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Introduction

This study aims at exploring how the technological pedagogical content knowledge (TPACK) framework can be used to improve the effectiveness of integrating IDEA ’04 and Research for Inclusive Settings (IRIS) modules in preservice teacher education. The purposes of this study are to maximize the potential of TPACK at the college and university level and to improve the quality of technology integration in teacher education. The results indicate that the use of TPACK in teacher education can offer teacher educators a way to enhance technology integration and to help preservice teachers build a more solid foundation of knowledge and practices.

With the development of technology integration in higher education (Bates & Poole, 2003; Garrison & Kanuka, 2004; Jonassen, Mayes, & McAleese, 1993), identifying a valid and effective way to examine the impact of technology integration in preservice teacher education is important and urgent. The TPACK framework extended from Shulman’s (1987) idea of pedagogical content knowledge has been proven as one of the most important approaches for effective technology integration in the classroom. However, there is limited existing research in preservice teacher education addressing how TPACK can be used to enhance the quality of technology integration, such as the IRIS modules. Grounded in action research, the present study aims at exploring how TPACK can be used to examine the impact of integrating IRIS modules in preservice teacher education.

Literature Review

Preservice Teacher Online Learning

Online learning has become an important component in preservice teacher education in two- and four-year institutions. Because online learning has the potential to maximize teaching and learning resources, more colleges and universities in the United States and elsewhere in the world have begun offering a number of hybrid or online courses.

The benefits of online learning are many. First, it promotes continued education opportunities for those who live in distant areas, which in turn expands geographic areas where information can be distributed. Second, it increases flexibility for learners to have access to knowledge without

physically sitting in a classroom for a specific amount of time. Third, it provides multiple methods of demonstration, discussion, and practice opportunities to reinforce instruction and subsequent comprehension (Smith & Robb, 2010). The use of technology also allows instructors to reach larger numbers of students than in a typical classroom setting.

Lever-Duffy and McDonald (2015) categorize the types of online learning as follows: blended delivery (traditional classroom instruction enhanced by technology), distance delivery (group instruction possible if mediated by technology), interactivity available in class and virtually online, and interactivity primarily online with little face-to-face contact. Because each online learning delivery system has its pros and cons, instructors must carefully identify appropriate online learning programs and evaluate the effectiveness of technology integration with caution (Ertmer, 1999; Ertmer, 2005; Harris, Mishra, & Koehler, 2009; Lever-Duffy & McDonald, 2015).

IRIS Modules

The IRIS modules funded by the U.S. Office of Special Education Programs (OSEP) are created by the IRIS Center at the Peabody College of Vanderbilt University. By November 2014, the IRIS Center has developed a series of web-based and research-validated training modules for public use with no cost for users. These modules cover 17 important topics related to inclusive education for learners, particularly those with disabilities at birth and through age 21 (IRIS, 2014). The topics of the modules include accommodations, assessment, assistive technology, behavior and classroom management, collaboration, content instruction, differentiated instruction, disability, diversity, early intervention/early childhood, learning strategies, mathematics, reading/literacy/language arts, related services, response to intervention (RTI), school improvement/leadership, and transition.

All IRIS modules are developed based on cognitive science research and the *How People Learn* theory (National Research Council, 1999). Each module has five components: *Challenge, Initial Thoughts*, *Perspectives and Resources*, *Wrap Up*, and *Assessment*. It begins by raising users' awareness with a realistic challenge through a scenario. Following the scenario, *Initial Thought* questions help participants to use what they already know to address the challenge. In the *Perspectives and Resources* section, users start to learn how to deal with the challenge through a variety of presentations, such as informational videos, hands-on examples, interview videos, and real-life experiences. In the *Wrap-Up* section, users view a summary of what they have learned in the *Perspectives and Resources* section and address the *Final Thoughts* questions on how they will deal with the challenge after learning from the module. Finally, users need to address a couple of questions related to the topic of each module in the *Assessment* section (Smith & Robb, 2010).

The IRIS Center's field-testing data from 39 faculty at 40 colleges and universities and from 1,257 students in 39 courses show that most of the users of the IRIS modules were highly satisfied with the quality of the modules, and they found the modules helpful to increase their knowledge and skills of the topic, as well as to improve their professional practices (IRIS, 2012). A recent evaluation conducted by the National Center for Education Evaluation and Regional Assistance indicates that approximately 80% of the quality and the relevance/usefulness ratings across the IRIS modules were either high or very high (Fiore, Nimkoff, Munk, & Carlson, 2013).

TPACK

Technological pedagogical content knowledge (TPACK) is a framework that explicitly describes the knowledge an educator needs to have in order to maximize the value of incorporating technology in the classroom (Koehler & Mishra, 2009). TPACK was conceptualized by Koehler and Mishra and is built on Shulman's (1987) instructional approach that addresses how different sources of knowledge are interconnected with each other in the learning context. Table 1 lists the TPACK components and their descriptions.

Table 1

The TPACK Components and Descriptions

Components	Descriptions
Content knowledge (CK)	Teachers' knowledge about the subject matter to be learned or taught
Pedagogical knowledge (PK)	Teachers' knowledge about the processes and practices or methods of teaching and learning
Pedagogical content knowledge (PCK)	The notion of the transformation of the subject matter for teaching
Technological knowledge (TK)	On-going and open-ended interaction with technology
Technological pedagogical knowledge (TPK)	An understanding of how teaching and learning can change when particular technologies are used in particular ways
Technological content knowledge (TCK)	An understanding of the manner in which technology and content influence and constrain one another

Note. Adapted from "What is Technological Pedagogical Content Knowledge?" by M. J. Koehler and P. Mishra, 2009, *Contemporary Issues in Technology and Teacher Education, 9*(1), pp. 63-66.

With the increase of incorporating technology in class, teachers' ability of integrating their technology, pedagogy, and content knowledge in a complex learning context is crucial to maximizing the potential of technology. The TPACK framework raises educators' awareness that there are multiple factors that contribute to effective technology integration (Koehler & Mishra, 2009; Mishra & Koehler, 2006). Because the influence of the interconnection among these factors is often immeasurable, instructors must be mindful of the different phases of knowledge embedded in technology integration. Figure 1 shows the TPACK framework.

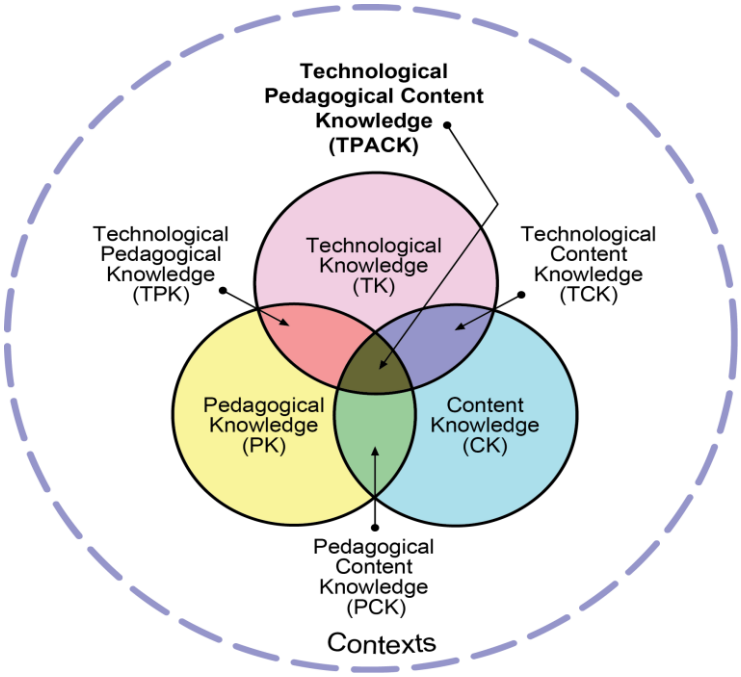

Figure 1. The TPACK Image. Adapted from tpack.org. Copyright 2012 by TPACK. Reprinted with permission.

Since Drs. Mishra and Koehler published TPACK in 2006, many studies have been conducted and have shown that TPACK has a positive impact on practitioners' use of technology in the classroom (Abbit, 2011; Chai, Koh, & Tsai, 2013; Schmidt et al., 2009; Voogt, Fisser, Pareja Roblin, Tondeur, & van Braakt, 2013). It was found that when preservice teachers were introduced to the TPACK framework, they became more confident in using technology in K-12 classrooms, and they viewed the use of technology more positively (Chai et al., 2013; Koh & Divaharan, 2011; So & Kim, 2009). The existing literature focuses more on the improvement of preservice and in-service teachers' integrative knowledge of content, pedagogy, and technology in K-12 classrooms, and focuses less on how teacher educators at the college and university level can use TPACK for their own practices in technology integration. The purposes of this study were twofold: (a) to maximize the use of TPACK at the college and university level, and (b) to help improve the quality of technology integration in preservice teacher education.

Because practitioners are "full-time inhabitants of those settings rather than episodic visitors" (Shulman, 2004, p. 297), it is believed that case studies conducted in practitioners' own classrooms serve as an invaluable means to examine the multiple aspects of a domain.

Action Research

Action research is an intentional, systematic, and reflective inquiry done by practitioners (Henderson, Meier, Perry, & Stremmel, 2012; MacLean & Mohr, 1999). Action research aims to improve teaching and learning outcomes and to describe the possible solutions to the questions that practitioners have in their classrooms. Because practitioners are "full-time inhabitants of those settings rather than episodic visitors" (Shulman, 2004, p. 297), it is believed that case studies conducted in practitioners' own classrooms serve as an invaluable means to examine the multiple aspects of a domain.

Action research typically involves a cycle of "identifying problems of meaning," "developing questions and examining assumptions," "gathering data," "analyzing data," "interpreting data," and "taking action" (Henderson et al., 2012, p. 2). Creswell (2015) described similar steps of action research which include: (a) "determining if action research is the best design to use," (b) "identifying a problem to study," (c) "locating resources to help address the problem," (d) "identifying information you will need," (e) "implementing the data collection," (f) "analyzing the data," (g) "developing a plan for action," and (h) "implementing the plan and reflecting" (pp. 591-592). To put it simply, action research involves a spiral process of three phrases: look, think, and act (Stringer, 2014).

Cresswell (2015) suggests that action should be taken when a study has a focus on a practical problem or issue in the community, and it should be used to help the practitioner grow professionally as a result of conducting the study. While action research is widely used and formally applied in the education fields (Ferrance, 2000; Grabe & Stoller, 2002; Groves & Zemel, 2000; Hine, 2013; Stringer, 2014), it is important to note that simply being an insider or speaking with a teacher's voice is not enough for the claims of action research (Shulman, 2004). To establish a warrant for the claims of action research, practitioners must display substantive sophistication of knowledge, collect and analyze multiple sources of quantitative and qualitative data to address an inquiry (Cresswell, 2015; Shulman, 2004).

Methods

Participants

Thirty-two preservice teachers at a southern public university voluntarily participated in this study. These participants were pursuing their initial teacher certification in special education and were enrolled in two introductory courses, Fundamentals of Literacy and Characteristics of Learners with Mild Disabilities. Both courses were three semester hours of credit and were taught by the researcher of the present study. All participants signed an IRB-approved, date-stamped informed consent form, and they received $10 as an incentive. The participation rates in both classes were 100%. Table 2 shows the participants' demographic information.

Table 2

Participant Demographics

Introductory Courses	Fundamentals of Literacy (n = 10)	Characteristics of Learners with Mild Disabilities (n = 23)
White American	5	16
African American	5	7
Male	0	2
Female	10	21

Course Design and Technology Incorporation

The semester was broken into three blocks of time, with the middle focused on a field placement when students had a chance to implement what they learned in the field, then a debriefing back in class afterward. During the 5-week block of field placement, all participants were placed in different K-12 classrooms in the university partner schools in order to complete their 30-hour fieldwork related to the course. The participants were supervised by their collaborating teachers and three university supervisors. After the field placement period, the face-to-face classes resumed.

Both introductory courses were delivered in a similar format that included: (a) blended delivery (traditional classroom instruction enhanced by technology), and (b) interactivity available in class and virtually online (Lever-Duffy & McDonald, 2015). During the first six or seven weeks of face-to-face classes, five IRIS modules were integrated in Fundamentals of Literacy (one class was cancelled due to Labor Day), and another six modules were integrated in Characteristics of Learners with Mild Disabilities. The modules were selected based on the topic and the contents of the texts each week. Table 3 shows the Fundamentals of Literacy course plan. The text used in this course was Raymond's (2012) *Learners with Mild Disabilities: A Characteristics Approach*. Table 4 shows the Characteristics of Learners with Mild Disabilities course plan. The text used in *this course* was Jennings, Caldwell, and Lerner's (2010) *Reading Problems: Assessment and Teaching Strategies*.

Table 3

Fundamentals of Literacy Course Plan

Week	Topic	Content (in-class activity)	Course materials
1	Introduction		
2	Assessment	Formal and informal assessment, tests of general reading assessment, diagnostic reading tests, curriculum-based measurement (CBM), etc.	Text: Ch. 4 & 5 / *IRIS Module:* Classroom assessment, Part 2: Evaluating reading progress
3	Instructional support	Instruction for struggling readers, early intervention programs, interventions for older students, total school or classroom interventions, peer-assisted learning strategies (PALS), etc.	Text: Ch. 6 / *IRIS Module:* PALS: K-1, PALS: 2-6, or PALS High School
4	Early literacy	Oral language development, listening comprehension, print knowledge and environmental print, alphabet knowledge, phonemic and phonological awareness, vocabulary and rapid naming	Text: Ch. 7 / *IRIS Module:* RTI, Part 3: Reading instruction
5	Diversity	Literacy in a multicultural society, English language learners, the role of parents and family, adolescents and adults with reading problems, etc.	Text: Ch. 14 / *IRIS Module:* Teaching English language learners
6	Students with special needs	Students with disabilities, learning disabilities and ADHD, students who are at risk for school failure, reading instruction for students with special needs	Text: Ch. 15 / *IRIS Module:* RTI, Part 5: A closer look at Tier 3

Table 4

Characteristics of Learners with Mild Disabilities Course Plan

	Topic	Content (in-class activity)	Course materials
1	Introduction		
2	Perspectives on disability	High-prevalence disabilities; the power of language, labeling, classifying, and identifying; the historical context of disability	Text: Ch. 1 / *IRIS Module:* What do you see? Perceptions of disability
3	Intellectual and developmental disabilities	History, definition, assessment and identification, levels of severity, prevalence, factors associated with risk, characteristics, instructional support	Text: Ch. 4 / *IRIS Module:* Universal design for learning
4	Learning disabilities	History, definition, assessment and identification, levels of severity, prevalence, factors associated with risk, characteristics, instructional support	Text: Ch. 5 / *IRIS Module:* SRSD: Using learning strategies to enhance student learning
5	Emotional or behavioral disorders	History, definition, assessment and identification, levels of severity, prevalence, factors associated with risk, characteristics, instructional support	Text: Ch. 6 / *IRIS Module:* Functional behavioral assessment
6	Attention disorders & other conditions	History, definition, assessment and identification, levels of severity, prevalence, factors associated with risk, characteristics, instructional support	Text: Ch. 7 / *IRIS Module:* Differentiated instruction
7	Autism Spectrum Disorder (ASD)	History, definition, assessment and identification, levels of severity, prevalence, factors associated with risk, characteristics, instructional support	Text: Ch. 8 / *IRIS Module:* Assistive technology: An overview

Data Collection Procedures

Consistent with the tenets of action research (Creswell, 2015; Henderson et al., 2012; Stringer, 2014), three steps were taken in the present study.

The first action. The researcher (i.e., the participants' instructor) first used her technological content knowledge (TCK) to plan how to use IRIS to enhance the traditional classroom activities. To do so, the strengths and weaknesses of the course materials were carefully reviewed in order to align them with the course objectives. When IRIS modules were integrated in the courses as participants' homework prior to each class, the research used the *Initial and Final Thoughts* questions embedded in each module to assess the participants' prior knowledge in each class. The researcher then used her pedagogical content knowledge (PCK) as well as technological content knowledge (TCK) to transform the subject matter for teaching and learning. That is, based on the participants' performance on each module, the researcher adjusted the in-class activities to improve or reinforce participants' knowledge.

The second action. The second action was to repeat the first action for each module until the participants completed all modules before their field placement period.

The third action. After a cyclical procedure of integrating the modules and adjusting in-class activities based on participants' performance on the modules, the researcher utilized technological and content knowledge (TCK) to evaluate how teaching and learning were intertwined when the IRIS modules were integrated in the courses and how they might have an impact on the participants' practices in their field placement. Later, the researcher served as one of the three university supervisors to observe the participants in their 30-hour field placement in K-12 public schools. One open-ended question on a survey questionnaire was conducted at the end of the study. The survey question given to the participants was: *How did IRIS modules help you increase knowledge and skills in relation to the characteristics of learners with mild disabilities/ fundamentals of literacy? What parts hindered your understanding and use of the modules?*

Data Analysis

This study utilized mixed research methods to analyze both quantitative and qualitative data. For the *Initial and Final Thoughts* answers, the participants' responses were turned from words into numbers using the content of each module as the coding scheme. The researcher adopted a coding scheme developed in her previous studies to analyze the participants' *Initial and Final Thoughts* responses. The coding scheme was based on the themes of each module. When the participants used the themes to address the scenario questions properly, their responses were coded. No participant was double-coded on each theme. Even if the participant used the same theme to address the questions in a module multiple times, his or her use of the theme was only recoded one time throughout the module, which indicated that he or she already knew the theme and could use it to address the question(s) properly. For the one open-ended question about the participants' perspectives toward the incorporation of the modules, the coding scheme was based on the themes emerging from the participants' responses. Two graduate students were hired and trained to code and analyze the data. When the inter-rater reliability did not reach 100%, the data were re-read, and a problem-solving process was undertaken until agreement was reached. The

problem-solving process included discussions and consultation with another scholar in the educational research field. Some minor adjustments to the initial codebook were made.

The integration of IRIS modules into the courses indeed had a potential to support teaching and to enhance the participants' learning.

In terms of the participants' fieldwork reflection papers, the data were grouped into two categories: (a) the participant applied the knowledge and skills from the coursework to the 30-hour fieldwork, and (b) the participant did not apply the knowledge and skills from the coursework to the 30-hour fieldwork. For those who applied the knowledge and skills from the coursework, the ways they applied the knowledge and skills to the fieldwork were analyzed. For those who did not apply the knowledge and skills to the fieldwork, the contextual factors were analyzed. Additionally, the researcher reviewed the other two university supervisors' observations of the participants and participants' classroom collaborating teachers' evaluations to ensure that all the participants completed their field placement adequately. Furthermore, the emerging themes from the participants' responses to the survey question about their perspectives toward technology integration were identified.

Results

Knowledge of the Materials

When reviewing the strengths and weaknesses of the course materials, the researcher noticed that the text used in the course, Fundamentals of Literacy, provided comprehensive information about the key components of reading instruction and a variety of effective reading approaches. Unlike the text, each IRIS module only has one clear focus, and it provides in-depth information about how to use one specific approach in real-life situations for learners at different grades, such as peer-assisted learning strategies (PALS). Similarly, the modules used in the course, Characteristics of Learners with Mild Disabilities, also compensated the use of the text. The text used in the course provided in-depth information about different types of disabilities, including historical development, assessment and identification, and characteristics of learners with mild disabilities. However, the text did not include sufficient hands-on activities about providing instructional support to students with disabilities. Thus, the integration of IRIS modules into the courses indeed had a potential to support teaching and to enhance the participants' learning.

Participants' Module Learning Outcomes

The incorporation of the IRIS modules helped the researcher know the participants' prior knowledge. Based on the participants' performance on the *Initial and Final Thoughts* questions, the researcher adjusted the in-class activities to improve or reinforce the participants' knowledge in each area. For example, when the participants did not address certain themes correctly or thoroughly, more class discussions and activities were emphasized in these areas.

There were five modules incorporated in the course, Fundamentals of Literacy. Prior to completing the first module, very few participants (less than 10%) mentioned using curriculum-

based measurement (CBM) to help struggling students. However, about 70% of the participants suggested using CBM after the completion of the module, and they were able to describe the procedures of using CBM, such as setting goals and making instructional decisions based on the CBM data, as well as communicating with students, parents, and other professionals about the use of CBM. In the second module, before completing this module, the only familiar concept for the participants when discussing peer-assisted learning strategies (PALS) was to pair students together to help improve their reading. After completing this module, 90% of participants addressed the benefits of PALS in detail. They discussed the use of PALS, including preparing materials (40%), training students for effective PALS (30%), motivating students to use PALS (30%), and maintaining students' interest in the program (20%). In the third module, there was an increase of 60% of participants that highlighted the importance of using high-quality reading instruction to enhance their students' reading capabilities (from 25 % to 85%). Of the participants in the study, 80% stated that teachers should incorporate high-quality reading instruction to help students under the RTI framework. After the fourth module, the participants were more aware of English language learners' struggles in school. Specifically, the participants discussed the importance of activating students' background knowledge (80%), teaching vocabulary and reading comprehension to ELL's (50%), and opportunities for practice (40%). In the final module, there was little mention or knowledge about Tier 3 in the response to intervention (RTI) approach prior to the completion of this module, and only 40% of the participants mentioned qualities and steps of Tier 3 intervention implementation prior to the module. After the module, all participants (100%) were capable of describing how to use the Tier 3 intervention implementation to help struggling students.

The results from incorporating another six modules in the course, Characteristics of Learners with Mild Disabilities, also indicate that after taking two to three uninterrupted hours to complete each module prior to the class, the participants demonstrated their immediate progress on the post assessment. After completing the first module, nearly 80% of the participants understood how perceptions impact people with disabilities in positive and negative ways. Twenty-two percent of the participants recognized myths and misconceptions about disabilities, and 26% mentioned that societal views can shape beliefs about people with disabilities. In the second module, although more participants (about 35%) were aware of the use of universal design for learning after completing the second module, most of them did not address how to set goals and incorporate instructional materials to support the implementation of this approach. After the third module, over 86.96% of the participants emphasized helping students use the self-regulated strategy development (SRSD) approach to enhance learning. The participants realized that teachers need to discuss learning strategies (26.09%), model them (17.39%), support the use of these strategies (17.39%), and establish time for independent practice (21.75%) in order to enhance students' use of self-regulated strategies. In Module 4, there was a drastic increase in the results after the completion of the module. Prior to the module, none of the participants used functional behavioral assessment (FBA) to address the scenario questions. After completion, nearly 70% of the participants mentioned FBA, and they seemed to understand how to use this approach to identify problem behavior and provide interventions. After completing Module 5, approximately 83% of the participants realized that classroom management and arrangement play a major factor in maximizing the learning of all students. Prior to the module, the participants did not take into account students' readiness and learning profiles (0%). However,

after the module, 74% of the participants were aware of this concept. More participants noticed the impact of differentiated instruction in all three areas: content (30%), process (30%), and product (26%). The percentages were still low, nonetheless, and thus in-class activities were adjusted to strengthen their knowledge in these areas. Furthermore, after the sixth module, many participants were still not familiar with the legislation of Free Appropriate Public Education (FAPE) and policies about intervention plans. Therefore, an educational policy professor was invited to the class as a guest speaker for a Q&A session.

Participants' Fieldwork Reflection Paper

The participants' reflection papers indicated that most participants found the incorporation of the IRIS modules and in-class activities helpful. The majority of them (73%) were able to apply numerous things that they had learned in their respective course to their field placement. For example, one participant stated:

> I had the opportunity to exercise the knowledge I gained from the reading and activities that I did on the IRIS modules. Throughout the day I used the techniques of differentiate instructions, phonemic, phonics, reading fluency, vocabulary, English language learners, and Tier 3. (Participant F2)

Echoing this response, another participant said:

> The tools that the textbook gave about helping students to become interactive [have] really proven productive in my efforts to help this student stay focused on the task at hand. Another tool that we discussed in class that I have hung on to is the idea of discovering student's passions and incorporating them into your lessons. This particular student's passion is music. I frequently integrate the use of songs and dance to keep his attention. Additionally, I implement from a particular IRIS module the idea that giving a test every Friday may not be the best way to assess a child's retention of the information. Test anxiety could set in or other unknown factors could affect a child's ability to perform well on the exam. I have started to break the big tests into smaller, more manageable assignments to decrease anxiety. Instead of just having a spelling test of 20 words every Friday, I test them over 5 words Monday, Tuesday, Wednesday, and Thursday. (Participant C10)

Although it is encouraging to see that participants' field experiences were highly related to the courses, it is also important to be aware that not all of the participants had the opportunities to practice what they had learned from the courses. A participant wrote:

> Learning about all we have learned in course so far and then going into my classroom made it hard. Throughout my field placement I could feel myself getting frustrated and disappointed in the teacher, but it was also good because I really got to see a lot of things and realize what I want, and what I do not want to happen in my future classroom. (Participant C15)

Participant C15's responses indicate that his or her collaborating teacher in the classroom might not have used adequate instructional methods to help students, which made the participant feel frustrated. However, such experiences still brought a positive impact on the participant's reflection about the type of educator he or she wants to be. Additionally, the course materials helped the participants to become critical educators. For example, one participant addressed how his/her collaborating teachers could have done better to help students succeed:

> The special education teacher that I worked with knows many strategies for helping students but she does not always help the students learn to use the strategy independently. The teacher did not go through the steps of self-regulated strategy development (SRSD) stated in the one of the IRIS modules. The students did not discuss the strategy or its benefits and they did not memorize the strategy. I did not observe any lessons on goal setting, self-monitoring, self-talk, or self-reinforcement. I believe spending time teaching strategies with the SRSD method would save the teacher and the students a lot of time overall. (Participant C12)

Overall, the field experiences were considered beneficial to the participant. The participants were able to see where course materials came into play in the real-life classroom through the experiences of being in the field. Some participants' reflection papers revealed the potential tension in their field placement. Because they were not in control of the classrooms, they might not be allowed to pull the lessons from the class discussions or from the IRIS modules directly into their field placement. Despite the tension, many of them expressed that the discussions and IRIS modules could still help them to recognize the importance of some instructional methods and to reflect on how they would handle the situations if they were the teachers of the classrooms, as well as to help them think about what they can apply to their classrooms when they start teaching.

Participants' Perspectives toward Module Incorporation

Based on the data, it is evident that the participants viewed the use of the IRIS modules positively. There were three main themes that emerged from the participants' responses toward the incorporation of the modules in the courses: the modules are engaging (86%), the modules are informative (92%), and the incorporation of the modules reinforces or compensates the texts (63%).

The course materials helped the participants to become critical educators.

Most participants explained that they liked the modules mainly because the modules were engaging and informative. One participant stated: "I love the IRIS modules. They contain information and examples. The information is presented in a variety of ways and related to a specific case study. The assessments help to finalize my understanding of the issues" (Participant C12). Another participant wrote: "IRIS Modules are helpful because they are very detailed and each module is very focused on the subject pertaining to each module" (Participant C18). Other participants also appreciated the examples and hands-on activities embedded in each module. For example, one participant described: "The modules are very beneficial. The videos and activities provide

examples of information that is sometimes difficult to understand, such as assistive technology" (Participant L7).

In addition, 63% of participants saw a clear alignment between the texts and the content of the modules. For instance, the participants wrote: "The IRIS modules are excellent resources that coincide with the information in our text" (Participant L2); "I like them because they take the information we are learning in the course a step further through activities" (Participant C17); and "…the IRIS modules were a great way to introduce each chapter and related well to the book" (Participant C6). Based on the participants' responses, it was evident that the incorporation of the modules provided the participants with prior knowledge related to the topic of each class as well as extended their knowledge of the concepts.

Discussion and Conclusion

The results of this action research demonstrate that using the TPACK framework assisted the researcher in knowing how the interconnection of technological, pedagogical, and content knowledge could help incorporate the IRIS modules in the teacher education program. Traditionally, the incorporation of technology is isolated from the content and pedagogical knowledge (Baran, Chuang, & Thompson, 2011). The present study provides evidence that a systematic alignment of course materials could increase preservice teachers' knowledge, practices, and critical thinking skills. With an increasing number of online learning resources being incorporated in teacher education programs, TPACK serves as a tool for teacher educators to reflect on their own teaching and to improve the quality of both teaching and learning.

Adopting TPACK in the two courses raised the researcher's awareness of what challenges the preservice teachers may encounter when incorporating technology in the classroom. For example, the participants explained that even if they could find the usefulness of the course materials, the tension in the real-life classroom did not allow them to apply what they had learned or had been taught to the field placement. Such feedback provides an invaluable educational opportunity for the researcher to discuss how educators can flexibly adjust their knowledge and teaching skills to meet different learning needs in different contexts with the participants. As Mishra and Koehler (2006) stated, developing an effective class with technology integration requires instructors to employ all of the key sources of knowledge—technology, pedagogy, and content—and to be aware of how these sources of knowledge are interconnected.

The use of TPACK in teacher education can offer teacher educators another way of viewing challenges when incorporating technology in class. It can also guide teacher educators to seek the best ways to implement technology and to make changes according to contexts. With the use of TPACK, when teacher educators notice that preservice teachers have a low level of prior knowledge of certain concepts, do not make adequate progress after completing modules, or do not have opportunities to apply knowledge in real-life classrooms, teacher educators should adjust their in-class activities to reinforce the concepts and to help preservice teachers cultivate new knowledge and skills. Also, teacher educators should encourage preservice teachers to revisit the modules they have completed and to use these modules as a tool to expand their post-service teaching repertoires.

Additionally, the triangulation data indicate that participants found the incorporation of IRIS modules helpful for multiple reasons. First, the modules were aligned with the learning objectives of the courses and supplemented use of the texts. Second, the modules were engaging because of their variety of presentations, such as videos, interviews, and hands-on examples. Third, field placement provided some opportunities for the participants to see, hear, practice, or critically think about the knowledge they learned through the modules and in-class activities. The results indicate that the use of TPACK appears to be a helpful way for the researcher to integrate technology in preservice teacher education more effectively.

Furthermore, because action research allows practitioners to repeatedly consider the problems, observe changes, collect data, and reflect on the effectiveness of action (Baskerville & Wood-Harper, 1996; Ferrance, 2000; Kemmis & Mctaggart, 1998; Grabe & Stoller, 2002; Stringer, 2014), using action research to examine the readiness in different dimensions of technology integration can help increase university course quality and effectiveness. In short, with the increasing body of evidence-based practices for the use of educational technology, it is recommended that teacher educators adopt action research to profile the use of TPACK in preservice teacher education.

It is important to point out that there is no single technology integration framework that can cover all factors involved in the use of technology. In their recent presentation, Mishra and Koehler (2014) encouraged educators to include more circles (factors) if they found the TPACK framework not comprehensive enough. On the other hand, if educators consider the TPACK framework too complicated, they can reduce the circles (factors) and choose one or two particular areas for technology integration.

Limitations and Future Research

There were several areas in the present study that could be improved upon in future iterations. First, although the participants demonstrated improvements in knowledge after completing IRIS modules, the study would have benefited from a maintenance measurement. Due to the time constraints and for financial reasons, the participants' field placement reflection papers still serve as a good indicator for how they maintained their knowledge and applied the knowledge to the fieldwork.

Second, the researcher was unable to observe all of the 32 participants due to time limits within the 5-week block and thus half of the participants were observed by the other two university supervisors. This might be a confounding extraneous variable in the participants' fieldwork practices. To compensate this, multiple data sources were used for data triangulation. An alternate way in future research is to ask preservice teachers to videotape their own teaching or to provide an inter-rater reliability training to all faculty fieldwork supervisors prior to observations.

Third, while the class sizes of the present study were still considered small, this study provides in-depth information across multiple data sets about how to incorporate technology for preservice teachers. It would be beneficial to examine the use of TPACK with a larger class size in future research.

Finally, the research adjusted her instruction and class activities based on the participants' performance after each module. Although using data to inform instruction is meaningful and important, adjusting instruction and class activities can lead to more positive results of participants' performance on following modules. To explore whether or not the adjustment of instruction and class activities skews the results of the effectiveness of each module, future research should include pre-assessments at the beginning of the semester and post-assessments at the end.

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