Teaching with Digital Technologies in University and School Contexts: Research and Professional Development using TPACK[1]

Roberta F. Hammett
Honorary Research Professor, Faculty of Education, Memorial University
hammett@mun.ca

Pamela Phillips
Senior Instructional Designer, DELTS, Memorial University
pamp@mun.ca

Abstract:

This article will discuss what undergraduate students (preservice teachers), graduate students (in-service teachers) and university instructors say about their experiences with and knowledge of digital technologies for teaching and learning. The research data come from a version of the Technological, Pedagogical and Content Knowledge (TPACK) survey (Schmidt et al. 2009-10) administered to university instructors and Education students. TPACK, as a framework for both research and teaching with technology, looks at three domains of knowledge - content, pedagogy and technology - and their interconnectedness. Our research was intended to document the experiences of technology integration for students and instructors in our university and local schools and should thus inform university teaching and professional development activities, particularly in Education.

Introduction

Research literature worldwide indicates that, while integrating digital technologies at all levels of education enhances learning (Bates & Sangra, 2011; Tamim et al., 2011; Hansen, 2008; Weigel, 2002), teachers and university instructors often do not do so effectively (Georgina & Horsford, 2009; Hew & Brush, 2007; Selwyn, 2007). Learning how to use technologies in education is particularly important for future teachers (Keengwa et al., 2014), though barriers persist (Etmer, 2005; Borko et al., 2009; Brown & Warschauer, 2006) and arguments continue as to how best to achieve this goal (Ottenbreit-Leftwich et al., 2012; Tondeaur et al., 2012; Yilmazel-Sahim & Osford, 2010). Current literature indicates that personally experiencing integration of technology is most effective, whether in one's own courses or in mentoring situations (Flanigan, Becker & Stewardson, 2012). Research also indicates that experiencing technology integration within appropriate content areas and in relation to particular pedagogies is also preferable (Harris, Mishra & Koehler, 2009; Lawless & Pellegrino, 2007).

Our research was intended to document the experiences of technology integration for our students and instructors in our university and local schools. As there is an increase in online courses and in the use of educational technologies in our university, we wanted to gain some insight to just what knowledge of educational technology our university instructors have and what knowledge our preservice teachers were taking with them into the schools and what related practices they were experiencing there. Our preservice education programs were under review

[1] We acknowledge the contribution of Lisa St. Croix, Gerry White and Cathy Wicks, our colleagues in this research and SITI presentation.

and reconstruction, and the emphasis on technology education shifted to an integrated model with technology learning generally either an optional course or integrated within education courses. We decided to use the TPACK survey (Schmidt et al. 2009-10; used with permission) to ask undergraduate students (preservice teachers), graduate students (in-service teachers) and university instructors to share their understandings and describe their use of technologies in their classrooms. We feel this study contributes to our institution's vision for teaching and learning: "Information and communication technology tools are employed appropriately to enhance the quality of the teaching and learning experience and facilitate access for all students" (Memorial University, 2011, s. 1, para. 1). In addition, further exploration of the research literature would be useful for informing future instructional design work at our institution and future professional developments for faculty.

TPACK Model

TPACK (http://www.tpack.org/) is a framework for thinking about and researching the effective integration of technology into learning environments and the nature of knowledge required by teachers for effective technology integration. At the core of the TPACK framework are the three primary forms of knowledge: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK), and four more knowledge bases that lie at the intersections: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and the intersection of all three concepts to make up Technological Pedagogical Content Knowledge (TPACK). We see TPACK as the basis of effective teaching with technology. Understanding its elements and their intersections will enhance ways digital technologies may be used in all educational settings.

Research Method

During a four-week period in summer 2012, we administered the survey using Survey Monkey to our institution's Education faculty and online instructors and to preservice teachers (undergraduate Education students) and inservice teachers (graduate students in our Master of Education programs). During the fall 2012, we administered the survey to our institution's instructors with a Desire2Learn course shell. In fall 2013, we surveyed targeted classes of preservice and inservice teachers.

We asked participants to provide demographic information and then self-assess their knowledge of and level of agreement with each aspect of TPACK on a likert scale. In the survey, depending on the group being surveyed, there were approximately 12 statements about different content knowledges (CK), 7 about pedagogical knowledge (PK), 6 about technological knowledge (TK), and 32 about their multiple intersections (CPK, CTK, TPK, and TPCK). The TPACK survey also included three long answer questions that elicited a written response and additional comments, intended to help us better comprehend what participants understood as technology integration. Many of the respondents did not answer these questions.

Findings

The findings we are presenting in this article summarize the results from all groups surveyed (preservice teachers, teachers in our Master of Education programs, and university instructors) and data from the interviews conducted in winter 2014. We analyzed the quantitative survey responses of each group using SPSS.

Most of the responses for all groups and all questions fell into the "agree" and "strongly agree" categories. Thus all respondents were expressing confidence in all of the TPACK categories and intersections. Technological knowledge statements were scored lower (60s) than technological pedagogical knowledge statements (90s), leading us to wonder about this seeming contradiction. Another area of lower agreement was related to professional development and being able to provide leadership in technology integration.

Long-answer responses seemed more revealing, though equally contradictory in that respondents described a wide range of experiences with technology. Preservice teachers, responding to the question about technology in their university educational experiences responded in these sample ways:

- "The use of technology in my education program was obsolete. The most that a Smart Board was used for was to put up a power point presentation…."

- "…I have so rarely experienced any professors making appropriate use of technology…. I have had one professor who I can say 100% understood what she was doing with her technology, and actually pushed my knowledge about integration with the curriculum."

- "In the Education course about Learning Technologies for Teachers, we created many computer projects that can enhance learning, such as the creation of WebQuests and videos based storybooks."

Preservice teachers, responding to a question about technology use during practicum in schools, also described a wide range of experiences:

- "My cooperating teacher did not have any technology background and was not using any sort of technology in her teaching approaches…. I introduced various websites the children could use to help with their literacy...."

- "I have not. My cooperating teacher used the smartboard as a glorified projector and was not familiar with more recent technologies."

- …"Overall technology was incorporated in most lessons from morning attendance to math, socials and science lessons. Mainly I would look up interactive activities online and create activities on the SmartBoard for the students and my co-operating teacher supported the use of technology in her classroom and would get me to show her how to use it."

In the written portions of the survey, we asked graduate students (teachers) to "Describe a specific episode where one of your colleagues or district personnel effectively demonstrated or modeled combining content, technologies and teaching approaches in a classroom lesson." These sample responses indicate that often PD is about technologies (TK) rather than their pedagogical and content uses (i.e., TPK and TCK):

- "Have received PD on technology usage but content and teaching approaches were not the focus. I have learned from other teachers ways to effectively combine technology, content and approach."

- "I have not witnessed any colleagues or district personnel effectively demonstrating or modeling combining technology, content and teaching approaches."

- District personnel/colleagues demonstrated the IWB….

Our institution's instructors, in their responses to questions about their use of technologies in their classes and their professional development opportunities, gave responses which indicated that many are not comfortable using technology, are scared of using media ineffectively, and feel somewhat isolated when learning about technologies.

In analyzing the responses to the long-answer questions, we also sorted them according to Papert and Harel's (1991) descriptions of learning theory with technology: Instructivism (passive learning process with the instructor or text sharing knowledge with the learner), Constructivism (with the learning engaging in activities to construct knowledge by building on experiences, particularly in social interaction, and Constructionism (whereby learners engage as constructors and, importantly, producers of their own personal representations of knowledge). Our findings indicate that the majority of technologies are being used by instructors, teachers, and preservice teachers in instructivist and constructivist ways to support delivering content and to engage learners. The pedagogy behind the use of the tools was not evident in most responses and the questions did not evoke any evidence of these technologies being used in a constructionist way, with students participating in the creation of digital resources to convey their research and understandings. For example, interactive whiteboards (IWBS) are being used for presentation purposes or to engage students. For example, one teacher described students who were engaged by selecting correct answers on a Smartboard or moving items around. Also, a preservice teacher described a teacher who used a multimedia jeopardy game to review material for an upcoming exam. Students were involved by choosing the questions and attempting to answer before revealing the answer. A university instructor described using PowerPoint this way: "I typically only use powerpoint to project images. This can be useful in foreign language classes in order to prompt students to use the language to describe the pictures." We would describe this as a constructivist approach. Another example we categorized as "constructivist" was the description of a professor who "spontaneously hooked his iPhone up to the projector and speakers and actually had us listen to the first three words/ beats of various song. From this, we had to guess the song and the genre." (Preservice teacher). In another instance, to engage students, a teacher "used an iPad app, Sight Word Sentence Builder. Students had to put the words in the correct sequence. It helped them with the conventions of writing but in a fun-engaging way."

Insights from Interviews

In addition, we conducted interviews with university instructors to better understand their technology use. Instructors surveyed and interviewed may teach fully online, fully face-to-face in the classroom, or sometimes online and sometimes in a classroom.

This statement represents a common response: “I wouldn't consider myself stellar in knowing about and using technology to present content, but I am open to suggestions/new ideas.” From instructors we also heard:

- Their technology competence survey answers relate to ‘everyday’ technologies of home, office and classroom;
- They desire more and better ‘plug and play’ technologies in classrooms;
- CK and PK are related to expertise, but often students from different faculties taking their courses present challenges that technologies and innovative teaching help solve;
- The Internet provides them with excellent teaching resources (e.g. videos, specialized sites);
- They say: “We don’t know what we don’t know – multiple opportunities for PD of multiple types are needed: tips, mentors, how-to sessions, just-in-time instruction….”

Most commonly classroom instructors use the Desire2learn space as a repository for lecture notes and other content. Desire2Learn, by its design, is a tool for course administration, for distribution of supplementary materials, and for a variety of modes of communication. Thus it may be used in instructivist, constructivist, and constructionist ways.

Conclusions

Few of our respondents made explicit the pedagogy behind their use of technologies. We heard few examples of technologies being used in constructionist ways, with students participating in the creation of digital resources to convey their research and understandings. We are not intending to convey value judgments about these learning theories or pedagogies. We understand that in classrooms there are times for listening to shared knowledge, for constructing knowledge collaboratively, and for re-presenting knowledge. Within our Faculty of Education, we have noted a rise in occasions of displays and presentations of student work and research, with courses often ending with mini conferences in which education students present research to their classmates and the invited public. We see these as constructionist activities.

21st Century Learning (http://www.p21.org/about-us/p21-framework), which stresses the integration of skills into the teaching of core academic subjects, is currently influencing K-12 and higher education contexts. If constructionist learning becomes more important as current pedagogy accepts (Daskolia & Kynigos, 2012; Laurillard et al., 2013), particularly in K-to-12 classrooms, then "[h]igher education has a key role in helping students refine, extend and

articulate the diverse range of skills they have developed through their experience of Web 2.0 technologies" (Hughes, 2009, p. 9). Web 2.0 technologies should be more easily available and appropriate professional development opportunities to learn their use provided for university instructors as well as preservice teachers.

At our university, The Comprehensive Framework for Teaching and Learning (Memorial University, 2011) supports 21st century learning. It recognizes work that is engaging, supportive, inclusive, responsive, committed to discovery, and outcomes-oriented for both educators and learners. The outcomes-oriented, qualities and attributes that Memorial wishes graduates to exhibit are in line with the goals of 21st century learning. Our university is already promoting and supporting other technologies that can be accessed within Desire2Learn, such as chat rooms, blogs, wikis, Online Rooms (Blackboard Collaborate) for synchronous voice discussions, and Elgg (a social networking platform with multiple affordances).

Generally speaking, as our tool kit of technologies and pedagogies increase, we as instructors move from using technology for course administration, whereby there is no change in the learning experience, to enhancing the course and thus learning possibilities. When we begin to think about purposes for adding technology and what activities or learning should be done in class or outside of class (using the flipped classroom approach), we encourage our students to develop their own understandings of pedagogy and technology introduction. TPACK provides a vision to help guide good teaching and learning and to effectively integrate technology into the learning environment. Explicit teaching of TPACK, especially TPK is important. Respondents indicate they need to know what they don't know; that is, more explanation of what constitutes effective technology integration. We thus recommend that the TPACK framework be incorporated in professional development and in teacher education programs, making the link between technology and content and pedagogy and technology more explicit.

We heard how teachers in schools sometimes learned from preservice teachers and other times taught them technology uses. Similarly, some instructors provide excellent experiences with technology integration to their students. Professional development and mentoring for all constituents – instructors, teachers, and preservice teachers – can create a teaching-learning cycle in which each group learns from and teaches to the others (see Figure 1).

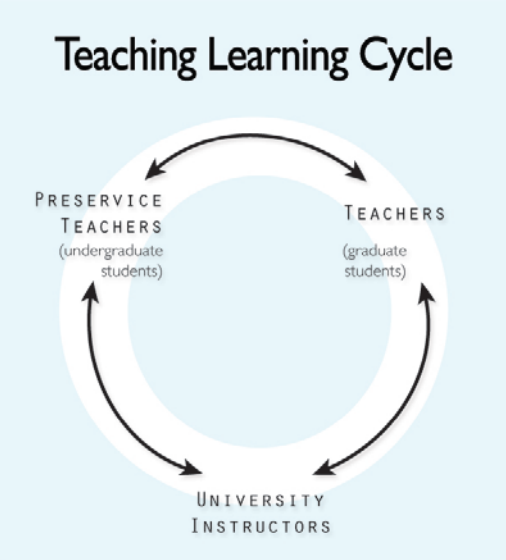

Figure1: Teaching Learning Cycle

References

Bates, A. W., & Sangra, A. (2011). *Managing technology in higher education: Strategies for transforming teaching and learning*. San Francisco, CA: Wiley.

Borko, H., Whitcomb, J., & Liston, D. (2009). Wicked problems and other thoughts on issues of technology and teacher learning. *Journal of Teacher Education*, *60*(1), 3-7.

Brown, D., & Warschauer, M. (2006). From the university to the elementary classroom: Students' experiences in learning to integrate technology in instruction. Journal of *Technology and TeacherEducation, 14*, 599–621.

Daskolia, M., & Kynigos, C. (2012). Applying a constructionist frame to learning about sustainability. *Creative Education, 3*, 818-823. Retrieved from http://search.proquest.com/docview/1282102891?accountid=12378

Ertmer, P. (2005). Teacher pedagogical beliefs: the final frontier in our quest for technology integration? *Educational Technology Research and Development 53*(4): 25-39.

Flanigan, R., Becker, K., & Stewardson, G. (2012). A contemporary preservice: Technology education program. *Technology and Engineering Teacher, 72*(2), 25-29. Retrieved from http://search.proquest.com/docview/1143637740?accountid=12378

Georgina, D., & Horsford, C. (2009). Higher education faculty perceptions on technology integration and training. *Teaching and Teacher Education, 25*, 690-696.

Hansen, C. C. (2008). Observing technology enhanced literacy learning. *Contemporary Issues in Technology and Teacher Education*, *8*(2), 108-121.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed, *Journal of Research on Technology in Education*, *41*(4), 393–416.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development, 55-3,* 223-252.

Hughes, A. (2009). Higher education in a Web 2.0 world. *JISC*. Retrieved from http://www.jisc.ac.uk/publications/generalpublications/2009/heweb2.aspx.

Keengwa, J., Onchwari, G., & Hucks, J. (Eds). (2014). Literacy enrichment and technology integration in preservice teacher education. Hershey, PA: IGI Global.

Laurillard, D., Charlton, P., Craft, B., Dimakopoulos, D., Ljubojevic, D., Magoulas, G., Masterman, E., Pujadas, R., Whitley, E. A., & Whittlestone, K. (2013). A constructionist learning environment for teachers to model learning designs. *Journal of Computer Assisted Learning, 29*(1), 15-30.

Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research, 77-4*, 575.

Memorial University. (2011). A comprehensive framework for teaching and learning at Memorial University. Retrieved from http://www.mun.ca/vpacademic/TLF_May_2011_FINAL_Framework.pdf.

Papert, S., & Harel, I. (1991). Situating constructionism. Retrieved from http://www.papert.org/articles/SituatingConstructionism.html.

Ottenbreit-Leftwich, A. T., Brush, T. A., Strycker, J., Gronseth, S., Roman, T., Abaci, S., vanLeusen, P., Shin, S., Easterling, W., & Plucker, J. (2012). Preparation versus practice: How do teacher education programs and practicing teachers align in their use of technology to support teaching and learning? *Computers & Education, 59*(2), 399-411.

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Kochler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education, 42*(2), 123-149.

Selwyn, N. (2007). The use of computer technology in university teaching and learning: a critical perspective. *Journal of Computer Assisted Learning, 23,* 83-94.

Tamim, R., Bernard, R., Borokhovski, E., Abami, P., & Schmid, R. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research, 81*(1), 4-28.

Tondeur, J., van Braack, J., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing preservice teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers and Education, 59*(1), 134-144.

Weigel, Van B. (2002). *Deep learning for a digital age: Technology's untapped potential to enrich higher education*. San Francisco, CA: Jossey-Bass.

Yilmazel-Sahim, Y. & Osford, R. (2010). A comparative analysis of teacher education faculty development models for technology integration. *Journal of Technology and Teacher Education, 18*(4), 693-720.