Technology Integration Matrix: Benefits to the Pre-Service Educator

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Descriptors: Technology Integration, Preservice Educators

Abstract

The purpose of this research was to determine how use of the Technology Integration Matrix (TIM) influenced preservice educators' metacognition about technology integration into teaching and learning practices. The TIM addressed preservice educators' needs to develop awareness of, and abilities to, apply the International Society for Technology in Education (ISTE) Standards for Teachers and Students (ISTE, 2015). The TIM assisted preservice educators in connecting the ISTE standards to content standards and theories of teaching and learning by developing effective lessons. Through completion of TIMs, preservice educators not only connected ISTE standards and content standards, but also visualized the relationships to pedagogical models and theories. Findings from this study included an increase in preservice educators' awareness of today's learners, ISTE standards, connections to pedagogy, and increased abilities to transform learning experiences.

Introduction

Today's learners need educators to transform learning experiences through effective integration of technology and the International Society for Technology in Education (ISTE) Standards for Teachers and for Students (ISTE, 2015) further emphasize that need. A Technology Integration Matrix (TIM) developed by the researchers was integrated into technology integration courses in a teacher preparation program in order to assist preservice educators in meeting the needs of today's learners. The TIM addressed preservice educators' needs to develop awareness of, and abilities to, apply the ISTE Standards for Teachers and for Students (ISTE, 2015). The purpose of the TIM is for the preservice educators to make connections and implement technology effectively. The researchers' purpose in conducting this study was to examine the effectiveness of this tool.

Literature Review

No matter the theory, method, or strategies used, integrating technology effectively is of utmost importance in meeting the needs of today's learners (Watson & Pecchioni, 2011). Technology provides educators with limitless possibilities to impact students' learning, but without effective planning and implementation, technology becomes wasteful and problematic. Technology will not make a bad teacher good, but a good educator can use it to make

great learning experiences. To assist preservice educators in the ability to effectively integrate technology, the researchers developed a Technology Integration Matrix (TIM). The purpose of the TIM is for the preservice educators to make connections between pedagogical theories, standards, and practical implementation of technology.

Zhao (2015) asserted that "educational systems have been struggling to produce creative and entrepreneurial citizens for decades" (p. 130). Today's learners, or 21st century learners, must have learning and innovation skills, life and career skills, information, media, and technology skills, in addition to content knowledge (Partnership for 21st Century Skills, 2015). It is imperative that an educational revolution take place in which creativity, development of diverse talents, global perspectives, innovation, and entrepreneurship are cultivated (Zhao, 2015). Personalizing the education experience through effective use of technology is the way to meet the needs of today's learners.

ISTE created technology integration standards for educators, students, administrators, coaches, and computer science educators (ISTE, 2015). The goal of such standards is to increase innovation in education. "ISTE Standards work in concert to support students, educators and leaders with clear guidelines for the skills, knowledge and approaches they need to succeed in the digital age" (ISTE, 2015, para. 1). Standards for students include creativity and innovation, research and information fluency, communication and collaboration, critical thinking, problem solving, decision making, digital citizenship, technology operations and concepts. The standards for teachers include words such as facilitate, model, design and develop, and professional growth. Nothing in the standards focuses on using specific technology tools, but rather how to effectively integrate all technology while encouraging creativity, innovation, and citizenship (ISTE, 2015).

Theoretical Framework

The TPACK (Technology, Pedagogy, and Content Knowledge) framework proposed by Koehler and Mishra (2005), explains that desirable use of technology in the classroom requires complex forms of teacher knowledge that integrates content, pedagogy, and technology. To Koehler and Mishra (2005), it is possible for instructors to support the development of a teacher's TPACK through programs that incorporate all sections of the framework throughout the process rather than in isolated chunks that focus on technology, content, or pedagogy individually.

Expanding on Koehler and Mishra's TPACK framework (2005), Wilson, Zygouris-Coe, Cardullo, & Fang (2013), further developed a Metacognitive-TPACK (M-TPACK) framework. This framework draws on the concepts of TPACK as proposed by Koehler and Mishra (2005). M-TPACK holds that for technology to be an integral part of teaching and learning, teachers must have a "positive disposition towards a technology and be metacognitive in their decisions and practices" (Wilson et al., 2013, p. 9). Teachers must have an explorative attitude towards technology use and recognize that technology integration plays a pivotal role in improving both content and 21st century skills (Wilson et al 2013). This framework holds that in addition to TPACK, a metacognitive teacher also has knowledge that the learning environment is about "access to content, research, support, expertise, real world artifacts, accessing information sources, ease of mobility, motivation, curiosity, communication, and collaboration" (Wilson et al. 2013, p. 10).

Methodology

In this study, the TIM provided preservice teachers with the metacognition they needed to effectively integrate technology into their content and pedagogical knowledge.
The following research question was examined:

How does use of the Technology Integration Matrix influence preservice educators' metacognition about technology integration in teaching and learning practices?

Participants and Setting

The study was conducted in a school of teacher education at a university in the Rocky Mountain region using a convenience sampling. The participants were recruited from the preservice educators enrolled in required technology integration courses taught by the researchers. The purpose of the courses was to teach preservice teachers how to effectively integrate technology in their future teaching practices in K-12 educational environments. The participants included students in online and face-to-face educational technology courses. All of the participants

were preservice educators studying early childhood education, primary education, or secondary education with various endorsement areas.

Participants in this qualitative study included approximately 204 students enrolled in Educational Technology (ET) 449, Integrating Technology into Secondary Pedagogy and students enrolled in ET247 and ET347 Integration of Technology in Elementary Pedagogy I and II. All participants were at least 18 years of age.

Data

The Technology Integration Matrix (TIM) developed by the researchers was incorporated into technology integration courses in a teacher preparation program. The tool addressed preservice educators' needs to develop awareness of, and abilities to, apply the ISTE Standards for Teachers and Students (ISTE, 2015), and to make connections between the ISTE standards, content standards, and theories and models for teaching and learning. A pre and post-survey was completed by students in all three courses which gathered demographics and posed qualitative prompts regarding metacognition of technology integration through use of the TIM. Participants for the focus groups were recruited from the face-to-face ET449 course, by a researcher who is not an instructor of ET449. The researcher sought four focus groups comprised of three to five participants each.

Data Collection and Analysis

The data analysis procedures used in this study are consistent with an interpretivist model of qualitative research. According to Erickson (1986) "the basic task of data analysis is to generate assertions that vary in scope and level of inference, largely through induction, and to establish an evidentiary warrant for the assertions one wishes to make" (p. 146). A comparative analysis of the data being collected was utilized (Strauss & Corbin, 1998). The three-step process of open coding, axial coding, and selective coding as described by Strauss and Corbin (1998) was conducted to construct assertions and understand the relationships among sets of data. Descriptive statistics were appropriate for summarizing the data obtained in the study. Specifically, researchers employed descriptive statistics when analyzing demographic data.

Researchers conducted a pilot study in the undergraduate elementary educational technology courses (ET247 and ET347) in the prior semester. The researchers analyzed student work samples from this pilot study, as well as work samples from the current study. The participants'' work samples are completed Technology Integration Matrices. A longitudinal aspect to the study is currently collecting data from participants who used the TIM in ET247 and continue to use it in ET347.

Pilot Study

Participants work samples from the pilot study showed an increase in metacognition of effective technology integration after completing Technology Integration Matrices throughout the semester. Participants' reflections on the matrices explained their initial confusion and uncertainty with integrating technology in future teaching and learning practices; however, by the end of the semester, reflections indicated improvement in their ability to confidently integrate technology. Findings further indicated an increase in preservice educators' abilities to transform learning experiences through effective implementation of technology.

Based on the pilot study, modifications were made to the TIM to maximize potential learning by eliminating superfluous components that did not enhance metacognition of effective technology integration. The modified TIM was designed to increase usability.

Results

Demographic Information

This study employed a convenient sampling method. The N for this study was 69 for both pre and post data. There were 39 participants from the elementary class ET247, and 30 were from ET449. Participants were asked to identify a major and area of licensure on the survey. Major areas included, elementary, secondary, K-12, and early childhood education. Areas of licensure selected included special education, English/language arts, math, social studies/history, Spanish, theatre, and biological sciences. Participants were asked to keep a content area in mind as they responded to the questions. This direction was to assist participants in looking at the questions through a pedagogical lens. A variety of content areas were selected.

Survey Data

To answer the research question, eight open ended questions were posed in both the pre and post survey. The questions were designed to determine preservice teachers' knowledge of effective technology integration, pedagogical/theoretical knowledge they associate with their teaching, and knowledge of ISTE standards; as well as how the matrix assisted them in making connections between theoretical frameworks and technology integration, and how the matrix helped increase their knowledge of effective technology integration. Each question was coded separately and pre and post-tests compared to determine increase or change in metacognition after use of the matrix by the preservice teachers. It is important to note that the classes in which the study took place are designed as technology rich classes and as such employ multiple technology integration projects to equip the preservice teachers with effective technology integration skills that align with the content and curriculum needs of their future students. The TIM was incorporated to assist with critical thinking and in planning technology rich lessons.

Technology integration was addressed in the survey. The first two questions: "What does effective technology integration mean to you" and "How will you use technology to transform learning experiences for your students", acknowledged that most of the participants had some knowledge of what that entailed in the pre-survey. The responses demonstrated some understanding and familiarity with use of technology to transform learning, however the post-survey elicited more comprehensive responses to these questions which can be interpreted as an increase in metacognition of what effective technology integration entails. These post-survey responses were more comprehensive after participating in a technology rich classroom that utilized the TIM as part and parcel of their learning. These responses also showed differentiation, as participants had a much broader understanding of technology use to diversify learning. For example, one participant's response in the pre-survey for these two questions was as follows:

> Q1: "It means learning how to adequately use technology in class."
>
> Q2: "I will use it for students with disabilities to be sure that they are able to learn everything that I am teaching properly and able to learn in a way that makes sense to them."

The participant's post-survey response included:

> Q1: "It means being able to use technology inside and outside of the classroom to ensure students are learning. Using technology to show students who learn a little bit different that it is indeed possible to learn like everyone else."
>
> Q2: "I will make it where there are multiple ways to learn the topic, from visual, to auditory and incorporating both in every lesson so students can pick and choose the way that is best for them to learn."

Some participants' responses were also different in regards to learner centered integration as opposed to general use of technology in the classroom. This improvement is illustrated in another participant's response:

> Pre-survey Q1: "The best way to apply technology in classroom", versus
>
> Post-survey Q1: "Integrating technology in your classroom so it is useful for the student to learn."

Regarding knowledge of ISTE standards, a question posed included participants' knowledge of ISTE standards for both teachers and learners and how they anticipated they would integrate or use these standards in their future classrooms. Out of 69participants, only 24 stated that they were familiar with ISTE standards in the pre-survey. One participant stated that:

> "As of right now, the school I am working at does not require or use ISTE standards to my knowledge. However, if I learn that they do, I will use them in the same way I use the CAS and CCSS. Backwards by design lessons are the best no matter what standards you are using. Therefore, I would use the standards as a starting point and build my lesson from there."

Most participants also had no prior knowledge or experience with any type of technology integration matrix before the class. Of the 69 participants that completed the pre-survey, only 9 were familiar with a technology integration matrix. After the pre-survey the participants were introduced to the matrix, theoretical frameworks and models, ISTE standards, and content standards. The matrix was used in conjunction with the technology rich modules and participants completed the matrix as part of each module. They used the matrix to reflect on the integration process and made connections between frameworks/models and standards.

In the post survey, they were asked three questions intended to capture how the matrix assisted their technology metacognition and integration process. Responses demonstrated that the matrix assisted them in this process. Specifically, these questions intended to determine how the TIM assisted the participants' in applying ISTE standards, how it prepared them to effectively integrate technology in their future teaching practices, and how the TIM assisted them in making connections between learning theories and technology integration. In answering the first question, how the TIM assisted in the application of ISTE standards, participants' responses reflected that use of the TIM helped them in applying ISTE standards across content:

"The TIM helped me understand the ISTE standards on technology more in depth to better cater to my students. I think it made very clear what tech is appropriate for classroom use."

"It gave me time to really ponder and come up with ideas that could actually be used within a lesson or as the lesson for all the different subjects."

"It helped me to look at the goals for teachers and students and adapt my activities and what I wanted to do to match those goals as well as come up with new activities to match goals I hadn't used yet."

"It helped me think about one lesson in several different contexts as well as the how one standard can be hit in many ways, or numerous standards in one lesson depending on small tweaks to the lesson, and work assigned to the students."

In answering the second TIM application question, how it helped them to effectively integrate technology in their future teaching practices, participants' responses demonstrated that the TIM assisted them by increasing their metacognition to effectively integrate technology in their future teaching practices. The following are some of the responses:

"It helped me think about the different components of technology and tackling it from an educational step by step process."

"It helped me think of ways to incorporate different technologies into a variety of subjects."

"It helped me to come up with new ways of teaching different concepts and now I have four different matrices to look at when planning classroom learning experiences."

"It taught me to always ask myself before I bring anything into my classroom 'what standard am I hitting?' Sure you can bring in a digital story telling of the book Charlotte's web, but what standard are you enforcing? connecting the material, bridging it with technology and book work."

The last question posed, intended to determine how the TIM assisted the participants in making connections between learning theories and technology integration. Responses demonstrated that preservice teachers' knowledge of the pedagogical theories and how they can use technology to influence and change their pedagogical practices improved. Participants were expected to critically think and come up with technology rich learning activities for their students using multiple pedagogical theories provided in the matrix. The following are some of the response:

"It helped me find appropriate connections between learning theories and technology integration. One of the most beneficial is understanding what formats aid students the most and which tech fits that need for them."

"Students can learn using technology. The matrix had us evaluate Bloom's Taxonomy methods and explain in detail how they applied to the classroom examples I had to think up."

"It helped me by making me find ways to incorporate technology into every subject not just the same subjects every time, I had to come up with a way to incorporate technology into every subject I teach so it is being used all the time."

"It helped to take one lesson and stretch and alter it to fit into the teaching theories, and how easy or hard it was, in order to be a good teacher you need to think about all theories and learning styles."

Focus Group Data

Participants in the focus group discussed the connections the TIM assisted them in creating. This focus group data further cemented that the TIM indeed helped with these connections between technology integration, standards, and theoretical frameworks. Some of the participants' comments within the discussion included:

"Just literarily the way it sets you up to have to make connections between the standards and the rest."

"I feel like it was a good place to finally bring all strategies with the standards together, you know you learn all the rest in the previous classes but they don't usually really connect them"

"I think even when I am teaching I will set up a similar matrix for myself . . . just to keep track of the standards I am hitting weekly and to keep track of where I wanna go in the future and help me plan in the lesson because it really keeps you a lot more organized . . . and make sure you are progressing at the end of the year."

"Made like a clear linear connection as to standards, technology standards were connected to as far as CDE so it made me realize that ooh so they are doing this with computers and they are doing this with CDE at the same time like this is the standards they are accessing while we are doing this in technology"

"The linear connection made me get creative with what your lesson plans are, coz you are like as long as I hit this . . . then I am actually accessing that standard. It reminds you that you are doing a lot more than just the lesson plan."

Longitudinal Data

The researchers chose to survey participants over a period of enrollment in both ET247 and ET347. Participants were introduced to the TIM in ET247, then they progressed into Integration of Technology in Elementary Pedagogy II (ET347) and have continued to complete the TIM. This aspect of the study was to demonstrate a long term effect of using matrices to help preservice educators to adopt and instill an effective technology integration approach for their future teaching practices. In studying these participants over a series of courses utilizing the TIM, we hoped to identify a longitudinal relationship in their metacognition of technology integration in their teaching and learning practices. The intent was to determine if the participants prolonged use of the TIM continued to influence and improve their technology integration metacognition. Four participants' responses in ET347 were matched with their responses from ET247 and analyzed.

In answering the first two questions: 'What does effective technology integration mean to you" and "How will you use technology to transform learning experiences for your students", these participants' responses varied slightly from their earlier responses. One participant's response illustrated a slightly better understanding of what effective technology integration meant:

> ET247 post-survey: "The best way to apply technology in the classroom", compared to
> ET347 pre-survey: "Effective technology integration means to me, when you understand the information that you are teaching and integrating technology when it is necessary and the most helpful."

Another participant responded:

> ET247 post-survey: "Effective technology integration is using means of technology to present information to students in new ways compared to traditional teaching methods. This includes having students make online videos instead of a poster, or keeping a blog, etc to teach students how to use the technology that surrounds them daily and make it a relevant way to learn in school."
> ET347 pre-survey: "To me it means an equal balance of appropriate technology to help enhance learning. Students of the upcoming generations will not know of a life without it, so using technology can help them make better connections from the learning material and their personal lives."

Finally, one participant's response in ET347 moves beyond integrating a technology tool just for the tools sake, to an approach that integrates technology to enhance learning and help students make connections between concepts using technology tools; as well as appreciating and identifying the ubiquity that technology affords learning:

> "I will use technology to transform the learning experiences for my students by getting my students familiar with technology and able to use technology for all their needs. It will give the students a different way of learning that they can also do at home besides the classroom."

This response can be interpreted as demonstrating a much better understanding of what effective technology entails. These ET347 participants will complete a final survey in the next couple of months to determine any longitudinal aspects to this study.

Conclusion

Today's learners need educators to transform learning experiences through effective integration of technology and the ISTE Standards for Teachers and for Students (ISTE, 2015). Through implementation of the TIM, researchers noted an increase in preservice educators' awareness of the needs of today's learners, the ISTE standards for technology integration, and connections to pedagogical models and theories. The use of the TIM in conjunction with integration tools and strategies in teacher preparation programs have the potential to better prepare preservice teachers for their future teaching practices. Preservice educators repeated use of the TIM throughout their teacher preparation programs can also help improve their abilities to make improved connections between ISTE standards, content standards, and pedagogical models and theories. In addition to these benefits, this study demonstrates that preservice educators' integration of the TIM did improve their M-TPACK, which better prepares them to use technology as integral part of teaching and learning in their future classes.

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