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Technology- Infused Teacher Preparation: Connecting Technology and Pedagogy

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Abstract

Mulder asserts that as teacher educators move away from stand-alone technology courses towards the integration approach, clear descriptions for what knowledge and skills pre-service teacher must develop are needed. and once decided, faculty in teacher preparation programs will need to clearly articulate an approach for integrating technology into the program. He goes on to explain the TPACK framework, which currently serves as a preeminent model for exploring technology integration in education.

Keywords

technology, pedagogy, educational technology, TPACK Framework, technology integration, pre-service teachers

Disciplines

Education | Educational Methods | Technology and Innovation

Comments

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Introduction

The multifaceted demands of the teaching profession today are significant: in a single day a teacher will plan lessons, present content, interact with students, manage a classroom, assess learning, communicate with parents and guardians, and collaborate with colleagues (Armstrong, Henson, & Savage, 2009). While all of these elements of the profession have been present for many years, there are new and different pressures placed on teachers due to the steady increase of technology in schools over the past decade, which has resulted in widespread access to the Internet, desktop and mobile computers, and other technologies (Brown & Green, 2013; Gray, Thomas, & Lewis, 2010; Project Tomorrow, 2013a; Project Tomorrow, 2013b). The presence of educational technologies—and expectations of their appropriate use—adds another layer of complexity for teachers: how can they best incorporate technology to benefit their students' learning?

The challenges of integrating technology into classroom practice may be even more pronounced for young teachers entering the profession. More experienced colleagues and administrators may have undue expectations of young teachers' comfort and expertise in using technology, as the generation of teachers entering the profession today has been labeled "digital natives" (Prensky, 2001). However, this generation's innately skillful use of technology and their supposed digital native status have been disputed recently (Bennett, & Maton, 2010; Littlejohn, Beetham, & McGill, 2012; Margaryan, Littlejohn, & Vojt, 2011), and research indicates preservice teachers are no better at integrating technology into their teaching than veterans (Ertmer et al., 2012).

Unfair expectations about their technological abilities aside, teachers entering the profession *will* have to work with technology in their teaching practice, as the presence of educational technology in the landscape of contemporary education is more pervasive than ever (Gray, Thomas, & Lewis, 2010; Project Tomorrow, 2013a), and Teo (2011) indicated that technology integration has become a basic job requirement for today's teachers. Thus, new inductees to the teaching profession are now required to develop an additional skill set prior to beginning their career that that their predecessors were able to develop slowly over time as new technologies were introduced into schools. Today's pre-service teachers must develop not only content knowledge and pedagogical skill, but also abilities to wisely integrate technology with these other key aspects of the teaching profession.

Even a strong teacher education program may not adequately prepare pre-service teachers if they fail to include a component aimed at developing their students' abilities to effectively integrate technology into their teaching practices. While there is certainly room for high-technology schools to provide in-service technological training and support for the teachers they hire, teacher preparation programs can do a better job of developing students' technological skills for teaching as a part of their pre-service training.

Based on their analysis of over one hundred different teacher preparation programs at a wide variety of institutions of higher education, Ottenbreit-Leftwich, Glazewski, and Newby (2010) outline a four step process for conceptualizing (or re-conceptualizing) the technology component for a teacher preparation program:

1. Consider how technology expectations fit into the broader context of a teacher education program.

2. Establish specific technology content goals for all pre-service teachers within the program.
3. Select approaches to best meet these specific technology goals.
4. Design learning activities that will incorporate these approaches to deliberately meet the technology goals.

Teacher educators would be well advised to reflect on this process as they consider how they will work to prepare their students to integrate technology into their future teaching. The goal of this paper is to illustrate a practical model for developing pre-service teachers' abilities to connect technology with pedagogy.

Shifting from Stand-Alone Technology Courses to an Integrated Approach

Historically, teacher preparation programs have included a stand-alone course aimed at developing pre-service teachers' skill and knowledge at using technology (Ottenbreit-Leftwich, Glazewski, & Newby, 2010; Pope, Hare, & Howard, 2005; Wang & Chen, 2007). While such courses are still widespread in teacher education, Grossman, Hammerness, and McDonald (2009) have called for dissolving the artificial line teacher educators have drawn between "foundations" and "methods" and instead consider integrating these two domains. In the realm of educational technology, this would mean reconsidering the value of separating instructional technology courses from pedagogical methods courses, and instead look for ways to integrate technology skills into other courses. As early as 2005, Pope, Hare, and Howard raised the question of whether learning technology skills in isolation from instructional methods actually benefits pre-service teachers, and would in fact result in true technology integration in the classroom. They instead advocated that teacher educators deliberately integrate technology into methods courses.

Wang and Chen (2007) strongly supported the integration approach, while noting that the

stand-alone technology course might still provide value to the students *if* the knowledge and skills developed in such a course are then integrated throughout the entire teacher preparation program. They argued that pre-service teachers still need to learn the basic skills of how to use various instructional technologies, and that a stand-alone course might be a good way to do so, but only if this course is full of examples explaining how technology can be used as a means of instruction in the context of various content areas (Wang & Chen, 2007). Simply learning how to use various technological tools will not actually result in technology integration; the use of technology must be contextualized.

This viewpoint is similar to that expressed by Koehler, Mishra, and Yahya (2007) who called for a move away from stand-alone technology courses, explaining that technology use in teaching must always be viewed in relation to the content to be taught as well as the pedagogies being employed. They argued that decontextualized approaches are in fact unlikely to promote technology integration since there is such a wide disconnect being modeled for the students.

Establishing Standards for Technology Use

Part of the challenge for preparing pre-service teachers with regard to technology is the wide variety of comfort with and efficacy related to personal use of technology present among individuals (Mishne, 2012). Students will have differing needs for developing knowledge about and comfort with technological tools for teaching and learning. This model must take into account this range of ability and be able to flex to the needs of the individuals. Fortunately, some research has already been done in assessing pre-service teachers' knowledge and skill in using educational technologies, and useful tools for this assessment are available (see Schmidt et al., 2010). Students with different levels of skill in using instructional technologies will need different levels of support, but having clear descriptors of the expected skills and attitudes will

aid in developing the technological abilities of all pre-service teachers (Ottenbreit-Leftwich, Glazewski, & Newby, 2010).

Faculty in teacher education programs will thus need to decide on the skills and attitudes pre-service teachers most need, and then deliberately provide opportunities to develop these. The International Society for Technology in Education (ISTE) has developed standards to guide teachers as they incorporate educational technologies into their teaching practices (ISTE, 2008). Several authors argued that the ISTE standards are an excellent depiction of the technology abilities today's teachers need (Mumford, 2011; Ottenbreit-Leftwich, Glazewski, & Newby, 2010; Rodriguez & Chung, 2012). The ISTE standards for teachers include performance indicators that clearly outline the skills effective teachers need to be able to exhibit, which makes these ideal for understanding what pre-service teachers must know, understand, and be able to do with regard to instructional technology. Embedding these into pedagogical methods courses and throughout a teacher education program will help to develop not just technological skills, but also develop a greater sense of efficacy for the ability to teach with technology (Abbitt, 2011; Mumford, 2011). Alongside these standards, a growing body of research indicates that strong connections between technology and pedagogy are necessary for successful teaching in the 21st Century (Abbitt, 2011; Baran, Chuang, & Thompson, 2011; Koh & Divaharan, 2011; Mishra & Koehler, 2006; Mouza & Karchmer-Klein, 2013; Pamuk, 2012).

Connecting Technology to Pedagogy and Content Knowledge: The TPACK Framework

Today's schools have adopted a wide variety of technologies, with the hope that their addition to classrooms will have a positive impact on student learning (Brown & Green, 2013; King, 2012; Project Tomorrow, 2013a; Project Tomorrow, 2013b). King (2012) suggested, "Instructional technologies are more present than ever" (p. 1201), but also noted, "all [educators]

struggle to interpret the appropriateness and utility of new technology in the classroom" (p. 1204). Without a framework to guide their implementation, there is little indication that simply having technological tools present in the classroom will impact students learning.

The TPACK framework depicts three overlapping domains of teacher knowledge: Content Knowledge, Pedagogical Knowledge, and Technological Knowledge. Viewed as a Venn diagram, the way these knowledge domains overlap result in seven distinct areas for consideration. Abbitt (2011) provided helpful short descriptors of each domain of the TPACK framework:

1. Pedagogy (PK) - Knowledge of the nature of teaching and learning, including teaching methods, classroom management, instructional planning, assessment of student learning, etc.
2. Content (CK) - Knowledge of the subject matter to be taught (e.g., earth science, mathematics, language arts, etc.).
3. Technology (TK) - Continually changing and evolving knowledge base that includes knowledge of technology for information processing, communications, and problem solving and focuses on the productive applications of technology in both work and daily life.
4. Pedagogical Content (PCK) - Knowledge of the pedagogies, teaching practices, and planning processes that are applicable and appropriate to teaching a given subject matter.
5. Technological Content (TCK) - Knowledge of the relationship between subject matter and technology including knowledge of technology that has influenced and is used in exploring a given content discipline.

6. Technological Pedagogical (TPK) - Knowledge of the influence of technology on teaching and learning as well as the affordances and constraints of technology with regard to pedagogical designs and strategies.
7. Technological Pedagogical Content (TPCK) - Knowledge of the complex interaction among the principle knowledge domains (content, pedagogy, technology). (p. 136)

The TPACK framework thus provides a structure for examining the role of technology and how it might support and enhancing students' learning.

Applying the TPACK Framework as a Model for Technology Integration

The TPACK framework may best be viewed as a contextualizing approach for helping pre-service teachers develop their ability to integrate technology. Learning technology skills in isolation from pedagogy and content are unlikely to result in technology integration; that is, learning how to use technology is not the same thing as learning how to teach with technology (Mishra & Koehler, 2006). Technology does not replace pedagogy. Pre-service teachers must understand how instruction is implemented in order to understand the implications of teaching with technology (Spector, 2012).

Many authors have proposed models for technology-infused teacher education programs based on the TPACK framework (Abbitt, 2011; Easter, 2012; Harris et al., 2010; Koh & Divaharan, 2011; Mouza & Karchmer-Klein, 2013; Pamuk, 2012). Of particular interest is Koh & Divaharan's (2011) model, which emphasizes the role of faculty modeling of technology integration as well as case study for developing pre-service teachers' abilities to connect technology and pedagogy.

The Importance of Modeling Technology Integration by Instructors

Many faculty members throughout higher education continue to rely on traditional, lecture-based teaching methods and make only modest attempts to incorporate technology into their own teaching practices (Brown & Green, 2013). To fully support development of pre-service teachers' ability to connect technology and pedagogy, it is incumbent upon instructors to model technology integration. Koh and Divaharan (2011) mentioned modeling as a key element for pre-service teachers acceptance of a given instructional technology; without the opportunity to see it in use, students are far less likely to be able to envision how a given tool might be integrated into classroom practice. The modeling of appropriate technology instruction by instructors seems to be a key element to support pre-service teachers' ability to integrate technology into their own teaching practices.

Baran, Chuang, and Thompson explicitly linked instructors' modeling the TPACK framework to pre-service teachers' developing thinking about technology integration, bluntly stating, "Teachers tend to teach in the way they were taught" (Baran, Chuang, & Thompson, 2011, p. 374). They imply that if the only technology use pre-service teachers see modeled is PowerPoint-based lecture, their imagination for other possibilities for technology integration will be limited.

Several authors (Koehler, Mishra, & Yahya, 2007; Koh & Divaharan, 2011; Pope, Hare, & Howard, 2005; Wang & Chen, 2007) have argued that instructors must deliberately explain their own technology integration, making it explicit for the students so they will understand the instructional decisions being made, and how technology supports the teaching and learning. This is a key element in Koh and Divaharan's (2011) TPACK-based model for supporting pre-service teachers' understanding of technology integration: instructors' modeling must be rationalized and verbalized for the students. The intent is that by examining cases of their instructors' use of

technology and how the lessons unfold, the pre-service teachers will develop understanding of how technology and pedagogy are interrelated within the context of particular content to be taught.

Case Study and Conversation as a Means of Exploring Technology Integration

Case study is a key element to Koh and Divaharan's (2011) model, but this is by no means the only example expressing the value of case study for promoting technology integration among pre-service teachers. Many authors have advocated the case study approach for examining technology integration (Ertmer, et al., 2012; Mouza & Karchmer-Klein, 2013; Koehler, Mishra, & Yahya, 2007; Wang & Chen, 2006). Additionally, results of an investigation of case study effectiveness by Razzouk and Johnson (2013) indicated that pre-service teachers examining case studies are more engaged in their learning, and in fact learn more when compared to more didactic methods of instruction. Because case studies require students to apply their knowledge and skills to solve authentic, contextualized problems, collaboratively examining case studies can be an effective way to assist pre-service teachers' developing abilities for technology integration (Kinuthia, Brantley-Dias, & Junor Clarke, 2010).

In support of this viewpoint, Mouza and Karchmer-Klein (2013) contended that cases are instrumental for aiding pre-service teachers' development of the skills and practices required for teaching, and that this may be especially true in the domain of technology, as technologies are continuously evolving. They make heavy use of Mishra & Koehler's (2006) TPACK framework as an organizing principle for the cases they assigned their students, which are intended to demonstrate to students how complex teaching with technology often is in practice. A clearer understanding of how the domains of the TPACK framework interact might best be explored

through the conversations about authentic cases of technology integration (Mouza & Karchmer-Klein, 2013).

Pre-service teachers should also be encouraged to share their own first-hand experiences related to teaching and learning (Dunlap & Lowenthal, 2013). Dunlap and Lowenthal suggested that collaboratively discussing educational experiences can be a rich formative experience for helping students understand how people think and learn. Conversations of this sort might help students clarify their thinking about technology integration, and even identify gaps between their beliefs and practices related to technology integration (Ertmer, et al., 2012). Koehler, Mishra, and Yahya (2007) suggested that small group discussions between teacher education faculty and pre-service teachers might be the key for developing strong technology integration skills.

Conclusion

Even the most technologically savvy, "digital native" pre-service teachers will need support to learn how to infuse their pedagogy with technology. To adequately prepare them for the rigorous realities of teaching with technology, teacher educators will need to reconsider the role of the stand-alone technology course, and shift towards more of an integration approach. The development of pre-service teachers' technological knowledge is best conducted within the context of their learning of pedagogy and content knowledge.

As teacher educators move away from stand-alone technology courses towards the integration approach, clear descriptions for what knowledge and skills pre-service teacher must develop are needed, such as the ISTE (2008) standards. Once such standards are decided, faculty in teacher preparation programs will then need to clearly articulate an approach for integrating technology into the program. It is in this light that Mishra & Koehler (2006) developed the TPACK framework, which currently serves as a preeminent model for exploring technology

integration in education. Teacher educators can thoughtfully embody the TPACK framework in their own teaching practices, demonstrating technology integration by modeling it in their own teaching. Finally, conversations about cases involving technology and pedagogy in contextualized teaching situations can expose gaps in students' thinking and help them better understand how they will integrate technology in their own teaching practices. Infusing technology throughout a teacher education program is the best way to support pre-service teachers as they develop a clear connection between technology and pedagogy.

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