrieved from http://edtech.boisestate.edu/goingvirtual/goingvirtual3.pdf

DiPietro, M., Ferdig, R. E., Black, E. W., & Preston, M. (2008). Best practices in teaching K-12 online: Lessons learned from Michigan virtual school teachers. *Journal of Interactive Online Learning, 7*, 10–35. Retrieved from http://www.ncolr.org

Duncan, H. E., & Barnett, J. (2009). Learning to teach online: What works for pre-service teachers. *Journal of Educational Computing Research, 40*, 357–376. doi:10.2190/ec.40.3.f

Ferdig, R. E., Cavanaugh, C., DiPietro, M., Black, E. W., & Dawson, K. (2009). Virtual schooling standards and best practices for teacher education. *Journal of Technology and Teacher Education, 17*, 479–503. Retrieved from http://www.aace.org/pubs/jtate/

Harms, C. M., Niederhauser, D. S., Davis, N. E., Roblyer, M. D., & Gilbert, S. B. (2006). Educating educators for virtual schooling: Communicating roles and responsibilities. *Electronic Journal of Communication, 16*, 17–24. Retrieved from http://www.cios.org/EJCPUBLIC/016/1/01611.HTML

Huling, L. (1998). *Early field experience in teacher education*. Washington, DC: ERIC Clearinghouse on Teaching and Teacher Education.

Karlsson, G. (2004). Distance courses in mechanics and in distance instructor training. *European Journal of Engineering Education, 29*, 41–51. doi:10.1080/0304379032000129313

Kennedy, K., & Archambault, L. (2012). Offering preservice teachers field experiences in K-12 online learning: A national survey of teacher education programs. *Journal of Teacher Education, 63*, 185–200. doi:10.1177/0022487111433651

Knowles, J. G., & Cole, A. L. (1996). Developing practice through field experiences. In F. Murray (Ed.), *The teacher educator's handbook: Building a knowledge base for the preparation of teachers* (pp. 648–688). San Francisco, CA: Jossey-Bass.

Macdonald, J., & Poniatowska, B. (2011). Designing the professional development of staff for teaching online: An OU (UK) case study. *Distance Education, 32*, 119–134. doi:10.1080/01587919.2011.565481

Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *The Teachers College Record, 108*, 1017–1054. Retrieved from http://www.tcrecord.org/

Rice, K., & Dawley, L. (2009). The status of professional development for K-12 online teachers: Insights and implications. *Journal of Technology and Teacher Education, 17*, 523–545. Retrieved from http://www.aace.org/pubs/jtate/

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*, 4–14. doi:10.3102/0013189X015002004

Townsend, J. S., & Nail, A. (2011). Response, relationship, and revision: Learning to teach writing in asynchronous contexts. *Journal of Literacy and Technology, 12*, 51–85. Retrieved from http://www.literacyandtechnology.org/

Turvey, K. (2008). Student teachers go online; the need for a focus on human agency and pedagogy in learning about 'e-learning' in initial teacher education (ITE). *Education and Information Technologies, 13*, 317–327. doi:10.1007/s10639-008-9072-x

Watson, J., Gemin, B., Ryan, J., & Wicks, M. (2009). *Keeping pace with K-12 online learning: An annual review of state-level policy and practice, 2009*. Evergreen, CO: Evergreen Education Group.

Watson, J., Murin, A., Vashaw, L., Gemin, B., & Rapp, C. (2013). *Keeping pace with K-12 online learning: An annual review of policy and practice, 2013*. Evergreen, CO: Evergreen Education Group.