Teacher Candidates' Perception of Acquiring TPACK in the Digital Age through an Innovative Educational Technology Masters Program

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Abstract

The TPACK (Technological Pedagogical Content Knowledge) model is a technology integration framework that identifies three types of knowledge that educators need to bring together for successful edtech (educational technology) integration - technological, pedagogical, and content knowledge (a.k.a. TPACK). This model used by educators when they implement digital tools and strategies to support teaching and learning. TPACK was developed by educational researchers Kohler and Mishra (2005) and is designed with the concept that content (what we teach) and pedagogy (how we teach) is the basis for any technology that teachers plan to use in their classroom to enhance learning. The purpose of this research was to investigate how the TPACK model helped teacher candidates acquire knowledge for teaching with technologies.

Introduction

In a local college's School of Education and Human Services, teacher candidates are prepared to use best practices of integrating technology into their classrooms or their future classrooms through hands-on projects and technology service learning in both the graduate and undergraduate technology courses, as well as through a new, innovative graduate educational technology program and in methods courses. The educational technology program's focus is on the TPACK model, in which integrated technologies are developed and transformed through learning experiences that are blended throughout a two-year cohort-based program. According to Maeng, Mulvey, Smetana, and Bell (2013), preservice teachers develop their expertise by selecting and using technology appropriately. They use technology for inquiry to present and engage, to facilitate data collection and data analysis, as well as to communicate and discuss results. Technology is essential to the teacher candidates' success as well as the overall program success in their preparation.

Teacher candidates come from various disciplines as content experts, thus the TPACK model fits well into each content area and facilitates the honing of their technology pedagogy. The TPACK model is seen through the use of individualized and cooperative group lesson and unit planning, course development, research- based cutting- edge technology projects such as 3D printing, electronic portfolios, e-textbook chapters, virtual reality, artificial intelligence and robotics along with ISTE (International Society for Technology in Education) guidelines. By designing technological artifacts or tasks to solve instructional problems, teacher candidates learn to teach with the TPACK model (Koehler & Mishra, 2005). This process facilitates teacher candidates' transformation of their content knowledge using the TPACK model to enhance their teaching.

Research supports student-driven programs to develop successful TPACK model programs. For example, Lu and Lei (2012) stated that "to help preservice teachers develop TPACK in a learner-centered, project-based, learning environment, we propose to integrate into this environment a Live Dual Model (LDM) strategy, which involves both live behavior modeling and cognitive modeling" (pp. 14-15). The combination of a student- driven approach, a blended delivery system, and a sequential course design, TPACK for technology integration is an effective model for instruction. In a blended learning environment, teacher candidates communicate, collaborate, and create integrated, interactive technology learning applications for course requirements in a series of technology-based courses that prepare candidates in areas such as technology foundations, digital literacy, mobile learning, integrating digital age tools, technology leadership, interdisciplinary studies, observation and practicum, and assistive technologies to name a few. The series of technology-based courses is devised of foundations, applications, leadership, and scholarship. This sequential technology education program (STEP) approach has courses designed to ensure teacher candidates are building the requisite skills as they advance to the next level.

The purpose of this paper was to assess teacher candidates' perceptions of successful technology integration of the TPACK model using three methods: (a) hybrid delivery system using the Canvas Learning Management (LMS), (b) the STEP approach, which is a sequential program design of foundations, applications, and leadership and scholarship, and (c) a student driven method of content delivery. The following research question was explored:

Do the blended learning experience, the STEP sequential program design, and a student driven approach promote the teacher candidates' perceptions and their acquiring of knowledge for teaching with technologies through TPACK?

Literature Review

Our review of the literature indicated that there is emerging research that supports the design models for successful TPACK technology integration. The TPACK model is "effective in helping preservice teachers develop TPACK in a technology integration course. The findings showed that the preservice teachers demonstrated the initial ability to transfer what they learned in the modeling to classroom teaching" (Lu, & Lei, 2012, p.14). Developing a responsive program that meets the needs of teacher candidates is an important component in training future teachers to successfully replicate the TPACK model as they progress through an educational technology program. Student-driven teaching and learning meets the needs of teacher candidates because it allows for individualization of the TPACK model in a variety of content areas. Assignments in the sequential educational master's program follow a student- driven design in allowing teacher candidates a way to model this teaching method in developing their TPACK method of technology integration. "With the advent of the technology, a salient component of teaching is not only to use technological gadgets to teach but also to integrate technological knowledge into pedagogy in order to offer quality student learning" (Szeto, & Cheng, 2017, p. 348).

Maeng et al. (2013) supported learner-centered and reform-based instruction to integrate technology into a graduate teaching program to support teacher candidate's use of the TPACK model in their student teaching. The authors' goal was to use educational technology to support students and demonstrate their development of TPACK technology enhanced instruction. Their data points included observations, lesson plans, interviews and reflections. Their results indicated their preservice teachers were successful incorporating technology appropriate to their "content and context" of their teaching and learning (p. 838). They concluded that their study's "realistic and practical examples of technology-enhanced inquiry offer insight that may ease the necessary transition teacher-centered, lecture-style teaching to more learner-centered, reform-based teaching" (Maeng et al., 2013, p. 855). Further, they emphasized that the lesson examples both developed and implemented by preservice teachers may be attainable for both experienced and inexperienced preservice and in-service teachers. Maeng et al. (2013) suggested that research in the future should develop a better understanding of the decision-making process for technology integration that supports teaching and learning for preservice and in-service teachers.

In an attempt to help preservice teachers learn about teaching with technology Lu and Lei (2012) developed the Live Dual Model (LDM). The purpose of their study was to develop a program, Live Dual Modeling through which preservice teachers would model teaching to peers in their courses. Live Dual Model was a student-centered approach to help students integrate TPACK into their teaching experiences (Lu, & Lei, 2012) Their results indicated that "LDM helped the preservice teachers bridge their content knowledge and their pedagogical knowledge, expand their understanding in pedagogical knowledge, and transfer the technology integration ideas from the modeling to real-world classroom teaching..." (Lu, & Lei, 2012 p. 20).

Technology integration is evident in schools across Long Island, New York. According to a study of middle school teachers across Nassau and Suffolk Counties on Long Island, New York, teachers use technology integration aligned with ISTE technology standards but not equally balanced across the recommended indicators (Esposito, 2013). According to Esposito,

> …teachers use digital tools to promote student learning and reflection often, promote digital citizenship often, use digital tools to communicate and collaborate with parents and community often, agree that principals support their technology efforts, use digital tools to communicate and collaborate with peers and colleagues sometimes, promote global awareness sometimes, and strongly agree their school supports their technology efforts. (p. 92)

Esposito (2013) recommended teacher preparation programs incorporate ISTE standards into practice and consider adopting the TPACK model for technology integration to support the needs of the students who are "global citizens in the 21st century" (p. 92). Built upon previous research this current study is designed to further develop the idea that teacher preparation programs that are carefully designed in a STEP format, offer flexibility in a hybrid delivery system, and focus on student-centered learning will promote successful technology integration using the TPACK model of instruction.

Background

Hybrid Delivery

"'Hybrid' or "Blended" are names commonly used to describe courses in which some traditional face-to-face "seat time" has been replaced by online learning activities. The purpose of a hybrid course is to take advantage of the best features of both face-to-face and online learning" (Learning Technology Center, 2018, p. 1).

Hybrid course models are pedagogically flexible and can vary greatly depending on how the instructor schedules and structures on campus face-to-face and off campus web-based sessions. These decisions are based on course objectives, learning goals, course content, and available resources. Pedagogical decisions on schedules for delivery method vary according to the needs and schedules of students, instructors, academic calendars, classroom space, and computer lab availability.

Table 1. STEP Sequence Courses in the Masters' of Educational Technology Program

STEP	Courses Titles	TPACK Development
Foundations	• Foundations of Educational Technology • Analyzing Digital Media in Teaching and Learning • Assessment Tools for Educational Technology • Interdisciplinary Curriculum and Methods in Educational Technology	CK of the TPACK model TK of the TPACK model • Student discussion directors established • Educational technology theories explored and shared using digital age tools • Digital literacy research based discussions presented in multimedia formats • Evaluate a variety of secure online assessment tools • Infusing cutting edge technology in all curriculum areas developing appropriate digital age technology tools to deliver content
Application	• Instructional Applications of the Internet-Integrating Digital Age Tools into Instruction, Classroom Management, Communication and Collaboration • Educational Website Design, Video Integration, Distance Learning, Blended and Virtual Schools • Mobile Learning and Teaching With Social Media For Educational Technology	PK of the TPACK model TK of the TPACK model • Lesson and unit planning is developed following the PK and TK of the TPACK instructional model • Teacher candidate create websites that are designed to facilitate collaboration and instruction rich in technology integration • Curriculum and course design is developed • Policies for social media and mobile learning are created to use in schools
Leadership and Scholarship	• Educational Technology Practicum Seminar • Educational Technology Practicum • Developing Reflective Research Practice in the Educational Technology Rich Classroom Environment • Teacher as Researcher in the Educational Technology Rich Classroom Environment	TPACK model emphasized • Observations of best practices, unit and lesson planning, integrating technology, and implementation during the practicum K-12 field placement • Reflections of professional practice • Formal year long research thesis with an IRB

Courses are designed using modules which can be configured by either the sequence of sessions throughout the semester or by topics covered during the course. The learning modules should be consistent in their approach and configuration. They may contain an overview of the module including learning objectives, support materials such as videos and readings, assignments, quizzes, surveys, and discussions.

The advantage of a hybrid delivery system to the students is that they can learn at times that are most convenient to their schedules "anytime, anywhere learning.". It is truly a student driven system. The hybrid format on our Canvas Learning Management System (LMS) encourages both synchronous and asynchronous communication and collaboration among students and faculty through a variety of available user-friendly tools including announcements, discussions, conferences, peer review, group projects, collaboration among groups through third party apps such as Google docs, and live chat.

Project-based, real-world learning is the basis for assignments in each course. Classrooms are open and all participants contribute to the body of knowledge being built in a learning community that often includes cutting edge ideas and the newest technology. A few examples are student Edcamps and discussion directors. Edcamps are participant-driven events allowing attendees to collaboratively determine the session topics and are presented by and for students.

STEP Sequential Course Design

Careful consideration of emerging technologies and current pedagogies helped design the sequence of courses. In obtaining the New York state approval for a master's program in educational technology, a needs-assessments of classroom teachers assisted and fostered the development of course design and sequence. Both faculty and teacher candidates in the educational technology master's program use TPACK model of instruction in course delivery. Teacher candidates hold an initial teaching certificate and have a concentration in a specific content area. The pedagogy presented to teacher candidates in this program is student driven and collaborative in nature, with a strong TPACK model of instruction for the purpose of technology integration in subject areas or in the area of teaching teachers how to integrate technology into core-content area teaching. This is accomplished by faculty modeling TPACK and student- driven, models of instruction for technology integration. Similarly, Szeto and Cheng (2017) shared their view of the importance for

preservice teachers to have the ability to "explore and integrate technology in their pedagogical and content knowledge" (p. 351). The authors designed a four-themed approach of TPACK development for preservice teachers to include curriculum and assessment, learning, teaching, and access (Szeto, & Cheng, 2017). The STEP design includes foundations, application, leadership, and scholarship. Each of the areas include specific courses that assist in the development of skills that foster each step and build greater understanding of TPACK design and technology integration. In the first set of courses, foundations, the CK (content knowledge) and the TK (technology knowledge) are emphasized in the delivery and curriculum of study. For this master's program, the content knowledge developed is the theories, applications, and assessment tools common to educational technology. The technology knowledge is developed in all three sections related to the student needs and content. The second, applications, the PK (pedagogical knowledge) skills are developed as teacher candidate's work on lesson and unit planning rich in integrating technology. In the last set of courses, leadership and scholarship, the TPACK model is wholly developed and practiced in a professional practicum experience. Teacher candidates spend 50 hours in the K-12 field classroom environment. **Table 1** shows the STEP design for the master's of educational technology.

Student Driven Learning Environments (SCLEs)

Hannafin and Land (2000) defined student-centered learning environments (SCLEs) as ones that "provide complimentary activities that enable individuals to address unique learning interests and needs" (p. 4). They found that important thinking processes, and learner engagement-when coupled with technology-are essential. Hannafin and Land concluded that student-centered learning environments may have emerged because of the advances of technology and that educators must continue to be aware of the changes in technology and optimize new ways of teaching for teacher candidates. As technology advances and new ways of communication and collaboration become more readily available, advances in the way professors interact with teacher candidates will also evolve.

The Canvas Learning Management System permits professors to incorporate online tools and outside applications into courses facilitating more collaboration, such as Prezi (www.prezi.com) and other presentation tools. Teacher candidates can collaborate on presentations and post their work on discussion boards in Canvas. Google applications are also integrated, external tools that promote document sharing and collaborating. Student-driven course assignments can be found in multiple sections, modules, assignments, and pages. Some examples of student driven assignments include lesson/unit planning using website design, interviewing educational technology professionals in a K-12 environment, and course design for professional development or higher education. Utilizing the TPACK model for technology instruction, teacher candidates develop lessons and unit plans in most of the educational technology courses. Lesson planning for teacher candidates may be student- driven through choices that can include topic, standard addressed, strategy, method, technology, activity, and/or assessment selections. Before presenting lessons in class in a modeling format, teacher candidates discuss the TPACK model and address the intersections of TK, CK, and PK in small group discussions and help in developing technology-rich plans.

Methodology

The main purpose of the study was to determine whether or not there was evidence of (a) teacher candidates' perception of development of their knowledge for teaching with technologies through TPACK through their experiences in the hybrid LMS delivery system and method, (b) course design in their progression of TPACK modeling for instruction, and (c) student-centered approach. Professional standards for managing and conducting research was obtained through the IRB (Institutional Review Board). A survey was administered to study participants who comprised of students in the master's of educational technology program with New York State certification in a range of initial and professional certification areas and content areas. Participation was voluntary and anonymous.

Students were asked 19 Likert-scale questions to determine their perceptions on how they rated the hybrid blended delivery system, STEP design including the areas of theory, using TPACK model of integration for lesson design and implementation, and leadership and scholarly roles in the local and greater community. Justification for an online survey included that students were accustomed to online surveys in their studies for all classes they attended. Response categories ranged from not at all to always for all questions in the three categories. In addition, demographic questions about subject area concentration, teaching level, and number of years teaching were also included.

Data Collection

This study was conducted using an online survey to identify teacher perceptions of the hybrid learning management system, the STEP course design features, and the student- driven approach in learning and applying the TPACK model of technology integration into their teaching. Teacher candidates were sent an email with a link to the online survey using the Canvas LMS. An educational technology program TPACK Pre-Professional Student Survey administered online to the first cohort group of 15 teacher candidates in the educational technology program via Survey Monkey to evaluate the perceptions of the teacher candidates in the three areas of the program's concentration: the hybrid nature of course delivery; the program's course sequencing designed to take teacher candidates from course on a foundational level, through an application level, and culminating in a scholarship and

leader level; and finally the student-driven nature of the program. Demographic questions were used to gather vital information about the candidates and to get a sense of who they are and what their teaching experience in the field might be.

Data Analysis and Findings

This survey was administered to teacher candidates in their last semester of the first educational technology cohort group. It was used to evaluate the program on all three levels of the program's design. Question 1 was designed to evaluate experiences using blended or hybrid learning tools, question 2 evaluated the program's course sequence design, and question 3 assessed the student-driven attributes of the program and Questions 4 through 8 gather demographical data.

The results of the educational technology program TPACK Pre-Professional Student survey are: the responses Not at All has been assigned a 1; Rarely a 2; Sometimes a 3; Most of the Time a 4; and Always a 5. Questions 1 to 3 in this section of the survey referenced the program's three areas of focus: the blended or hybrid deliver system, the sequential nature of the program, and the student- driven pedagogy.

Question 1 solicited teacher candidates' perceptions on the blended or hybrid delivery system, asking questions about their feeling of success in the blended learning environment, the tools available to them in the LMS to navigate, organize, manage their course work, usage of online discussions in the LMS, ease of communicating and collaborating with course mates utilizing the LMS, submission of assignments, checking course grades and getting feedback from peers and instructors through the LMS. The overall average response from the teacher candidates was 4.77 out of 5.

Question 2 asked teacher candidates to evaluate the STEP progressive sequencing nature of the program including the importance and the necessity of integrating technology into teaching and learning; their understanding of the TPACK model and the theory behind its use; designing, developing, implementing lessons, and leading based on sound scholarly research practices using the TPACK model within their content area and preferred teaching method. The overall average response from the teacher candidates was 4.8 out of 5.

Question 3 invited teacher candidates to rate the program's student- driven coursework by applying the TPACK design model through the use of collaborative tools, the LMS, the hybrid course format, the program's course sequence, the application of prior knowledge, theory, methods, strategies, and best practices, the program's unique activities such as Edcamp and discussion directors, as well as their confidence in accepting leadership roles and doing scholarly research. The overall average response from the teacher candidates was 4.917 out of 5.

Questions 4 through 8 deal with the demographical data of the first educational technology cohort group which consisted of fifteen teacher candidates. Students were spread throughout the disciplines, with eight from the concentration of math, four teaching English, seven social studies teachers, four science teachers, five special education teachers and one teaching assistant. The average age of the teacher candidates sampled was 25 years 8 months, with the oldest candidate being 34 and the youngest 23 years old.

Implications for Practice

The implications of this study inform the educational technology community of the importance of meeting the needs of the non-traditional teacher candidates. By offering hybrid courses at non-peak times for on campus meeting, shrinking course durations to seven-week semesters, and running courses continuously and concurrently throughout the year. As well as reducing costs drastically so that teacher candidates can complete the program in as little as 20 months and can apply for an individual path to state certification is essential. We hope to eventually go fully online as well as offer the program at various satellite center throughout an expanded yet localized area.

Conclusion

The purpose of the educational technology master's program is to develop teachers TPACK model of instruction into teaching and learning. The combination of the hybrid delivery, STEP course design, and the student driven approach has positively been evidenced as a one way to advance TPACK knowledge for teacher candidates. The purpose of this study was to include teachers' perception of the program components related to their own TPACK model of instruction technology integration for future program development. As discussed in the data analysis section, teacher candidates agree the components in the educational master's program have contributed to their development of the TPACK model of instruction in their teaching and learning. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors; however, the research was supported by this College.

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