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New Perspective on TPACK Framework in the Context of Early Childhood Education: The "A" Stands for Affective

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Abstract
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Keywords
TPACK Framework, Affective Knowledge, Early Childhood Education, Technology Affordances

Cover Page Footnote
This research project was funded by a grant from Samuel N. and Mary Castle Foundation. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the foundation.

New Perspective on TPACK Framework in the Context of Early Childhood Education: The "A" Stands for Affective

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The purpose of this exploratory single-case study is to investigate the affordances of iPad transpired within a technological pedagogical and content knowledge (TPACK) framework by four early childhood educators with varying Technological Knowledge (TK) at a low-income preschool. Pre/post and follow-up survey, group and follow-up interviews, classroom observations and document of iPad workshop data were analyzed using coding methods in two cycles. The exploration in how teachers discovered the iPad affordances indicated parallel progression in TK and change in their value system. The exploration in the progression of TK and change in their value system suggest a relationship between progression of TK towards TPACK and of affective-valuing (AV) towards affective-characterization (AC).

INTRODUCTION

Today the ubiquity of mobile technology is apparent across all ages. Some of the key findings by the Joan Ganz Cooney Center indicate rapid growth in young children's exposure to and consumption of different types of digital media as well as use of mobile devices (Gutnick, Robb, Takeuchi, & Kotler, 2011). Gutnick, et al. (2011) indicate that there is a drop in desktop computer ownership by 18% but an increase in laptop ownership by 31% among 60% of the families surveyed since 2005. Additional survey results indicate portability to be a popular feature in technology devices. According to Rideout (2014), the use of mobile devices such as smartphones and tablets has grown in numbers for adults as well as for children.

The affordances of these mobile devices have created opportunities for learning in some cases but also grave concern for young children's development in other cases (DeCurtis & Ferrer, 2011; Patten & Valcarcel, 2007; Verenikina & Kervin, 2011). While there are studies to support positive outcomes for children using technology, McManis and Gunnewig (2012) explain that there are some essential components to how the integration of the technology into the learning environment should be framed. They indicate that the technology needs to be developmentally appropriate for young children, and be integrated into the classroom. Also, tools need to be provided to help teachers implement technology successfully.

There is a growing global community facing the challenge of how to integrate technology into educational settings. Although there is much research looking at this general problem, early childhood educators are faced with the additional challenge of limited research within the context of the early learning environment (Guernsey, Levine, Chiong, & Severns, 2012). Early learning environments are a unique context that is different from other age levels (Guernsey, 2014). There is a need to explore what developmentally appropriate technology integration means and how to assist teachers to understand and implement technology integration successfully (Clements & Sarama, 2002; NAEYC & Fred Rogers Center for Early Learning and Children's Media, 2012). One of the obstacles in assisting teachers to understand and implement technology integration successfully is lack of time for professional development (USDOE, 2010). McManis and Gunnewig (2012) recommend providing built-in support and creating effective learning communities as identified by Galinsky (2012). In recognizing these challenges, it is imperative to provide insight through research on how to assist early childhood educators to integrate technology within their pedagogical and content knowledge.

According to a policy brief published by New America, "the digital age brings a profusion of new challenges and opportunities for the field of early education" (Guernsey, 2014, p. 2). Guernsey (2014) proposed the need for redesigning the digital age architecture in order to reform the system working with the birth-through-third grade continuum, thereby enhancing the benefits and facing the challenges with deeper understanding. According to Guernsey, five goals to promote this effort were to 1) set high expectations for the use of technologies when working with children of birth-through third grade, 2) boost the workforce by preparing and supporting pre- and in-service early childhood educators to appropriately integrate technology, 3) enhance current assets by distributing critical information, 4) connecting researchers, educators, and children's media industries, and 5) encourage evaluation and research in the area of digital-age interventions and appropriate technology integration with this age group (Guernsey, 2014).

The purpose of this exploratory single-case study was to investigate how the affordances transpired within a technological pedagogical and content knowledge (TPACK) framework by four early childhood educators at a low-income family preschool. Early childhood education (ECE) is defined as education for birth to age eight although this study focused on the educators of preschools covering ages three to five.

The goals of the research were to address the two specific needs: the need for evaluation and research in the area of digital-age interventions including appropriate technology integration with this age group and the need to boost the ECE workforce by preparing and supporting pre- and in-service early childhood educators to appropriately integrate technology. The research question for this study was how did the affordances of iPad transpired within a TPACK framework for early childhood educators?

CONCEPTUAL FRAMEWORK

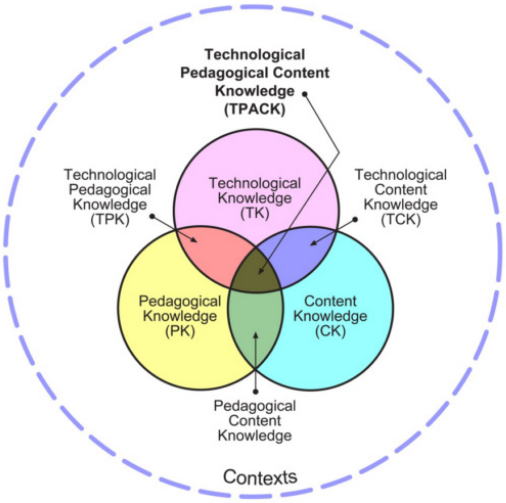
The conceptual framework of this research is based on the technological pedagogical content knowledge (TPACK) model. This conceptual framework originated from Shulman's ped-

agogical content knowledge (PCK) framework (Shulman, 1987), but added technological knowledge thereby providing a revised framework that integrated technological pedagogical content knowledge (TPACK). Mishra and Koehler (2006) introduced this concept and soon numerous researchers started to use this concept to frame their research. The intricacies of the different knowledge components and their relationships are illustrated in Figure 1. The desired knowledge for pre- and in-service teachers to gain is at the center of this diagram where they can integrate all three knowledge areas into practice.

It is timely to use an exploratory qualitative case study to discover the depth of the TPACK framework within the context of early childhood education since currently there is only one quantitative study within this context.

TPACK is a framework where the relationships between a teacher's knowledge of content (CK), pedagogy (PK), and technology (TK) are well orchestrated to bring about effective teaching. Mishra and Koehler (2006) and Koehler and Mishra (2009) further added the combination and intersections of these components as technological pedagogical knowledge (TPK), pedagogical content knowledge (PCK), and technological content knowledge (TCK).

Figure 1. *"The TPACK framework and its knowledge components" (Koehler & Mishra, 2009, p. 63)*



Koehler, Mishra, Kereluik, Shin, and Graham (2014) indicate that numerous instruments were developed to assess pre- and in-service teachers within the TPACK framework but only 66 research publications met the inclusion criteria among 303 TPACK related articles. From those research articles, 141 instruments of various types were found. There were four categories to instrument types which were "self-report, open-ended questionnaires, performance assessments, interviews, and observations" (Koehler, et al., 2014, p. 104-105).

TPACK for Early Childhood Educators

There were several studies that addressed content specific areas using TPACK (Graham et al., 2009; Hammond & Manfra, 2009; Niess, 2005) but to date, there is only one research study that addressed early childhood teachers. Chuang and Ho (2011) investigated TPACK for early childhood teachers in Taiwan. They used a sample of 335 in-service teachers using a TPACK survey adapted from Schmidt et al. (2009). Early childhood teachers who were older had higher self-assessed PK and PCK than the younger teachers but younger teachers had higher self-assessed TK. Regardless of age, teachers who spent 20 hours or more using technology a week had higher TK and TCK than those who spend less than five hours a week.

This study indicated that technology was commonly integrated into the early childhood classroom globally (OECD, 2006). For example, early childhood centers in Australia received more than 300 computer units through International KidSmart Early Learning Program (O'Rourke & Harrison, 2004). In Taiwan, there are more private preschools and those schools tend to have abundant resources including technology. Thus, Chuang and Ho (2011) concluded that early childhood teachers must develop TPACK to be effective teachers of today.

In addition, developmentally appropriate integration of technology in the early learning environment appears to be a controversial issue yet currently there is a lack of in-depth research on this topic (Parette, Quesenberry, & Blum, 2010). These variables contribute to the research design and methodology for this study.

METHODS

This case study was grant-funded by Samuel N. and Mary Castle Foundation with main purpose to explore the affordances of iPad for preschool teachers. The participants were selected using purposive sampling. The early childhood education context was important to this study and the four preschool teachers were carefully selected using two criteria. First, the preschool teachers needed to have some teaching experience and second, they had to be willing to learn and explore affordances of the iPad.

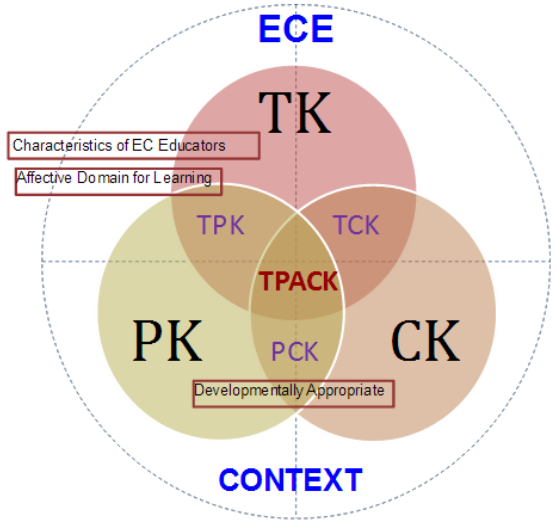
Instrumentation or sources of evidence (Yin, 2014) included surveys, interviews, observations, and documentation. The three types of surveys were pre-survey, post-survey, and a follow-up survey that included five follow-up questions. The main interview was a group interview with additional follow-up interviews. Extensive observations were conducted in each teacher's classroom and documentations included transcription of the three iPad workshops, field notes, and email correspondences with the participants.

The data analysis used a two-stage coding method. Saldaña (2009) described these two stages as "cycles of coding." The first cycle of coding established characteristics of different levels of technological knowledge and changes that occurred over time in relation to their technological knowledge. The second cycle of coding provided in-depth analysis of the data (Saldaña, 2009).

The initial data were collected without the TPACK framework in mind. However, when existing data were analyzed, some preliminary themes emerged (Saldaña, 2009). These preliminary themes provided general guidelines for the possible case study proposition that the characteristics of early childhood educators, the affective domain for learning, and developmentally appropriate practices play an important role in analyzing the TPACK framework. Figure 2 provides the TPACK framework in ECE context.

With the insights gained from the initial review of existing data, all data (both initial and follow-up) were re-coded with the conceptual framework in mind. Further, follow-up interviews were undertaken with the conceptual framework in mind to add depth to understanding the teacher's knowledge and skills.

Figure 2. *TPACK framework in early childhood education (ECE) eontext*



Participants and Context

The selection process of the participants was a purposive sampling since the four teachers were selected using specific criteria for the purpose of exploring how they used iPads for assessment, teaching, and learning. In addition to their willingness to participate, the four participants needed to have differences in technological knowledge. It was also important that the teachers begin with established pedagogical and content knowledge. This meant that the teachers needed to have some teaching experience rather than being brand new teachers. These variations in composition of the teachers helped us explore the viability and appropriateness of this approach and how different demographic characteristics may impact the use and effectiveness of technology-aided teaching in preschool setting.

Differences in characteristics among the participating preschool teachers included technology literacy level, technology comfort level, and teaching experience. These variations in composition of the teachers helped us explore the viability and appropriateness of this approach and how different demographic characteristics may impact the use and integration of technology in preschool setting.

The pre-survey from the existing data provided some general characteristics of the participants and their initial self-rated technological proficiencies as shown in Table 1. Pseudonyms for the teachers and the schools are used throughout this report to ensure participant anonymity.

Table 1. *Characteristics of Participants Related to Technology*

Pseudonym	Years of Teaching	iPad Proficiency	Computer Proficiency
Jennifer Park	32	Novice	Novice
Nina Chang	9	Intermediate	Intermediate
Kristina Nakamura	34	Novice	Novice
Hannah Nystrom	35	Intermediate	Proficient

DATA COLLECTION

In preparation for the data collection, two steps were taken at the beginning of the grant project. To ensure the study was conducted ethically, an Institutional Review Board (IRB) form was submitted and approved. Stake (1995) indicates the need to triangulate in order to validate the data collection and analysis processes. Among four types of data source triangulation (Denzin, 1984), the existing data for this grant project was fortunate to establish data source and investigator triangulation. This study afforded multiple sources of evidence and three investigators to collect and analyze the data.

The surveys consisted of three types: pre-survey, post-survey, and a follow-up survey. All surveys were administered online and emails were sent to the participants reminding them to complete the surveys by a due date. The primary purpose for the pre-survey was to establish a baseline for their technological knowledge (TK), their demographics, their understanding of the project, and their concerns or desires for learning technology. The post-survey documented change in the teachers' technological knowledge (TK), technological content knowledge (TCK), and technological pedagogical knowledge (TPK). Finally, the follow-up survey provided information regarding sustainability and applicability of their integration of technology in their current and future practice.

The interviews consisted of two types. A group interview was conducted at the end of the iPad workshops and follow-up interviews were conducted at the end of May 2014. The group interview was semi-structured and provided opportunity for the participants to share their responses to the three questions. The questions for the follow-up interviews were constructed after initial coding of the existing data.

The observations in the classrooms were conducted over two days. Two investigators observed four classrooms at different times during those two days. This established validity and reliability through investigator triangulation (Denzin, 1984).

The documentation was collected on different occasions. The main documentation consisted of the three iPad workshops conducted by three investigators. The recordings of the workshops were transcribed and field notes were coded for in-depth analysis.

Analysis of existing data using exploratory methods was the basis of the follow-up interview questions. Exploratory and affective coding methods were used to analyze the follow-up interviews and a second cycle of coding determined in-depth analysis of all the data. Exploratory coding methods are exploratory in nature usually for "preliminary assignments of codes to the data" (Saldaña, 2009, p. 118). Affective coding methods "investigate subjective qualities of human experience by directly acknowledging and naming those experiences" (Saldaña, 2009, p. 86).

The existing data were collected and analyzed during the grant project that provided some pre-coding information. Although Computer Assisted Qualitative Data Analysis Software (CAQDAS) was not used for this purpose, the researchers involved in the grant project noticed words, phrases, and concepts that stood out. While exploring iPad affordances, the themes emerged provided initial impression of the study. However, the shift from initial impressionistic to more in-depth analysis of the data required preliminary examination of the existing data. First, a grand perspective on the "units of social organization" (Saldaña, 2009, p. 14) was examined. The "units of social organization" is based on Lofland, Snow, Anderson, and Lofland (2006) notion that "the intersection of one or more actors [participants] engaging in one or more activities (behaviors) at a particular time in a specific place" (p. 212). These units intersect with cognitive

aspects or meaning, emotional aspects or feelings, and/or hierarchical aspects or inequalities. Second, evaluating which data to include and how much data to include were examined. Third, the condition of the data was evaluated for accuracy, consistency, and formatting in order to prepare for CAQDAS.

First Cycle Coding

The data consisted of collection of documents, interviews, surveys, and observations. Data collected through recordings such as group interviews, individual interviews, and workshops were transcribed before the initial coding. The first cycle of coding involved two steps. The first step involved holistic coding method using only the existing data. From this coding, more focused interview questions were developed for the follow-up interviews. The second step involved a provisional coding method to create the three major coding categories of affordances, affective, and TPACK.

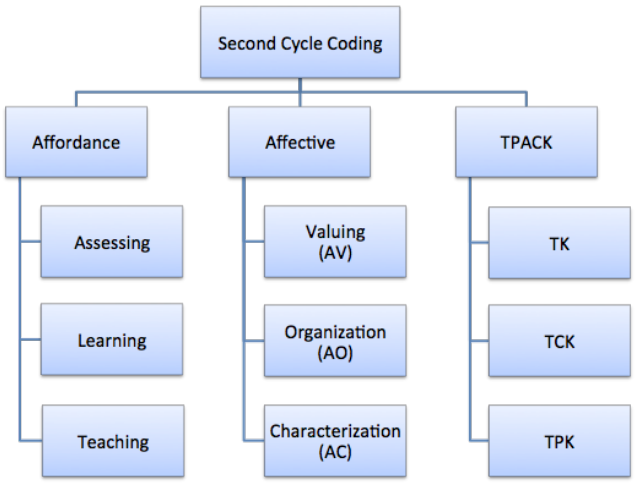
The first cycle of coding used affordances, affective, and TPACK categories. The subcategories for affordances were assessing, learning, teaching, and additional codings under "other" subcategory. The subcategories for affective were the five levels of affective domain taxonomy (Krathwohl et al., 1964; Krathwohl, 2002) and additional codings collectively clustered under "other" subcategory. The subcategories for TPACK consisted of the seven components in the TPACK framework (Koehler et al., 2014) with additional attention to technology related components divided up into iPad technology and general technology.

For reliability, three colleagues reviewed samples of the first cycle codings. The feedback provided by the colleagues were consistent with the initial codings but there was some confusion with the code descriptions. Thus, the descriptions were updated and other comments were incorporated into the coding process.

Second Cycle Coding

After several iterations of the first coding cycle, many codes were consolidated, deleted, and revised. In the second cycle, the assumptions regarding the participants were reviewed and subcategories were updated as indicated in Figure 3.

Figure 3. *Second cycle coding categories and subcategories.*



There were three assumptions made prior to data analysis. The first assumption in regard to affective domain taxonomy is that the participants had already surpassed the initial two levels of the taxonomy, which are receiving and responding levels. The simple fact that the teachers agreed to participate in the study demonstrated that they were not only conscious of the challenges of technology integration in the context of early childhood but they were willing to respond to that awareness. The second assumption is that the participating teachers in this study were assumed to have high levels of pedagogy and content knowledge in the context of early childhood education. This assumption was made because all the teachers had extensive teaching experience. The third assumption is that the affective domain taxonomy operates on a continuum. The nature of human affect is never in a vacuum but rather in a continuum at various levels. The first two assumptions were confirmed after first cycle of coding, therefore we eliminated the affective subcategories of receiving and responding. For the same reason, the TPACK subcategories, PK, CK, and PCK were eliminated so this study could focus primarily on the technological knowledge and its relationship to content and pedagogical knowledge.

RESULTS

In the second cycle of coding, the theming of data focused primarily on Technological Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical and Content Knowledge (TPACK).

Technological Knowledge (TK)

The second cycle of coding for Technological Knowledge consisted of technological knowledge related to the iPad (TK-iPad), Technological Knowledge related to general technology/computer skills (TK-technology), and Technological Knowledge related to assessment (TK-assessment).

The pre-survey included six Likert-scale questions on computer experience and based on self-ratings of overall computing skills, Hannah indicated that she is proficient, Nina indicated she is intermediate, Jennifer and Kristina reported to be novices. All of them reported having some level of familiarity with mobile devices and all have used Apple products such as iPhones, iPods, and iPads. Hannah reported she has three years of iPad experience and Kristina reported having one year. Nina, Kristina, and Hannah reported their self-rate on learning new technology as average whereas Jennifer indicated learning new technology is somewhat challenging.

Overall, the teachers had very diverse set of technology skills and knowledge. The post-survey indicated increases in technological skills and knowledge by teachers from the pre-survey. In response to the item, "confidence level in using technology and digital media to plan activities with young children," three teachers agreed that they were confident and one teacher remained neutral. Similarly, in response to the item, "confidence level in using technology and digital media to teach digital literacy concepts to young children," one teacher indicated strongly agree that she is confident, two teachers agreed that they were confident, and one teacher remained neutral. In addition to Likert-scale responses, open-ended responses were indications of the increase in their technological skills along with their confidence in using technology.

In regard to their self-rated iPad proficiency, all reported an increase but Jennifer remained as novice. Jennifer's self-rated iPad proficiency remained the same as novice but coding indicated that technological knowledge regarding the iPad (TK-iPad) did

increase for Jennifer. For example, when she first started this project, she reported that she did not use iPad in the classroom because "[She] might do something wrong to jeopardize the function of the iPad." However, during observation, she was comfortably using iPad in the classroom. Figure 4 provides photos of her using the GOLD® app (first photo) and working on an app with children (second photo).

Nina and Hannah both increased iPad proficiency from intermediate to proficient and Kristina increased from novice to intermediate.

Figure 4. *Examples of Jennifer's increase in iPad proficiency*

Technological Content Knowledge (TCK)

Technological Content Knowledge (TCK) refers to knowledge of the reciprocal relationship between technology and content. Again, the second cycle of coding subdivided TCK into Technological Content Knowledge related to iPad use (TCK-iPad), Technological Content Knowledge related to general technology/computer skills (TCK-technology), and Technological Content Knowledge related to assessment (TCK-assessment). All teachers used iPads for teaching and learning in the classroom for various curricular content. Hannah reported how she adjusted the iPad app for math when she worked with a younger child. Jennifer was observed to use iPad app to enhance children's learning by providing interactive four season song at circle time and Kristina also used the iPad photos and videos to enhance learning about butterflies, numbers, and shapes. Nina used iPad apps that provided enhancement of vocabulary building and language development. Figure 5 shows examples of how the iPad was used to enhance content knowledge. The first photo is an app Hannah used to enhance vocabulary building and letter formation. The second photo shows a child using the iPad app to practice her math skills.

There were some differences in how the iPad and technology were used by each teacher. However, all the teachers used the iPad similarly when assessing different content knowledge of the children. Since all the teachers were trained in the GOLD® Assessment System, they used the GOLD® Assessment System app for assessment of the children's progress. Although the frequency in use of GOLD® app varied by teacher, overall use of GOLD® app by all the teachers increased over time.

The general theme that emerged from the second cycle for TCK indicated that technological knowledge pertaining to various content increased over time and the majority of the teachers used technological knowledge to enhance content knowledge rather than as a main teaching method. One of the observation note stated, "[Hannah] uses iPad more and more everyday. She uses iPad for videotaping, photos, GOLD® app, literacy, math, and geography apps. She also takes pictures with camera, iPad, and iPhone."

Figure 5. *Examples of TCK*

Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge (TPK) refers to an understanding of how technology can constrain and afford specific pedagogical practices. The subdivision of TPK also consisted of Technological Pedagogical Knowledge related to iPad use (TPK-iPad), Technological Pedagogical Knowledge related to general technology/computer skills (TPK-technology), and Technological Pedagogical Knowledge related to assessment. The overarching pedagogy in early childhood education is in reference to Developmentally Appropriate Practice (DAP). The pedagogy is to use methods that are appropriate for the particular developmental level of the child. The general theme that emerged from TPK was all the teachers' DAP integration of technological knowledge increased over time. Jennifer mentioned how her children used the iPad to take photos for an interactive app called, "Alien Assignment." She said her three- and four-year-olds need handles that provide better grip when holding and carrying the iPad. Thus, she purchased an iPad case that was developmentally appropriate for her children. The photograph on the left in Figure 6 illustrates how larger handles provided a secure grip for the child.

Nina expressed that she had to adjust how she worked with the children when she was trying out the storytelling app called, "Toontastic" during the observation visit. She realized that the multi-steps involved in creating a story through this app were

too complicated for the young four-year-olds but for the older four-year-olds and five-year-olds, they were appropriate. In the follow-up interview, she noted that she adjusted how she presented this app when she worked with different age groups. She also experimented with the Educreations app to provide practice opportunities for her student to write his name as shown in the lower photo in Figure 6.

Figure 6. *Examples of TPK*

During group interview, Kristina mentioned how she adjusted her presentation of YouTube videos to children to make it appropriate. She said, "you kind of have to play them, because some of them are longer than others, some of them are not clear, some of them are too long. So I look for the time first, the short ones, and then you look to see who uploaded it, and you look at their things, so I figured out how to save those [to my] playlist." Kristina works with three-year-olds and developmentally the children's attention span at this age is limited, so she consciously chose videos that were the right length.

Hannah was initially afraid to let the children carry the iPad in the classroom. However, towards the end of the project, she created an iPad station where children can choose the pre-loaded developmentally appropriate apps on her iPads.

Technological Pedagogical Content Knowledge (TPACK)

Technological Pedagogical Content Knowledge refers to knowledge about the complex relations among technology, pedagogy, and content that enable teachers to develop appropriate and context-specific teaching strategies. Evidence of this was provided in the follow-up interviews related to TPACK.

DISCUSSION

This study focused on understanding how early childhood educators use technology, and how to provide support to increase their technological knowledge and integrate technological knowledge to provide developmentally appropriate learning environments.

Many educators are initially apprehensive about integrating technology in the classrooms mainly because of conflicting ideas about appropriate use with young children (Beach & Stefanick, 2010; Hutinger et al., 1994; Kelley et al., 2003). However, teachers' attitudes and beliefs in technology impacting student learning affected their willingness to explore and gain technological knowledge (Rivera et al., 2002; Wardle, 2000). In addition, the affective dimension was influential for educators (Pierre & Oughton, 2007; Saluja et al., 2002; Shephard, 2008) in making the shift in their attitudes and beliefs and in increasing their technological knowledge as it pertains to pedagogical and content knowledge.

Technological Knowledge and Change in Value System

The participants of this single-case study included early child educators with varying technological knowledge (TK). TK included iPad skills and knowledge as well as general computer skills and knowledge. Initial survey indicated that all had previous personal experience with mobile devices and two had previously used an iPad although neither considered to be proficient with this technology.

In post-survey, teachers self-rated an increase in technology skill and confidence over those indicated in the initial survey. The most novice and least confident of the four indicated improvement but was still tentative in her abilities. Those who experimented with personal uses in addition to classroom uses had greater learning gains.

Overall, teachers gained skills and knowledge in mobile technology as well as confidence and openness towards technology use for learning, new insights into more efficient use of technology in assessment, and possible distinctions between age appropriate uses of mobile technology for children. Perhaps the most powerful evidence was obtained from Jennifer and Kristina who indicated that they were novices in the iPad and technology skills in the beginning of the study but gained enough confidence to volunteer to present at a conference. All four teachers indicated they were excited to continue to learn and explore new uses of iPads and to complete assessments successfully with the new tools.

The participating teachers improved skills and changed attitudes about what was possible in using technology with children. The findings showed that there were intricate relationships between their change in attitudes and beliefs with increased technological skill integrated with their pedagogical and content knowledge.

Attitudes and Beliefs Matter

The relationship between progression in affective taxonomy and TPACK supported that attitudes and beliefs mattered in not only gaining technological knowledge but also teachers moving from having TK towards TPACK. When looking at the frequency of coding in TK to TPACK and AV to AC, they both increased over time but when examining data more closely, it revealed that the progression from AV to AC was a necessary component to making TK to TPACK and vice versa.

Most of the research focuses on cognitive domain but there is a need to investigate cognitive objectives as a means to affective goals (Asch, 1952; Festinger, 1957; Heider, 1958; Rhine, 1958; Rosenberg, 1956) as well as affective objectives as means to cognitive goals (Bruner, 1960; Festinger & Carlsmith, 1959; Ja-

hoda, 1956; Kelman, 1958; White, 1959). This study found that achievement of cognitive and affective goals happen simultaneously similar to what Suchman (1962) suggested. The affective goal, in this case the varying affective taxonomy levels (AV, AO, AC) pushed the cognitive goals, in this case technological knowledge (TK, TCK, TPK, TPACK) but technological knowledge also influenced their affective knowledge.

Some of the open-ended questions addressed how they felt they learned to use their iPads, and the role that the professional development (PD) played in that learning. There were distinct differences in ways of learning among teachers: one preferred to research herself but another teacher, the most novice, preferred specific lessons and instructions. All appreciated opportunities for discussion during the workshops with the other teachers and wanted more of this as a focus of PD. In general, they said the PD opportunities were insufficient. They also noted that one advantage was the chance to talk about the iPad uses and that this would be difficult without release time. When asked about continuing issues, three indicated concerns about the fragility of the iPads when used in the classroom. General issue comment was not having enough time to learn everything they want to learn.

The teachers learned best when given the opportunity to share with each other and explore independently. However, for the most novice user more formal "how to" instruction was needed as well. Time was important for learning, particularly release time for talking and PD.

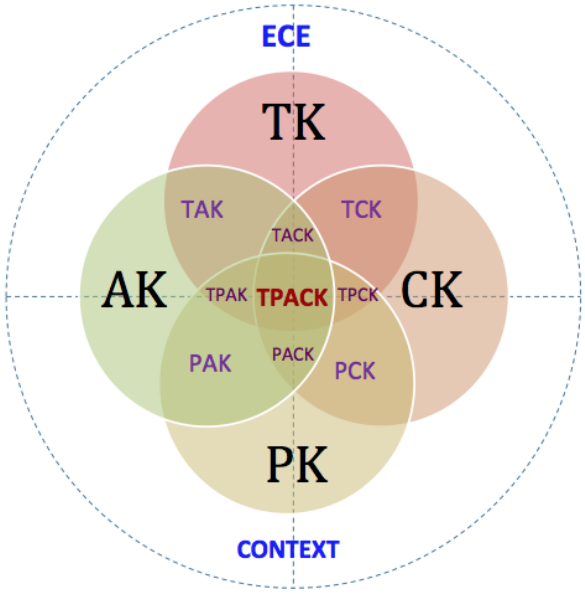
This study adds additional insights to previous studies of TPACK framework. The contribution this study makes to previous studies is adding another layer to the study of TPACK framework in the context of early childhood education. The use of mobile technology in educational setting less than a decade but the rapid spread of use in formal and informal educational setting is dramatic. Wu et al. (2012) reviewed trends from mobile learning studies from 2003 to 2010 by analyzing 164 carefully selected publications. They provide distribution of mobile learning studies by research purpose which indicates small percentage addressing the affective domain during mobile learning and learner characteristics in the learning process. This study investigated the obvious shortage in research which addressed the characteristics of early childhood educators and how affective domain factors into their technological skills and knowledge construct.

"A" for Affective Knowledge in TPACK

The findings of this exploratory case study on how technology integration occurred within the TPACK framework revealed that affective knowledge was a key component in moving teachers toward integration of technological knowledge with content and pedagogical knowledge. Thus, this study suggests modifying the framework to include affective knowledge for TPACK framework. Mishra and Koehler (2008) explained that "A" in TPACK was added to make the acronym easier to pronounce by adding a vowel. However, this study suggests that "A" in TPACK could represent affective knowledge. Figure 7 represents how a new TPACK framework within the addition of an Affective component would look.

The expansion of additional affective knowledge to the TPACK framework now provides four foundation knowledge components and eight components within the framework that "address how these bodies of knowledge interact, constrain, and afford each other" as defined by Mishra and Koehler (2008). This revised framework needs future studies in terms of how this knowledge will integrate but there are critical implications to future practice for in-service PD or pre-service teacher training.

Figure 7. *Technological Pedagogical Affective and Content Knowledge (TPACK)*



This study addressed a portion of needs to further our understanding of TPACK in the context of early childhood education. Currently, only one TPACK study has been conducted within the context of early childhood educators. The findings regarding "Affective Knowledge" being important when viewing from a TPACK framework can be also true in other educational contexts. It will be interesting to see if affective knowledge plays a larger role in further understanding the TPACK framework beyond early childhood educators.

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