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Examining the Factors of a Technology Professional Development Intervention

Kelly L. Unger
Wayne State University, kellyunger@wayne.edu

Monica W. Tracey
Wayne State University, Monicatracey@wayne.edu

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Monica W. Tracey
Wayne State University

Abstract

This article discusses technology integration literature used to guide the design and implementation of a technology professional development intervention (TPDI) for secondary education teachers. Qualitative multiple-case research methods were used to examine teachers' perceptions of the TPDI factors to provide a deeper understanding of which factors teachers' perceived to be beneficial to the quality of the TPDI. A content analysis methodology was used to compare teachers' perceptions at two different phases throughout the study:

- Phase 1: while participating in the TPDI and,
- Phase 2: after transferring the knowledge and skills taught in the TPDI to teaching practice.

The results demonstrated seven beneficial factors to include when designing technology curriculum for adult learners: *relevant, learning, access, reactions, interactions, clear and easy, and instructor*. While this study examined a specific TPDI, the instructional design incorporated factors rooted in constructivist design principles, making the implications of the findings relevant to the instructional design of technology learning environments for higher education and business environments.

Keywords: Technology curriculum; Technology integration; Situated cognition; Instructional Design

In response to the ever increasing demand to compete in a global economy, the United States needs to prepare its students with the appropriate technical knowledge and communication skills to be competitive in the 21st century (Watson, 2007). Teachers with online technology skills and equipped with effective pedagogical strategies for teaching in an online environment are the keys to achieving this goal. Teachers must effectively model the appropriate use of emerging technological tools and concepts to students, our nation's future leaders. In turn, it is the responsibility of school districts and higher education institutions to prepare our nation's teachers to model and teach the use of these tools. Therefore, teacher educators must remove the various barriers that inhibit technology integration (Ertmer, 1999; Goktas, Yildirim, & Yildirim, 2009; Rogers, 2000), and provide quality technology learning environments for teachers. The quality can be influenced by a variety of factors, but Guskey and Sparks (1996) suggest that the factors with the most direct influence can be grouped into content, processes, and contextual factors. This study examined secondary education teachers' perceptions of a technology professional development intervention (TPDI) to provide a deeper understanding of which factors teachers' perceived to be beneficial to the quality of technology professional development (PD) they received. This article discusses the technology integration literature that was used to guide the design and implementation of the TPDI, the research methods used to address the research questions, and the findings of seven beneficial factors to include when designing and providing technology learning environments for teachers.

Background

Educators and researchers have analyzed various components that promote technology integration. The three components relevant to this study include (1) assessing teachers' levels of technology integration, (Hixon & Buckenmeyer, 2009; Holland, 2001; Moersch, 1995; Rieber &

Welliver, 1989), (2) barriers and enablers (Ertmer, 1999; Ertmer, Ottenbreit-Leftwich, & York, 2007; Goktas, Yildirim, & Yildirim, 2009; Rogers, 2000), and (3) technology professional development factors (Di Benedetto, 2005; Ehman, Bonk, & Yamagata-Lynch, 2005; Levin & Wadmany, 2008; Wells, 2007). Each of these components describes the complex nature of technology integration and suggests ways of addressing its complexity. All of the studies point to PD as playing an influential role, and suggest factors to be included in technology PD that are the most effective for successful technology integration by teachers.

The critical information common among the levels of technology integration literature is that at each level, teachers demonstrate different attitudes, practices, and skill sets. They also demonstrate "that there is much more involved in technology integration beyond acquiring technical skills" (Hixon & Buckenmeyer, 2009, p. 140). For example, teachers new to the profession may have more technical skills and be more comfortable with the technology tools, but "may lack an appreciation for the value of technology as an instructional tool" (Ertmer et al., 2007, p. 55), and lack the organizational and management skills to use it effectively. This finding indicates that teachers' level of technology integration impacts the design and development of technology learning programs. There is a need for teachers with low levels of technology integration to experience hands-on training, administrative support, on site technology support in the classroom when needed, and be exposed to other experts and teachers who model the use of the technology. As teachers' levels of technology integration increase, the literature confirms that there is a need for technology instruction to include peer collaboration strategies, curriculum writing, planning, and student management activities, and times for them to present and share their knowledge to their peers through demonstration and formal studies (Holland, 2001; Mierzejewski, 2009).

Research on barriers and enablers to technology integration supports that technology instruction for teachers is important, but there are other factors besides instruction that impact technology integration that should be addressed with teachers (Ertmer, 1999; Ertmer et al., 2007; Donovan, Hartley, & Strudler, 2007; Hew & Brush, 2007; Rogers, 2000). Teacher educators and PD providers need to include attitudinal instructional factors into teacher learning activities. Attitudes, or affective knowledge, is one of five learning domains founded by leading instructional technology researcher Gagne (1985), and requires learning activities that result in a change in behavior. Learning activities designed to affect attitudinal change need to have the teacher personally and emotionally involved with the instruction, demonstrations from role models, and real-world practice experiences. It also demonstrates the need for instruction that is learner-centered where teachers have a voice in the process and are well informed of the decisions regarding the technology, and are actively engaged in the learning (Donovan et al., 2007). A learner-centered approach and active involvement provides a personal and emotional connection, which helps to provide a better environment for attitudinal change.

The literature on barriers and enablers, suggests that technology instruction that is supported by the administration and peers, and includes instruction on pedagogy, technology, and management through reflective and collaborative activities would be beneficial for addressing technology integration barriers (Ertmer, 1999; Ertmer et al., 2007; Donovan, Hartley, & Strudler, 2007; Hew & Brush, 2007; Rogers, 2000). An established district technology plan should be in place to ensure access to necessary resources such as hardware, software, and human support. A teachers' job is to see that children are successful with the content area they are teaching and teachers need to be able to evaluate and manage the technology they are integrating into the content. Instructional activities related to the evaluation of the technology

and to student achievement with the technology should be considered when designing instruction for addressing technology integration barriers.

Research on technology PD factors suggest that hands-on, learner-centered, and collaborative technology training activities that focus on technology, pedagogy, content, and management concepts and skills, and incorporates time for planning are key to successful technology PD (Di Benedetto, 2005; Ehman et al., 2005; Ertmer et al., 2007; Kopcha, 2010; Levin & Wadmany, 2008; Macdonald, 2008; Wells, 2007). Technological pedagogical content knowledge (TPACK) is a framework that incorporates all of those factors, and has been widely used in the preparation of pre- and in-service teachers for technology integration. TPACK is a framework used to discuss the complex and interwoven relationships of the three main components of knowledge (content knowledge, pedagogical knowledge, and technological knowledge) needed for teachers to integrate technology (Mishra & Koehler, 2006). The TPACK framework guided the design, development, and implementation of the TPDI for this study.

When analyzing the technology integration literature across these three components, (1) teachers' levels of technology integration, (2) barriers and enablers, and (3) technology professional development factors, the following emerge as important factors to be incorporated into a TPDI to increase its quality and effectiveness:

- technology plan that ensures appropriate resources (hardware, software, instruction, support, planning time) are available;
- administrator, peer, and technical support;
- teacher (learner)-centered training;
- training on technical, pedagogical, content, and management concepts and skills;
- hands-on practical/authentic training activities;

- collaborative learning environment activities including: modeling, reflection (journal and discussions), presenting, mentoring, observation; and
- engaging activities to assist in attitudinal change.

We believe it is our responsibility as educational researchers, teacher educators, and technology PD providers to examine which of these factors teacher perceive as the most beneficial with assisting them to integrate technology into their teaching practice.

The purpose of this qualitative multiple-case research study was to examine secondary education teachers' perceptions of a technology professional development intervention (TPDI). This study was designed to provide a deeper understanding of which factors teachers' perceived to be beneficial to the quality of technology instruction they received. This study examined two research questions:

1. While participating in a technology professional development intervention, what do secondary education teachers perceive to be beneficial factors that impact the quality of a technology professional development intervention?
2. After transferring the knowledge and skills taught during the technology professional development intervention to teaching practice, what do secondary education teachers perceive to be beneficial factors that impact the quality of a technology professional development intervention?

METHOD

This study was conducted in Michigan, which was the first state to implement an online learning graduation requirement, that requires all high school graduates "to have an online course or learning experience" (Michigan State Board of Education, 2008, p. 2). Even though this requirement was passed in 2006, through both professional and casual conversations it was

determined that many teachers throughout Michigan were unaware of this requirement, so we found it to be relevant content for the TPDI. This requirement impacts secondary education teachers. The relevant empirical factors previously discussed were incorporated into the design of the TPDI to address this requirement. The five-week TPDI was designed for increasing the knowledge and skills of secondary education teachers for online teaching. It introduced online teaching, current teacher technology standards, and application of planning effective online instruction and materials for preparing students for learning and working in the global economy of the 21st Century. Along with online teaching content, teachers learned various Google Applications to assist in the implementation of online instruction with their students.

Participants

The TPDI was implemented in an online environment, using Google Applications for online communication and collaboration. The participants for this study teach at a rural consolidated high school located in Michigan. Table 1 provides a visual representation of the demographics for the teacher participants.

Table 1:
Visual Representation of Research Participants

Participant	Age	Degrees	# of Years Teaching	Years Teaching at this School	Teaching Courses	Grade Level	Previous Online Learning Experiences
Brenda	52	BA English/Journalism; MAInstructional Design and Technology	15	11	Video Projects; Broadcasting; Tech Communications and Web Design	Mixed Classes of 9-12	2
Jason	50	BS History; MBA	27	26	United States History/Geography; AP United States History	9th; AP 11-12	0
Julie	50	BA Chemistry; PhD Biochemistry; Teacher Certification	6	6	Chemistry; Honors Chemistry; AP Chemistry	10-12	1
Kristy	26	BA English Education, minor Spanish Education; Enrolled in MA English Teaching Program	3	3	British Literature; Writing Center	11-12	0
Nancy	34	BA History, minor in Social Studies and Communications; MATeaching and Learning	12	12	Civics and Law	10-12	Entire MA Progam was online; Taught 1yr Part-time

Teachers participated in the five-week TPDI during the summer months from July through August. The instructor and participants did not interact at any time throughout the study in the face-to-face environment. Teachers received instruction in the online environment using the same Google Applications they later used in their teaching practice with students, providing an authentic learning environment. They experienced the Google Applications first-hand as learners, and designed online instructional materials to use as teachers with their students. The

five teacher participants were exposed to case studies, scenarios, and readings from exemplary online secondary education teachers and experts, which provided demonstrations of pedagogical approaches to online teaching. Participants completed a variety of instructional activities including a guided teacher reflection journal about the TPDI, discussion board postings, collaborative activities, and instructor and peer online text and video communications. The majority of activities centered on designing online instruction and materials to implement into their teaching practice at the start of the school year. Before implementing the online instructional materials with their students, the teachers received feedback from the instructor and others about the instruction and materials they designed. This was an introductory course to online teaching and Google Applications, so the materials the teachers designed were implemented in both the classroom and online environments. Similar to previous years, teachers met with their students face-to-face at the beginning of the year, but now had a course website that hosted the online instructional materials and activities that they designed throughout the summer.

Research Design

As the multiple-case research design approach emerged as an appropriate method for this study, it was important to avoid collecting data without any propositions in mind to minimize the possibility of gathering data that did not point to the area of interest (Yin, 2009). The key propositions for this study came from the Guskey and Sparks' model (1996), which provides a comprehensive demonstration of the relationships between teacher PD and student learning. The premise of the model suggests that the quality of PD is directly influenced by:

- content characteristics,
- process variables, and

- contextual characteristics.

These three elements were used as the propositions, or categories, to assist in collecting, finding, and reporting the information needed for establishing meaning of the participant data to answer the research questions for this study. Guided teacher reflection journals were the main data gathering source during both phases of the study. Subject matter expert (SME) evaluations and a researcher journal were secondary data sources used for strengthening the credibility, consistency, and transferability of the findings, but were not used for addressing either of the research questions. The SME evaluations of the TPDI were conducted prior to Phase 1. The researcher journal was kept throughout the entire design and development of the TPDI through completed data analysis.

SME Evaluation of the TPDI. The TPDI was not piloted prior to implementation; however, the initial draft was evaluated by a panel of subject matter experts (SMEs) to assist in modification and validation of the TPDI. Expert review is one of five approaches used in validating instructional design models and products (Richey, 2005; Richey & Klein, 2007). The panel received the design document for the TPDI for expert review of the content, methods, activities, strategies, and evaluation items.

Qualitative research was a relevant method for this study, because it examines secondary education teachers' perceptions of a specific TPDI at two different points in time: (a) while participating in the intervention (Phase 1) and (b) after transferring the knowledge and skills to teaching practice (Phase 2). Each teacher's perceptions were likely to vary because of the differing professional and social experiences encountered prior to participating in the TPDI. Differences can be found in the subject area and number of years they have taught, the pedagogical methods they currently use in their teaching practice, processes and methods they

apply in their own learning, and in their technological abilities in and out of the classroom. These real-world contextual differences can influence the way teachers perceive the TPDI factors, making it difficult to separate the phenomenon from the context (Yin, 2009). Examining multiple contexts of the same phenomenon can provide a more in-depth perspective of the phenomenon. In this study the perceptions of multiple teachers participating in the same TPDI were examined at two different times to see if their perceptions of the TPDI factors changed after transferring the knowledge and skills from the learning environment to the teaching environment with their students. Multiple units of data from each teacher participant provided insight into *how* and *why* perceptions changed between the two phases (Yin, 2009).

Data

The guided teacher journals, created and saved as a Google Document, provided rich information on *how* and *why* teachers may have perceived certain factors to be better than others for their learning and transferring the TPDI to teaching practice. Teachers documented their perceptions of the factors used throughout the TPDI, and shared this document, so only the participant and the researcher had access to it throughout the study. The teachers were provided with guided questions to assist them with focusing their journal entries specifically about the content, processes, and contextual factors of the TPDI throughout both phases of the study. The guided questions also assisted by providing a framework of propositions for organizing and synthesizing the data during analysis (Guskey, 2000; Yin, 2009).

The guided questions were created following the suggestions of Guskey (2000), and were also dependent upon the content, processes, and contextual factors of the TPDI for each week. *Content* guided questions were composed to stimulate participant's perceptions about the *content* taught in the intervention. Questions centered on the content's relevance and credibility, newness

of knowledge and skills, and practicality of using the knowledge in teaching practice. *Process* guided questions related to how the content was presented by the instructor and various instructional activities and assignments. *Contextual* questions were designed to collect data about the environment and setting of the TPDI, participants' previous online learning and teaching experiences, personal backgrounds, and other information that impact their perceptions. The guided questions were posted on the TPDI's website and on the assignment checklist for the week.

Ruona (2005) advises that data analysis, at least informally, should not wait until the end of data collection, but instead begin with the first pieces of data collected. The simultaneous process of reviewing data and reflecting are beneficial for conducting better research (Ruona, 2005). Reviewing the data as the study progressed allowed for altering the data collection processes if needed. We were able to assess if the data generated by the participants was sufficient for addressing the purpose and research questions of the study (Ruona, 2005).

Data were collected from five participant cases for both phases of the study, totaling eight weeks of journal entries for each case. A content analysis (Ezzy, 2002) methodology, for analyzing the data was used for this study. The data analysis process used for analyzing the guided teacher reflection journals followed Ruona's (2005) four stages for analyzing qualitative data: (1) data preparation, (2) familiarization, (3) coding, and (4) generating meaning.

After Phase 1: Participating, data was organized into Microsoft Word, an inductive content analysis approach was used for segmenting the data into three factors to identify themes and concepts within the data (Ezzy, 2002). Through a reading and note taking process, certain content, processes, and contextual factors mentioned throughout the journals were highlighted, as they served as the key propositions for organizing and dividing the data into three categories.

Ruona (2005) suggests using a word processor for "formatting data into tables, which allows you to organize your data, segment the data into meaningful 'chunks', merge data across participants, and sort in a variety of ways" (p. 251). Ruona's (2005) approach was used for organizing the participant data in a table within Microsoft Word 2007, but an independent iterative process developed to "actively engage with the data, begin analysis, and record insights about what [was seen] in the data" (Ruona, 2005, p. 254). Modifying Ruona's (2005) approach was needed to employ a process that was more conducive to the study, and more applicable for the understanding of the data, because this "is the most important part of the [analysis] process" (Ruona, 2005, p. 254). Table 2 depicts the three iterative steps used for familiarizing and segmenting the data. This process was completed for each of the three (content, process, and context) factors.

Table 2:
Sequential approach for Chunking Data

Step 1: Chunk Data by Participant	**Sequential Approach Completed for Each Participant**
	1. Separate data by participant into individual files 2. Separate individual participant data by weeks 3. Read data by week and separate into Content, Processes, Context, and/or Feelings/Backgrounds
Step 2: Chunk Data by Weeks	**Sequential Approach Completed for Each Week of the TPDI**
	1. Print original data file created during data preparation 2. Read data by weeks searching for comments related to one of the three specific factors, and segmenting that data by underlining in a selected color ink 3. Reread data by weeks searching for comments related to one of the three specific factors, and take notes regarding that data in the margins of the document

	4. Compare the data underlined with the margin notes 5. Document interpretations from the comparisons into a separate document
Step 3: Compare Documents	**Sequential Approach Completed for Comparing Documents Created during Steps 1 and 2**
	1. Compare documents generated from Steps 1 and 2 See (Author, 2012) for complete process details.

Coding the data allowed us to conceptualize large amounts of qualitative data, in this case the guided teacher reflection journals, into smaller categories to assist in generating the participants' meaning. The initial overarching codes of content, processes, and contextual factors were easy to label and define because they were used to create the guided questions for the teacher reflection journals. Through within-case analysis, sub-categories emerged within the three overarching categories, and were continually refined to develop a consensus of meaning for each individual teacher's case.

Upon completion of within-case analysis, a cross-case analysis was conducted to generate a synthesis of the themes and sub-themes which emerged from all three context, process, and context factors from Phase 1: Participating data. This cross factor analysis of the themes and sub-themes provided a way to synthesize and condense the coded categories even further to better portray the factors teachers found to be beneficial while participating in the TPDI. This process was repeated for Phase 2: Transferring data. Finally, after comparing all themes that emerged from each of the three content, process, and contextual factor categories, more rounds of constantly comparing the categories from both phases of the study was conducted, until the same themes reoccurred regularly (Lincoln & Guba, 1985) with each round of comparison.

RESULTS

Analysis of the data from both, Phase 1: Participating and Phase 2: Transferring of the study generated various themes within each of the three factors used to organize the data. This section discusses the results from Phase 1: Participating, Phase 2: Transferring, and comparison of both phases.

Teacher vignettes reflecting the results from each teacher's case were created for both phases of the study (Author, 2012). This article, however, discusses the results from an interpretational analysis of themes or patterns within the content, process, and contextual categories found among all five cases. The section concludes with a synthesized description of the themes across the three categories.

Phase 1: Participating

During Phase 1: Participating, the unit of analysis was the participating teachers in the TPDI. The five teachers completed guided teacher reflection journal entries for five weeks throughout the TPDI. Themes emerged using within-case analysis to generate initial categories, which were continually refined to develop a consensus of meaning from the guided teacher reflection journals. The categories were refined through further analysis and each category was assigned a code. The codes were applied to the data for each of the three factors: content, processes, and context. Since the coded data was in table format in Microsoft Word, categorizing and manipulating the coded data assisted in providing for better understanding of the teachers' meanings (Ruona, 2000).

Further analysis of the content, processes, and contextual factors demonstrated themes and sub-themes that appeared common amongst all three categories of factors. This cross factor analysis of the themes and sub-themes provided a way to synthesize and condense the coded

categories to better portray the factors teachers found to be beneficial while participating in the TPDI. The cross factor analysis of the themes and sub-themes demonstrated seven factors that teachers found to be beneficial for impacting the quality of the TPDI. Throughout Phase 1, teachers described that TPDI factors that were relevant to them as the most beneficial, and factors related to the access to appropriate resources as the least important to the quality of the TPDI.

Table 3:
Frequency of beneficial factors as they appeared throughout Phase 1: Participating

1	Relevant
2	Learning
3	Reactions
4	Instructor
5	Interaction
6	Clear/Easy
7	Access

Table 3 displays the complete list of the seven beneficial factors and the frequency of how often they appeared throughout all of Phase 1: Participating data. The beneficial factors are numbered 1 thru 7, with 1 meaning it was the factor most frequently mentioned as beneficial and 7 meaning it was the least frequently mentioned factor. Again, all of these factors were found to be beneficial for impacting the quality of the TPDI during Phase 1: Participating of the study.

Phase 2: Transferring

During Phase 2: Transferring, the unit of analysis was the TPDI participating teachers. The five teachers completed guided teacher reflection journal entries throughout the first three weeks of the school year. During those three weeks they implemented the instructional materials they created throughout the TPDI. The teacher reflection journal entries were guided by the same questions used during Phase 1. In this phase the questions guided teachers to reflect back to the

TPDI, and discuss which content, process, and contextual factors they found to be beneficial now that they were transferring the knowledge and skills to practice. The same within-case analysis was used to generate initial categories that were continually refined to develop a consensus of meaning from the guided teacher reflection journals. The categories were refined throughout further analysis and each category was assigned a code. The codes were applied to the data for each of the three factors: content, processes, and context in table format within Microsoft Word, to assist with categorizing and manipulating the coded data for better understanding of teachers' meanings.

Further analysis of the content, processes, and contextual factors demonstrated themes and sub-themes that appeared common amongst all three categories of factors. This cross factor analysis of the themes and sub-themes provided a way to synthesize and condense the coded categories to better portray the factors teachers found to be beneficial while participating in the TPDI. The cross factor analysis of the themes and sub-themes demonstrated seven factors that teachers found to be beneficial for impacting the quality of the TPDI. Throughout this phase, teachers described that TPDI factors that were relevant to them as the most beneficial, and factors related to the instructor were the least important to the quality of the TPDI.

Table 4:
Frequency of beneficial factors as they appeared throughout Phase 2: Transferring

1	Relevant
2	Learning
3	Access
4	Reactions
5	Interaction
6	Clear/Easy
7	Instructor

Table 4 displays all seven beneficial factors and the frequency of how often they appeared throughout all of Phase 2: Transferring data. The beneficial factors are numbered 1 thru 7, with 1 being the factor most frequently mentioned as beneficial and 7 the least frequently mentioned factor. All of these factors were found to be beneficial for impacting the quality of the TPDI during Phase 2: Transferring of the study.

Both Phases Compared and Synthesized

After comparing all of the themes that emerged across each of the three content, process, and contextual factor categories, one final comparative analysis was conducted of the factors from both phases of the study. Table 5 displays a visual representation of the changes between the factors of the two phases.

Table 5:
Changes in Factors between Phase 1 and Phase 2

Ranking of Phase 1: Participating	**Factors**	**Ranking of Phase 2: Transferring**
1	Relevant	1
2	Learning	2
3	Reactions	4
4	Instructor	7
5	Interaction	5
6	Clear/Easy	6
7	Access	3

DISCUSSION

The technological pedagogical content knowledge (TPACK) framework (Mishra & Koehler, 2006) was used to design the TPDI used in this study, because it encapsulated the technology PD factors, described in the background section, into one theoretical perspective. The Guskey and Sparks (1996) conceptual model illustrates the relationships between professional

development (PD) and student learning. This study did not utilize the model in its entirety to verify the TPDI's impact on student learning, but it did serve as a guide to examine the teacher's perceptions of the TPDI's content, processes, and contextual factors. The following section discusses the seven beneficial factors found in this study to impact the quality of the TPDI.

Beneficial Factors

Teachers perceived seven beneficial factors that impact the quality of the TPDI. Those factors, included: 1). Relevant, 2). Learning, 3). Access, 4). Reactions, 5). Interaction, 6). Clear and easy, and 7). Instructor. In this section, each of the seven factors is discussed with explanations as to why each was determined as beneficial by the teachers. We also outline connections between the seven factors identified by the teachers in this study and the important empirical factors used to design the TPDI. The factors, because of their overlapping nature, were discussed in a way that demonstrates their interdependence, and therefore are not discussed in a specific order.

In both phases of the study teachers perceived that the most beneficial factors of technology PD are *relevant* to their teaching responsibilities, and most importantly, impact student learning. The second factor included items that teachers perceived as beneficial to their own *learning.* Similar to *relevant*, it remained consistent in frequency between the two phases. Their perceptions directly align with both of the models (Guskey & Sparks, 1996; Mishra & Koehler, 2006) that were used to guide this study; in that student learning should be the end goal to any professional development. Teachers need to *learn* in order to impact student learning, which was discussed as their most relevant professional responsibility. Because of the overlapping qualities of these two factors, they are examined together.

A key reason the teachers discussed the factors of the TPDI as relevant was because the school district, during the previous school year, adopted the Google Applications for Education platform. The school district planned to launch the platform as their main digital online communication system for all educational stakeholders, including administrators, teachers, students, and parents at the start of the 2011-2012 school year. The presence of Google Applications within the school environment demonstrated that the district administration had some technology plan in place. It was not determined if the technology plan was publicized to the teachers, but it did demonstrate that the administration supported the tools since they made the decision to switch their entire technology platform. Two factors from the literature determined as important to quality PD, included having (1) a technology plan that ensures appropriate resources (Goktas et al., 2009) and (2) administrator, peer, and technical support (Ertmer, 1999; Rogers, 2000; Holland, 2001; Hew & Brush, 2007; Hsu & Sharma, 2008). The platform switch made the tools relevant to the teachers, because they knew they were going to have to learn to use the tools in order to communicate with their students, other teachers, and parents. The teachers also recognized that their overall key responsibility as a teacher is to prepare students for their futures. The teachers described their students' futures as, the rest of their high school careers, college, or the work environment. No matter which way they viewed it, they perceived it was their responsibility to be equipped with the appropriate technology tools and skills to support and impact student learning, so students can be successful in their futures. The learning module of the TPDI that focused on local and national technology standards impacted the teachers because it illustrated the importance of having these technology skills, especially with the increase of online K-12 teaching and learning environments (iNACOL, 2011). The technology standards module was further demonstration to teachers about the

importance of having and integrating these skills from an administration level, from the state and national government.

The majority of the TPDI instructional activities for the teachers, centered on them designing online instructional materials to implement into their teaching practice at the start of the school year. Hands-on learning (Ertmer et al., 2007; Hew & Brush, 2007; Holland, 2001; Wells, 2007) and authentic and practical experiences (Ertmer et al., 2007; Holland, 2001; Hsu & Sharma, 2008; Wells, 2007), such as these, where teachers design instruction and instructional materials that they can use in the classroom have been found to be effective factors in technology PD. Providing teachers with real-world authentic educational problems is also known as the "learning by design" approach (Koehler & Mishra, 2005; Mishra & Koehler, 2003). This approach places teachers in the environment where they "go beyond thinking of themselves as passive users of technological tools and begin thinking of themselves as active designers of technology" (Mishra & Koehler, 2003, p. 103). The instructional activities where teachers designed their own instruction and instructional materials during Phase 1: Participating, and then implemented them with their students in Phase 2: Transferring, provided the environment for "weaving together components of technology, content, and pedagogy" (Koehler & Mishra, 2005, p.95) in order to solve relevant problems within their teaching practices. These activities where teachers were actively *doing*, were perceived positively by teachers as impacting their *learning*, which was the second most beneficial factor found in both phases of the study. In Phase 1teachers were creating or designing, their instruction and instructional materials, and in Phase 2 teachers discussed various items and practices they learned as they were implementing the materials with their students. This approach allowed them to work in a comfortable and safe learning environment during Phase 1 with the assistance of the instructor, who was able to model

and demonstrate best practices, and provide feedback on the instruction and materials that were relevant to them. When they implemented their designed instruction and materials in Phase 2, the teachers found that their learning continued, because they were actually *learning by doing*, or transferring the knowledge, skills, and materials from the TPDI to the environment intended, which was their teaching practice. By learning in the same instructional environment that their students would be learning in, when the teachers began to teach their students, they were able to help with troubleshooting and recognize if they needed to implement another approach. This demonstrates that by allowing the teachers to interact with the knowledge in a changing environment, provides opportunity for better understanding in a situated context. The situated context allowed for teachers to actively use the tools, "rather than just acquire them, by contrast, build an increasingly rich implicit understanding of the world in which they use the tools and of the tools themselves" (Brown, Collins, & Duguid, 1989). Situated cognition theory is the perspective that "knowledge is situated, being in part a product of the activity content, and culture in which it is developed and used" (Brown, Collins, & Duguid, 1989, p. 32). Mishra & Koehler's (2006) TPACK framework is grounded in situated cognition theory, and they argue that their "learning technology by design" approach helps to design and "create conceptually and epistemologically coherent learning environments" (p.1034). As demonstrated by the teachers in this study, *learning by doing* activities that were relevant to their teaching practices, were beneficial factors both during and after transferring the TPDI knowledge and skills to practice.

Teachers perceived that TPDI factors which they had previous experience using were viewed in both positive and negative manners. If the instructional material was something teachers experimented with prior to participating in the TPDI, and decided then that they didn't like it, their negative perceptions remained intact. One teacher, for example, demonstrated

throughout Phase 1 that there were beneficial parts of the course, but for the most part she was frustrated. She tried using Google Sites in the previous school year and didn't like it. She used another similar tool and believed it performed better than Google Sites. She became additionally frustrated the closer she approached the beginning of the school year. She was overwhelmed and irritated for two reasons. First, because of student enrollment numbers, her class schedule was altered and she had to teach other courses. Second, she thought that she *had* to use all of the instructional materials that she created, because of committing to participating in the study, even though she didn't like all of the tools that were covered. She opted to use technology tools she was comfortable using, and simply provided a link to the instructional materials she created for her students, but didn't really use them.

If teachers had a previous experience with a component of the TPDI content, but never developed a strong negative or positive feeling about the content, then teachers found the content component to be beneficial. Since teachers had not developed a strong reaction from their previous encounter with the content, when they encountered it again, this time, in the TPDI, they found it beneficial. Exposure to the content a second time expanded their awareness and allowed them to build upon their knowledge and skills, in turn creating a positive learning experience. If the teachers encountered factors that were *new* to them, even if the experience was bad, they determined it was beneficial because they were glad to have had the experience. For example, interacting in Skype; even though there were a few access issues at first, it was still determined to be a beneficial learning experience for three of the teachers because they had never used the tool before. They appreciated the experience, because it enhanced their knowledge of the tool, even if there were a few glitches at first.

The only major difference that emerged between the two phases was factors related to the feedback and modeling of the *instructor,* and the teachers having *access* to technology and instructional resources as needed. During Phase 1, the instructor was the fourth most frequently mentioned beneficial factor. The how-to video tutorials, which were created by the instructor, and the feedback and modeling of the instructor were both found to be beneficial for teachers' learning. Demonstration and modeling of tasks and concepts within the instructional environment assisted teachers, because they knew they would be implementing the tasks and concepts into their own teaching practice. Ertmer (1999) states "demonstrations by peers, mentors, or seasoned practitioners can illustrate effective ways to use technology to teach existing and expanding content. In addition, members of a learning community…can become models and mentors for each other" (p. 54). In Phase 2, the teachers ended up doing many of the same instructional strategies and activities with their students that they learned and practice throughout the TPDI. The instructor, however, was mentioned the least, during Phase 2, while access factors rose from the bottom of the seven factor list to the top third spot.

Teachers barely discussed access issues to content or technology during Phase 1, because teachers were still in the learning environment. They had not yet transferred the knowledge and skills to teaching practice with students until Phase 2 of the study. When transferring the knowledge and skills to practice, teachers experienced technology issues, and discovered various areas of content they needed or wanted to know now that they were in the situated context of their teaching environment. The teachers handled access issues differently throughout the phases. One teacher's enthusiasm and eagerness for learning the Google Applications and online teaching concepts, for example, allowed him to see through any access experiences of the TPDI, and put a positive spin on how it increased his learning. This attitude carried over into Phase 2 of

the study when he displayed that technology access issues would not deter him in using the instructional materials he created. Instead, when he and his students' encountered technology access issues while he was implementing his instruction, he embraced the negative experience and utilized it as a teaching moment. He demonstrated to his students that technology doesn't always work when, or the way we intend, so we have to learn to make adjustments. He then praised his 9th grade students for their maturity in handling the situation.

During Phase 1, one teacher often demonstrated insecurities of not completing her work correctly and preferred higher levels of interaction with the instructor. In Phase 2, she often stated that she was not able to help her students at times, because the skills to do so were not covered in the TPDI. This is most likely because she teaches technology related courses. She wanted more content to be covered, and was frustrated that she was not able to manage the amount of electronic assignments coming in. Her desire for access to additional content is a non-instructional setting issue, surrounded by two contextual factors. First, she teaches technology courses, and is constantly using the Google Application tools, so she has more students who work solely on technology-based projects. Therefore she determined that she needed or wished the TPDI would have included a wider array of instructional topics. However, during Phase 2: Transferring she wanted, or felt that she needed more exposure to other topics; she also said, during Phase 1 that the TPDI was a lot of content to digest. Her insecurities led to not trusting her abilities to complete tasks on her own, which contributed to her increased needs for more interaction through various instructional delivery methods that were familiar to her, i.e., telephone and face-to-face classroom instruction.

Even though the youngest teacher with the least amount of teaching experience years was not particularly satisfied with the overall experience of the TPDI, she still demonstrated that she

wanted to know more about teaching with technology. Even though "new teachers may be more comfortable with the technology tools, they may lack an appreciation for the value of the technology as an instructional tool…and the organization and management skills needed to use technology effectively" (Ertmer et al., 2007, p.55). This was demonstrated in her descriptions of how she found the most benefit from the collaborative assignments because she was able to see how others planned on using the various tools and concepts within their teaching practice. This shows that this teacher did not benefit directly from the Google Applications content, but she did want to learn how those within her school planned on using the tools in their teaching practice. She was interested in understanding the way her colleagues viewed the technology tools together with their teaching practice, so she could make adjustments to her teaching practice in order to appropriately adapt to the culture (Brown, Collins, & Duguid, 1989).

One teacher wanted to do more things with the Google Applications as she started using them in practice, and wished she knew how, but didn't have time to research. It can be assumed that her level of technology integration is high and could have benefitted from more advanced topics (Holland, 2001; Mierzejewski, 2009). She was the only one who did not mention any benefit from the collaboration activities. Even though she mentioned various access issues, she demonstrated throughout her journal that her "intrinsic factors such as confidence and commitment" (Ertmer et al., 2007, p.57) were not going to keep her from using the technologies with her students. It was evident that she operates in a perfectionist mind set and prefers to make the best use of her time, and does not feel that working collaboratively, when related to technology, is the best for her.

Contextual factors, such as access to instructional resources and technology, were discussed more throughout Phase 2. During this phase teachers were no longer completing or

interacting directly with each other, the content, or assignments of the TPDI, so the process variables were no longer a direct influence as they were in Phase 1. This most likely contributes to why the instructor was mentioned less frequently in Phase 2, and access to resources increased. Teachers started implementing materials and started noticing which resources they didn't have access to in order to help them accomplish what they wanted in their teaching practice. Access also increased because all teachers experienced technology access issues at the beginning of the school year, which were not an issue during Phase 1.

An *extra resources* section on the website was provided and was pointed out each week during Phase 1, but none of the teachers used or accessed them throughout the course. The intention was that teachers would access the extra resources throughout the TPDI if the instructional materials were too easy or not as advanced as they had hoped. After going through Phase 2, it was discovered that it would be more beneficial for the teachers if those extra resources included items that were specifically related to the Google Application tools, or best practices for using them in teaching practice. This would have been a resource spot for teachers to access when they needed them when transferring to practice.

Even though the instructor was available during Phase 2 by phone, email or Google Chat, it appeared that teachers might have benefitted from a synchronous meeting time throughout the first few weeks of Phase 2 as teachers transferred their resources to classroom practice. A scheduled time may have provided an open forum for the teachers to interact with the instructor and each other about their experiences, and potentially receive advice for addressing the issues. It's undetermined if they would have taken advantage of a synchronous meeting, because of the dominant statements regarding independent time, personal lives, and how hectic the beginning of the school year is with other items.

Time was described frequently throughout both phases of the instruction. Whether discussing content, instructional activities, or available technology tools, teachers benefitted from factors that were clear and easy to understand; factors that that got straight to the point in order to make effective and efficient use of their time. Having clear and easy to understand instructional materials and tools to use was important to the teachers, because with those items in place they could work independently and complete the tasks they needed when they wanted on their own time. The teachers found the instructional video tutorials clear and easy to use during the TPDI, and benefitted from being able to access those resources with ease when transferring knowledge and skills to teaching practice. Three of the teachers, for example, found benefit from the assigned book for the TPDI. The book appeared to be something they perceived as easy and comfortable to use for learning the material, and provided them another easy resource to access during Phase 2 as a reference.

This TPDI did not have collaborative *learning by doing* assignments where teachers worked together on creating instructional materials, as they did throughout Mishra and Koehler's (2005) work. It appeared, however, that from this group of teachers that they wouldn't have reacted in a positive way to collaborative activities because of time availability, differences in levels of technology integration, and reactions or interest in the Google Application. Empirical literature on technology integration levels demonstrates that teachers at different levels benefit from different types of learning strategies (Hixon & Buckenmeyer, 2009; Holland, 2001; Moersch, 1995; Rieber & Welliver, 1989). It is possible that if instructional activities were designed to allow teachers to participate in different roles throughout a collaborative project that each teacher could have learned from each other, fostering "the social network within the culture help[ing] them develop its own language and belief systems and promotes the process of

enculturation" (Brown, Collins, & Duguid, 1989, p.39). Enculturation is the process a person partakes to fit in with the behaviors of the cultural or community norms (Brown, Collins, & Duguid, 1989). The process usually entails observing and practicing the behaviors of others within the community, and if "given the opportunity to observe and practice [the behaviors], people adopt them with great success" (Brown, Collins, & Duguid, 1989, p.34). Implementing assignments where teachers created instructional materials collaboratively could have helped by having teachers like Nancy model best practices on integrating various online teaching concepts and Google Applications into teaching practice.

Enculturation was demonstrated throughout this study, in numerous ways, but the best example is from the collaborative discussion board questions. Teachers did not really benefit from the discussion boards, except when they were directly responding to the instructor's questions and when they received feedback and thought provoking responses from the instructor. Overall, the teachers' experience with the discussion board wasn't that beneficial for their learning, because they skimmed over other's responses, or it was cumbersome to navigate through the questions, or was hard to respond differently after another teacher had already responded. However, during Phase 2, as they implemented their instruction with their students, they found the discussion board to be a successful approach for their online teaching practice. Even though teachers didn't find the discussion board activities overall beneficial for their learning, they still implemented it in their own practice. This stems from the process of observing the instructor utilize and have the teachers practicing this activity. It also can be linked to either their own personal experience, or from others who have participated in higher education online learning, that online discussion boards are a standard practice in the higher education online environment (Mason & Rennie, 2008). This demonstrates that "the culture and the use of

a tool act together to determine the way practitioners see the world; and the way the world appears to them determines the culture's understanding of the world and of the tools" (Brown, Collins, & Duguid, 1989, p.33). The next section discusses the implications this study has on the design of technology PD.

Implications for Technology Learning Environments

The findings of this study suggest that the factors found in previous technology integration and professional development literature were beneficial factors to include for increasing teachers' perceptions of a quality TPDI. The findings impact the instructional technology field by providing another empirical body of research, which identifies beneficial design factors that should be considered when designing technology learning environments.

The overarching purpose of this study was to examine if teachers' perceptions of beneficial factors of a TPDI changed as they transferred the knowledge and skills from the instructional environment to their real world teaching practice. The findings from this study demonstrate that teachers' perceptions of the factors remained fairly consistent between the two environments, except for two factors, *access* and *instructor*, which switched in frequency of importance between the two phases.

A beneficial factor to consider when designing technology learning environments is to include content, processes, and contextual factors that are *relevant* to the teachers, which aligns with previous research (Ertmer, 1999; Rogers, 2000; Holland, 2001; Mishra & Koehler, 2003; Koehler & Mishra, 2005; Ertmer et al., 2007; Wells, 2007; Hew & Brush, 2007; Hsu & Sharma, 2008; Goktas et al., 2009). Gathering information through an assessment (Di Benedetto, 2005) of the (1) technology tools and best practices embraced by the school culture, (2) global, national, and state technology requirements, standards, and best practices currently used throughout the

educational environment, (3) core subject areas taught by the teachers, and (4) exemplary use cases of other teachers and school districts that have demonstrated success with similar content, will help incorporate relevant instructional content, activities, and delivery methods. Instructional designers and teacher educators should incorporate factors that assist in creating an environment that promotes *learning* through *clear, easy*, and appropriately sequenced segments to assist teachers' with constructing their own knowledge from their previous experiences. Presenting this information with *learning by doing* activities that are situated in a relevant contextual environment, typically increases teachers' positive *reactions* to the instruction, in turn, making it "more likely to be transferred or applied in other settings" (Richey, Klein, & Tracey, 2011, p. 132).

Even though some teachers wanted more face-to-face *interaction*, it was the online learning environment that enabled them to troubleshoot technology issues in teaching practice. Instructional designers must consider providing and creating an instructional environment that allows for real world authentic practice and experience (Brown, Collins, & Duguid, 1989; Holland, 2001; Mishra & Koehler, 2003; Koehler & Mishra, 2005; Hew & Brush, 2007; Wells, 2007; Richey, Klein, & Tracey, 2011). These experiences must first be provided in an environment that is comfortable for the teachers' to explore, practice, experiment, and make mistakes with the tools and content. The practice environment should include activities, which for the majority are designed to be completed independently, but should also incorporate opportunities for collaboration. These collaboration opportunities should be designed to provide modeling by expert teachers, or instructors, from within the group in order to benefit teachers who may be in a lower level of technology integration (Kopcha, 2008). They should also provide an increased perception of enculturation so that teachers feel comfortable incorporating some of

the same activities into their own teaching practice. It also opens various channels for increased *access* to support through others who are available within the school environment. The modeling teacher also benefits from being able to construct their own knowledge expertise through the practice of sharing and teaching others. This implication aligns with Kopcha's (2008) "systems-based mentoring model for technology integration" (p.175). The model suggests that a mentor can help teachers overcome barriers to technology integration by helping to establish:

> a culture of technology integration, modeling of technology use, and creating teacher leaders [and] culminating the establishment of a teacher-led community of practice that uses the resources currently available at the school to support and sustain the implementation of the system (Kopcha, 2008, p.175).

Instructional designers should also consider including opportunities for teachers to extend beyond their comfort zones by gaining relevant practice with a small group of students. These kinds of experiences allow teachers to assess how students will react to their new approach to teaching, and allow them to adjust and alter any technology, pedagogical, or management issues that may arise (Mishra & Koehler, 2003; Koehler & Mishra, 2005; Hew & Brush, 2007). The instructor, or model teacher, should still be present in this environment as a support to ease comfort issues, and to provide feedback so the teacher can make necessary adjustments, but slowly becomes less involved in order for the teacher to be comfortable on their own. This scaffolding mechanism provides teachers with the support they need to generate their own learning path (Brown, Collins, & Duguid, 1989; Richey, Klein, & Tracey, 2011).

In order to provide effective instructional environments, designers also need to incorporate into the design an *instructor* who is able to provide clear, effective, and timely feedback, model best practices, and ensure teachers are engaged throughout the instruction as it

was designed. The *instructor* is a beneficial factor for technology learning environments because he or she provides access to the knowledge and skills the teachers need. The *instructor* needs to be able to model the best practices, because teachers tend to replicate the activities and practices they learned during instruction into their own teaching practices. Depending on availability of instructors to implement the instruction, designers may have to design and develop an instructor guide. This guide would be created to assist the instructor with implementing the intended instruction. Additional training sessions with the instructor may also need to be accounted for depending on the instructor availability. The designer should consider instructor availability at the beginning of the design project, so they can plan accordingly and work within the project budget and timeline for implementation.

As teachers transferred their knowledge and skills to practice, teachers' found that having access to resources when they needed was more beneficial at this point than the instructor. This demonstrates that incorporating awareness and practice of where and how to access resources is an important factor to be included when designing instruction. The implication of this finding also aligns with previous research on incorporating appropriate access to resources for increasing the sustainability and transferring success of knowledge and skills after the instructional environment fades away (Reiber & Welliver, 1989; Ertmer, 1999; Hew & Brush, 2007; Wells, 2007; Goktas et al., 2009).

Table 6 identifies seven beneficial factors instructional designers, professional development providers, and teachers educators can use for designing quality technology learning environments.

Table 6
Beneficial Design Factors for Quality Technology Professional Development

Beneficial Design Factor	**Description**
Relevant	Content, processes, and contextual factors are designed around technology tools and best practices as demonstrated at the global, national, state, and school level, promoting an instructional environment that impacts teaching practice and student learning.
Learning	Designers build upon teachers' previous knowledge by incorporating instructional content and activities that are situated in their contextual environment of practice.
Access	Engaging and participatory activities are included throughout the design to increase awareness of where to find technology tools, learning resources, and community support when transferring knowledge and skills to practice.
Reactions	Based on prior information gathering, designers incorporate various instructional strategies to address any negative attitudes and beliefs. In case any additional negative perceptions arise throughout the instruction, additional activities are designed and included, so the instructor can select and implement.
Interactions	Majority of design should incorporate independent work, but provides collaborative learning by doing activities as well, for modeling of expert instructor or teachers from the group to benefit teachers in lower levels of technology integration; also provides experts the opportunity to increase knowledge and skills through sharing with others.
Clear and Easy	Instruction, instructional materials, and instructional activities are designed to be easily understood by teachers in order to utilize their time efficiently and to keep negative reactions and attitudes at bay.
Instructor	Design should incorporate an expert instructor who can model and demonstrate best practices because teachers will replicate what they have learned. Designers assess availability of instructor, which guides the design, budget, and timeline. May need to develop instructor guide to ensure instructor is engaged with teachers and provides clear, easy, and timely feedback.

Implications for the field recommend incorporating relevant learning by doing activities that are structured to impact teachers' perceptions of how their knowledge can be expanded by

creating their own learning path in a situated contextual environment. While this study examined a specific TPDI designed for secondary education teachers at a high school in Michigan, the design of the TPDI incorporated factors that are rooted in constructivist design principles, making the implications of the findings from this study relevant to instructional design. These recommendations could be used to guide instructional designers when designing environments for other technology training and adoption initiatives for employees, and students in higher education.

Recommendations

Based on this study, it is recommended that future research be conducted in the following four areas, including the impact of: (1) implementing the recommended instructional strategies based on teachers' levels of technology integration and TPACK, (2) incorporating activity types into technology professional development for increasing teachers' level of technology integration and TPACK, (3) using the entire Guskey and Sparks (1996) model for examining the impact of quality professional development on student learning, and (4) designing technology training for other adult learners outside of the educational environment.

Conclusion

The purpose of this study was to examine which technology professional development factors teachers perceived as the most beneficial for impacting the quality of a TPDI. In summary, the perceptions from the teacher participants in this study determined that beneficial factors that should be included in technology learning environments, should:

- be relevant and practical to their teaching practice;

- provide access to resources beyond the conclusion of the TPDI, such as instructional how-to videos that demonstrate the technology tasks, and the instructor and content resource;
- enable flexibility to work in an independent environment that allows for working at their own pace with relaxed due dates for assignments; and
- contains easy, clear, and organized instructional messages for content delivery, instructor feedback, and instructions and requirements for assignments.

It is concluded that the technology integration and professional development literature align with the TPACK framework, which was used to successfully guide the design and implementation of the TPDI, used for this study. The theoretical perspectives of TPACK were beneficial for increasing the secondary education teachers' perspective of factors that impact the quality of technology professional development. It is recommended that further research be conducted to explore the other research areas described in this article.

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