EXAMINING THE ROLE OF THE LEARNING ACTIVITY TYPES APPROACH IN TEACHERS' TECHNOLOGY INTEGRATION

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DECLARATION OF ORIGINALITY

I, Kader Baş, certify that

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ABSTRACT

Examining the Role of the Learning Activity Types Approach in Teachers' Technology Integration

Teachers have a crucial role for technology integration, but teacher training programs still have room to be more effective in supporting teachers to integrate technology in their classes. It has been theorized that effective teaching with technology is the result of technological pedagogical content knowledge (TPACK) (Mishra & Koehler, 2009). Learning Activity Types (LAT) is an instructional planning TPACK development approach (Harris, Hofer, Schmidt, Blanchard, Young, Grandgenett, & Olphen, 2010). This study investigated the role of LAT approach in teachers' technology integration using three measures: the adopted TPACK Survey (Hacıömeroğlu, Şahin & Arcagök, 2014) which is used to investigate self-reported technology integration level, Technology Integration Assessment Rubric (Hofer et al., 2010) which is used to investigate lesson plans, and TPACK-Based Technology Integration Observation Instrument (Hofer et al., 2010) which is used to investigate actual lessons. The study used one-group pretest-posttest pre-experimental design. The participants were 15 teachers from a private school in Istanbul. The survey results indicated that there is an increase in TPACK scores of the teachers . Except TCK scores, they are not statistically significant. Also, there is a statistically significant increase in the lesson plan scores. Additionally, most of the teachers' observation scores are above the average. The study supports the literature that LAT is an effective strategy for TPACK development and different types of assessment methods are essential to assess TPACK development.

ÖZET

Öğrenme Etkinlikleri Türleri Yaklaşımının Öğretmenlerin Teknoloji Entegrasyonu Üzerindeki Rolünün İncelenmesi

Öğretmenlerin teknoloji entegrasyonu konusunu iyi kavramaları etkili bir öğrenme ve öğretme süreci için önemlidir. Öğretmen eğitim programları teknoloji entegrasyonu eğitimi konusunda gelişime ihtiyaç duymaktadır. Mishra ve Koehler etkili teknoloji entegrasyonu için TPAB (Teknopedagojik Alan Bilgisi) bilgisinin gerekli olduğunu savunurlar (2009). Bu çalışmanın amacı ise ÖET (TPAB geliştirme yaklaşımı) temelli atölye çalışmasının öğretmenlerin teknoloji entegrasyonu üzerindeki rolünü TPACK Survey (Hacıömeroğlu, Şahin & Arcagök, 2014) (teknoloji entegrasyonu seviyesi öz değerlendirme ölçeği), Technology Integration Assessment Rubric (ders planı değerlendirme ölçeği) (Hofer et al., 2010) ve TPACK-Based Technology Integration Observation Instrument (Hofer et al., 2010) (gözlem yolu ile ders değerlendirme ölçeği) kullanarak tespit etmektir. Bu çalışma tek grup ön test-son test ön deneysel çalışma olarak planlanmıştır. Çalışmaya İstanbul'da bulunan bir özel okulda çalışan 15 öğretmen katılmıştır.Çalışma sonunda öğretmenlerin TPAB skorlarında bir artış gözlenmiştir. TAB skorları dışındaki artış istatistiksel olarak anlamlı bulunmamıştır. Öğretmenlerin ders planı skorlarında da istatistiksel olarak anlamlı bir artış görülmüş. Bu öğretmenlerin çoğunun ders uygulamalarının gözlemlenmesi sonucu teknoloji entegrasyonu skorları da ortalamanın üzerindedir. Bu bulgular LAT stratejisinin TPAB gelişiminde etkili olduğu ve farklı ölçme yöntemlerinin bir arada kullanılmasının çalışma sonuçlarının analizindeki önemini göstermektedir.

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CHAPTER 1

INTRODUCTION

Technology integration in education is defined *as the curriculum-based use of tools and resources to support learning and teaching* (Harris, Grandgenett, & Hofer, 2010). Integration of technology naturally brings many benefits, such as interactivity, flexibility, better understanding, and unlimited access of resources in a learning environment (Tikam, 2016). It enhances learning environments and supports analytical thinking and interdisciplinary studies. Motivated by the prospect of greater economic, social, educational, and technological gains, many countries make reforms for technology integration in education. Non-negligible part of the resources such as money, expertise and research for technology integration is spent to enhance teaching and learning (Jhurree, 2005). Apple Classrooms of Tomorrow (ACOT) project (Dwyer, 1990), Preparing Tomorrow's Teachers to Use Technology (PT3) (Whittier & Lara, 2003), UNESCO Korean Republic Funds-in-trust (UNESCO KFIT) in 2015-2019, Innovative Technologies for Engaging Classrooms (ITEC) in 2010-2014, Creative Classrooms Lab (CCL) in 2013-2015 and Fırsatları Arttırma ve Teknolojiyi İyileştirme Hareketi (FATIH) in Turkey (Akgün, Yılmaz & Seferoğlu, 2011) are some of the technology integration projects in education.

Many technology integration projects are being conducted in different countries including Turkey for long years. They spent effort to integrate technology in their education. ACOT, started in 1985, is a research-based and Apple Computer-funded project, whose aim was to create technology supported effective learning environments (Dwyer, 1990). To develop students twenty-first century skills, such as critical thinking, problem solving skills, creativity, and innovation (Trilling & Fadel, 2009) in technology supported classrooms, P21 took in action in 1999 (Whittier & Lara, 2003) in the US. In Africa UNESCO KFIT project is applied in Mozambique, Rwanda, and Zimbabwe to strengthen the education system by integrating information and communication tools (ICT). In Europe ITEC project is conducted to enhance the teaching and learning with technology in twenty different countries. Also, to evaluate 1:1 tablet scenario which every student has a tablet in schools CCL project is created in eight countries. During the project teachers are supported by training, guidance and resources for tablet use in classrooms. In 2010, the Turkish Ministry of National Education introduced the FATIH project to support technology integration in Turkish schools. Within the scope of the project, internet connection, student tablets, smart boards, digital content are provided. In addition, teachers are supported with computer training.

Naturally, countries that make considerable amount of investment in technology projects are interested in the effects of these investments. Unfortunately, studies revealed that technology integration in schools was rare (Bauer & Kenton, 2005; Ertmer, 2005; Bingimlas, 2009; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012), teacher training was not effective, and teachers were not sufficiently prepared for technology integration (Bauer & Kenton, 2005; Bingimlas, 2009; Chen, 2008; Ertmer, 2005; Mueller, Wood, Willoughby, Ross & Specht, 2008). There are also studies examining the results of FATIH project in Turkey. These revealed aimless use of tablets, technical problems, and insufficient in-service training for technology integration in education (Altın & Kalelioğlu, 2015; Gürol, Donmuş & Arslan, 2012; Keleş, Öksüz & Bahçekapılı, 2013; Pamuk, Çakır, Ergun, Yılmaz & Ayas, 2013).

Both FATIH and other projects highlight the essential role of the teacher for technology integration in education and the role of effective teacher training. However, current teacher training programs still have room to be more effective in supporting teachers to integrate technology in their lessons (Arslan & Şendurur, 2017; Başak & Ayvacı, 2017; Kula & Deryakulu, 2017; Saritepeci, Durak & Seferoglu, 2016; Zhao & Bryant, 2006).

It has been theorized that effective teaching with technology is the result of technological pedagogical content knowledge (TPACK) (Mishra & Koehler, 2009). There are three major strategies to develop TPACK: Learning technology by design (LTBD), Technology Mapping (TM), and Learning Activity Types (LAT) (Herring, Koehler & Mishra, 2016). In LTBD, in-service teachers work to design lessons which include technological solutions for problematic pedagogical issues in small groups. The process helps teachers for technology integration in pedagogy and development of TPACK (Herring, Koehler & Mishra, 2016). TM also focuses on pedagogical problems. In the studies that TM strategy is used pre-service teachers design lessons in which pedagogical problems are solved with technology (Herring, Koehler & Mishra, 2016). Teachers make content that students have difficulty to learn more understandable by using their technological knowledge (Herring, Koehler & Mishra, 2016). LAT is an instructional design-based method; in-service teachers prepare lesson plans in steps defined by the LAT approach. First, they define their learning goals, and then choose appropriate activities for them. At the end, corresponding technologies are determined for related content (Herring, Koehler & Mishra, 2016).

All these approaches can be used in TPACK development depending on the needs of teachers and the context of learning environments (Herring, Koehler & Mishra, 2016). However, TPACK development studies show that in-service and pre-service teachers may get different results because of their prior knowledge (Chai, Koh & Tsai, 2010; Jang, 2010). Also, both quantitative and qualitative methods make more realistic assessment for TPACK development (Başak & Ayvacı, 2017; Chai, Koh & Tsai, 2010; Jang, 2010). In general, science or mathematics teachers are included in TPACK development studies (Jang, 2010; Niess, Zee & Gillow-Wiles, 2010).

In addition, most of the technology integration studies in Turkey focus on teaching how to use a specific technology without considering teachers' technology integration (Öçal & Şimşek, 2017; Sarıtepeci, Durak & Seferoğlu, 2016). However, technology integration is not about only using a specific tool; it is the curriculum-based use of tools in education.

In Turkey teacher candidates take educational technology courses in their universities as part of their programs of study; however, their TPACK level is not satisfying (Gulbahar, 2008). There is in-service training offered as part of the FATIH project, but these are mostly technology-based (Öçal & Şimşek, 2017; Saritepeci, Durak & Seferoglu, 2016). Teachers need more directed approaches to integrate technology in their lessons. Thus, there is a need for effective teacher training programs in Turkey in which teachers with different majors are included, mixed assessment tools are used, and an appropriate TPACK development approach and strategies are used. For that, the most appropriate approach is LAT approach as it provides a step by step guidance for technology integration, appeals teachers with different majors, and TPACK development can be assessed with both quantitative and qualitative tools in LAT studies. Beside these, LAT is specifically useful for in-service teachers because in-service teachers already have PCK.

The purpose of the current study is to examine the role of a LAT-based workshop in teachers' technology integration using three different assessment methods.

The research questions are:

1) Is there a difference between the TPACK framework components and the overall TPACK pre-test and post-test scores of the teachers who participated in the LAT-based workshop?

2) Is there a difference between the teachers' lesson plans, as evaluated by the Technology Integration Assessment Rubric, before and during the LAT-based workshop?

3) What is participants' technology integration level as evaluated by the TPACK-Based Technology Integration Observation Instrument after the LAT-based workshop?

The hypotheses of the study stated as:

1) There is an increase in the TPACK framework components and the overall TPACK pre-test and post-test scores of the teachers who participate in the LAT-based workshop.

2) There is an increase in the teachers' lesson plans, as evaluated by the Technology Integration Assessment Rubric, before and during the LAT-based workshop.

3) Most of the teachers' classroom teaching scores, as evaluated by the TPACK-Based Technology Integration Observation Instrument, after the LAT-based workshop are above the average.

CHAPTER 2

LITERATURE REVIEW

In this literature review, technology integration, adult learning, teacher professional development, technology integration studies, TPACK, TPACK development studies, and TPACK development strategies are presented. A summary of this literature will be provided at the end.

2.1 Technology integration

Harris, Grandgenett and Hofer (2010) defined technology integration *as the curriculum-based use of tools and resources to support learning and teaching*. It provides interactivity, flexibility, better understanding, and unlimited access of resources in a learning environment (Tikam, 2016) and enhances learning environments. Consequently many countries including Turkey make technology integration projects to get benefitted from the greater economic, social, educational, and technological gains.

Naturally, the countries which make the projects also conduct studies to measure the effects of these studies. But, these studies revealed that technology integration in schools was rare (Bauer, & Kenton, 2005; Ertmer, 2005; Bingimlas, 2009; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012), teacher training were not effective, and teachers were not sufficiently prepared for technology integration (Bauer & Kenton, 2005; Bingimlas, 2009; Chen, 2008; Ertmer, 2005; Mueller, Wood, Willoughby, Ross & Specht, 2008).

The standards of International Society for Technology in Education (ISTE) emphasize the importance of teachers' technology use in the teaching and learning process. The standards list the roles of twenty-first century teachers as learner, leader, citizen, collaborator, designer facilitator and analyst by emphasizing the technology integration in education (ISTE, 2018). Partnership for 21st Century Learning (P21) framework also emphasizes the value of technology in learning. Technology has a significant role in twenty-first century education (Partnership for 21st Century Learning, 2009). In addition to ISTE and P21, Associations for Educational Communications and Technology (AECT) addresses the role of technology in education (AECT, 2012).

As it can be seen, technology integration is the one of the most significant issues in education for the twenty-first century. It brings many benefits for teaching and learning. And teachers are viewed as the main actors of technology integration process (AECT, 2012; ISTE, 2018; P21, 2009). So, teacher training has an essential role in effective technology integration because technology integration does not mean learning a new software at a micro level, it is a macro level integration encompassing a range of skills and a wide web of knowledge. The teacher training must focus on these skills and knowledge. However, current technology integration training was not effective, it should be improved (Arslan & Şendurur, 2017; Başak & Ayvacı, 2017; Kula & Deryakulu, 2017; Saritepeci, Durak & Seferoglu, 2016; Zhao & Bryant, 2006).

Technology integration studies showed that effective technology integration required TPACK (Mishra & Koehler, 2009), and technology integration training must focus on teachers' TPACK development. There are several strategies for TPACK development, and the major strategies involve LTDB, TM and LAT (Herring, Koehler & Mishra, 2016). Using different types of assessment methods for TPACK development is also emphasized in technology integration studies (Başak & Ayvacı, 2017; Chai, Koh & Tsai, 2010; Jang, 2010; Herring, Koehler & Mishra, 2016). Different assessment methods for TPACK development are presented in the LAT strategy (Herring, Koehler & Mishra, 2016).

To sum up, technology integration makes learning environment more effective (Harris, Grandgenett & Hofer, 2010) and teachers are the main actors of technology integration (AECT, 2012; ISTE, 2018; P21, 2009). Hence, technology integration training gains importance in teachers' professional development because it increases the effectiveness of learning and teaching. TPACK is a requirement for effective technology integration in education (Mishra & Koehler, 2009) and there are three major strategies for TPACK development (Herring, Koehler & Mishra, 2016). So, teacher training for technology integration should develop teachers' TPACK by using these strategies (Herring, Koehler & Mishra, 2016). As it is stated in technology integration projects, different assessment methods for TPACK development should be used in technology integration training (Başak & Ayvacı, 2017; Chai, Koh & Tsai, 2010; Jang, 2010; Herring, Koehler & Mishra, 2016).

2.2 Adult learning

Andragogy, which was defined as *the art and science of helping adults learn* (Knowles, 1980, p. 43), is significant for teacher training. There are assumptions of andragogy that affects the outcomes of teacher training. Adults are independent, problem-centered, and internal motivated learners, they have rich life experiences and applicable issues are significant for their learning (Merriam, 2001). Adults are active learners (Dirkx, 1989) and motivation is critical for them (Ashton, 1984).

Effective teacher training requires incorporation of following adult learning assumptions. Because the training is designed for educational issues, content of training must be applicable and address educational problems. Additionally, design of teacher training should make teachers active (Dirkx, 1989) and use their experiences in their learning (Merriam, 2001). Also, teachers should be motivated to participate in the training for an effective training (Ashton, 1984).

2.3 Teacher Professional Development

Teacher professional development is defined as teachers' learning for teaching their content (Avalos, 2011). There are five factors which affect teachers' professional development: *content focus*, *active learning*, *coherence*, *duration*, and *collective participation* (Desimone, 2009). *Content focus* is about teaching the subject effectively with activities that help students learn (Desimone, 2009). *Active learning* is about the chance to participate in activities during teacher professional development (Desimone, 2009). *Coherence* is about the consistency of what teachers know and what is taught in professional development (Desimone, 2009). *Duration* of professional development should be sufficient, and lastly *collective participation* is about the collaboration between the teachers from same environments (Desimone, 2009).

Teacher professional development focuses on the learning of teachers and there are five features (*content focus*, *active learning*, *coherence*, *duration*, and *collective participation*) for an effective teaching and learning in the classroom (Desimone, 2009). These features should be met in teacher professional development environment. TPACK development strategies should be taken into account for TPACK development studies.

2.4 Technology integration studies

There are many technology integration studies in different countries including Turkey. In this part these technology integration studies are reviewed.

Fenton studied about required professional development for iPad integration, she used a survey which is consisted of four multiple response and open-ended questions to collect data from 191 volunteer secondary teachers from 10 school regions (2017). And analysis of data revealed that teachers need to be motivated to participate in technology integration training, technology integration training should be divided according to participants' level of expertise of technology and implementation and collaboration among teachers in training is beneficial.

An empirical study about technology integration was conducted by Cottle (2010) with 43 middle school teachers as participants. They engaged in Infusing Technology training. Then they got pre and post-test, Moerch's Level of Technology Integration (LoTi) measuring technology integration level. Only 35 participants' pre and post test scores were available. Twenty-three of the participants were also engaged in following training and they were interviewed for an examination of their views on the effect of training. The result of the study showed that training did not have a significant effect on technology integration level of teachers. Also, the analysis of the interviews revealed that technological issues were constraints for technology integration while collaboration among teachers, support of specialist and administration recommendation that motivates teachers were facilitators.

Kritz and Shonfeld (2011) conducted a study to examine the effects of ICT training. 19 teachers from an elementary school participated in the training. The purpose of the training was to help teachers use ICT skills to aid students for ICT projects. In the publication there is no information about the content and the process of the training. However, the impact of the training was evaluated with interviews and a questionnaire scaled from 1 to 5 by the teachers. The analysis showed that training improved ICT skills of the teachers and the level of technology integration of teachers was changed. Also, it is suggested that training should create an environment in which teachers can collaborate with other teachers and their instructor in/out of the class, technology integration requires new kind of pedagogical knowledge and training should be organized regularly to be effective.

To examine the relationship between the technology integration training and the prominent level of technology integration in education Zhao and Bryant (2006) conducted a study. In the study there were 22 teachers as participants who took technology integration training. The content of the training was about how to integrate technology in curriculum, to use technology, to use technology for classroom management and to use technology with pedagogical knowledge. The teachers participated in the training 3 years before the study. The data were collected by observations, interviews, and document analysis. Seventeen teachers did not participate in any following training or study, 5 teachers were included in following training with a technology integration specialist mentor in their classroom. The result of data analysis showed that technology integration training helped teachers to have positive attitudes toward technology integration, too many software was introduced in training to teacher with different level of technology use proficiency with time limit, and effectiveness of training is not high without following support.

Başak and Ayvacı (2017) compared ICT integration in Korea and Turkey by reviewing thesis, articles, announcements, and books. In the study the term *ICT* *integration* is used interchangeably with *technology integration*. According to their study, in Korea technology integration plans were applied; four highly effective plans have been administered since 1988 for teachers' technology integration training. Every year many people from different countries have been visiting Korea to investigate their training methods. The study revealed that the success of the programs derives from the obligatory training, continuous assessment of the development in education, and effective organization of the training. Overall results of the study emphasized positive effect of technology integration training on technology integration. Additionally, it was not enough for prominent level integration without following support. Training would be probably more efficient when teachers are classified by their prior knowledge and branch.

In the FATIH project, teachers are expected to take a 30 hours in-service training including the following subjects, FATIH project in education, basic technology use, selecting digital tools for assessment and evaluation. Vural and Ceylan (2014) conducted a study to examine the content and efficiency of the training. Teachers who completed the training successfully in schools were interviewed. The content of the interview was social media use, technology use in classroom, efficacy of technology use, technology use proficiency before and after training, impacts of the training they take in their classrooms and evaluation of the training process. The participants answered the questions in the content. The study revealed that teachers had positive attitudes towards technology but not technology use. And, the teachers mostly use social media like Facebook. Additionally, there were basic technology use distinctions between the teachers from different branches and the teachers have problems about digital content use. They also had difficulty digital content use in training. As a result, technology integration training was not remarkably effective for teachers; especially "digital content use" subject. Also, duration of the training did not help teachers for technology integration.

Another study about teachers in pilot schools of FATIH project was conducted by Keleş et al. (2013). The aim of the study was to investigate the effects of FATIH project by examining opinions of the teachers. Eleven high school teachers participated in the study and they were asked about tablet and smartboard use, effects of FATIH project on teaching and learning and suggestion for the project by interviews. Analysis of teachers' responses disclosed that in-service training was not effective for technology integration, training should not be based on software use, it should have included pedagogical knowledge and motivated teachers to use technology.

The studies emphasize that technology integration training should not be simply software use-based, new kinds of pedagogical knowledge should also be taught. As it can be seen there are many technology integration studies in different countries including Turkey. In addition, the role of assessment is significant in technology integration training, and collaboration positively affects technology integration. These are the factors that increase the effectiveness of technology integration training.

2.5 TPACK

TPACK is a type of knowledge teachers needs for teaching and learning with technology effectively (Mishra & Koehler, 2009). Developed by Mishra and Koehler (2009), TPACK is built on the Shulman's pedagogical content knowledge (PCK), which is suggested in 1986 and 1987 (Mishra & Koehler, 2009). TPACK focuses on teachers for effective technology integration and it takes three components as requirement for technology integration; technology, pedagogy, and content. These concepts and the relationship between them create 7 types of knowledge; CK, PK, TK, PCK, TCK, TPK and TPACK (see Figure 1).

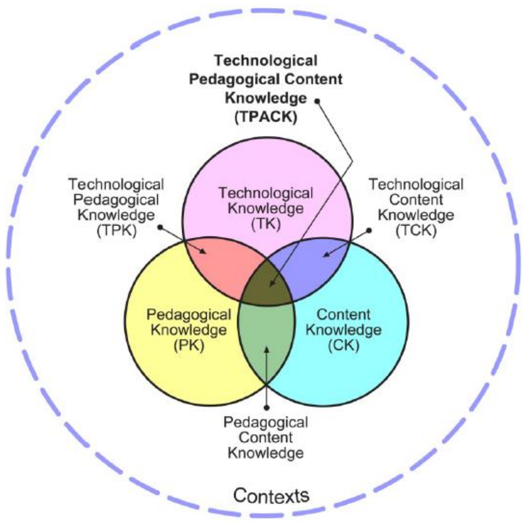


Figure 1. The TPACK framework and its knowledge components (Mishra & Koehler, 2009)

Content knowledge

CK is about the knowledge teachers have about the content they teach. Technology integration effectiveness is strongly related with teachers' content knowledge (Mishra & Koehler, 2009).

Pedagogical knowledge

PK is about the knowledge teachers have about the pedagogy which they use to teach their content. It requires understanding what is learning and how to support it by using best way (Mishra & Koehler, 2009).

Technological knowledge

TK is related with the competency of using technology in line with the needs (Mishra & Koehler, 2009).

Pedagogical content knowledge

PCK is the type of knowledge teachers need to teach a specific content with an applicable pedagogy. In other words, it is about knowing suitable method for teaching a specific content (Mishra & Koehler, 2009).

Technological content knowledge

TCK is the type of knowledge that is required to choose an appropriate technology to teach a specific content.

Technological pedagogical knowledge

TPK includes technology and its effect on the way teaching and learning occurs.

Technological pedagogical content knowledge

TPACK is a requirement to teach a specific content by using appropriate pedagogy with applicable technology.

There are many TPACK development studies (Baran & Canbazoğlu Bilici, 2015). Primary data sources of TPACK studies are self-report instruments. Mostly, the participants of the studies are pre-service teachers whose major is science or mathematics (Baran & Canbazoğlu Bilici, 2015).

2.6 TPACK development studies

There are several technology integration studies focusing on developing teachers' TPACK (Chai, Koh & Tsai, 2010; Harris et al., 2010; Jang, 2010; Koh & Chai, 2014; Niess, Zee & Gillow-Wiles, 2010; Shin, Koehler, Mishra, Schmidt, Baran & Thompson, 2009). The results of the studies support the idea that TPACK is required for effective technology integration and effective strategies for TPACK development are needed.

Koh and Chai (2013) conducted a research study to examine the effect of teachers' perceptions on TPACK development which was the result of information and communication technologies' (ICT) design activities. They studied with 102 in-service teachers and 164 pre-service teachers. Firstly, they used a survey to determine the teachers' TPACK perceptions. Then in-service and pre-service teachers got separate training. Pre-service teachers took 12 weeks (24 hours) of lessons about preparing lesson plans to teach their content with appropriate pedagogy and ICT. On the other hand, in-service teachers participated in lessons in which the teachers develop TPACK-based lesson plans for 3 days. At the end of the study all teachers completed a TPACK survey with 36 items and the results of first test showed that gender and age were effective factors for pre-service teachers' TPACK perception while only gender was a factor for in-service teachers. The overall result of the study showed that TPACK perceptions of the teachers affected their TPACK development. The effect was different for pre and in-service teachers. Additionally, for further studies mixed methods, different teaching strategies in training and longitudinal studies should be taken into consideration.

Chai, Koh, and Tsai (2010) conducted a pre-posttest design study to facilitate pre-service teachers' TPACK development. They organized 24 hours ICT lessons with

889 pre-service teachers in Singapore. Out of 12 sessions, 5 sessions focused on PK development, 6 sessions were for TK and rest of sessions was for TPACK development. To gather the data TPACK Survey of Schmidt et al.. (2009) was used. The data showed that there is a statistically significant difference between the teachers' pretest and posttest scores of TK, PK, CK and TPACK. Also, the results emphasized that pedagogy plays a key role on the effect of training and in-service teachers may get better results from these types of training because of their pedagogical experiences.

The study of Niess, Zee and Gillow-Willes (2010) was about the development of TPACK with spreadsheets to teach mathematics and science in online environment. Twelve K-8 teachers were the participants of the study. They got training during the study. At the beginning of the study the researchers determined the TPACK level of the teachers (Recognizing, Accepting, Adapting, Exploring and Advancing), then they gave the lessons (Niess e.al, 2010). They designed lessons for 4 units and a final portfolio;

1st Unit: Use of spreadsheets in learning the content

2nd Unit: Integration spreadsheets in subject matter they teach

3rd Unit: Assessment methods for spreadsheets integrated lessons

4th Unit: Curriculum planning for spreadsheet integrated teaching

Final Portfolio: 10 spreadsheet problems with worksheets and assessment rubrics, lesson plans for these problems being incorporated and reflection of these lesson plans.

There are different types of data sources in the study; observation of teachers' lessons (at the beginning of the study), assignments in lessons, online course content teachers created and interviews of the teachers (at the end of the study). The results of the research showed that the course developed the teachers' TPACK but there was a difference between the development's levels of the teachers as an effect of different teaching approaches that teachers have (Niess, Zee & Gillow-Wiles, 2010).

For TPACK development Jang (2010) used interactive white boards' technology (IWB) and peer coaching in a study with 4 in-service secondary science teachers. The teachers studied by observing peer instruction, giving instruction, and reflecting their TPACK and met every two weeks for TPACK development. Their journals, interviews and written assignments were used to evaluate the result of the study. It was found that the teachers used the technology as an instructional tool and it helped them to deal with teaching the content. Jang also stated emphasize the significance of quantitative data for TPACK development studies.

In summary, these studies pointed out the significance of TPACK for effective technology integration, crucial role of mixed assessment methods in TPACK development, and role of prior teaching experience on TPACK development. Therefore, effective strategies for TPACK development need to take these issues into account.

2.7 TPACK development strategies

There are diverse types of TPACK development strategies. The three major strategies are: Learning technology by design (LTBD), Technology Mapping (TM), and Learning Activity Types (LAT) (Herring, Koehler & Mishra, 2016).

In LTBD studies in-service teachers work to design lessons that include technological solutions for problematic pedagogical issues in small groups. The process helps teachers for technology integration in pedagogy and development of TPACK (Herring, Koehler & Mishra, 2016). TM also focuses on pedagogical problems. In the studies that TM strategy is used, pre-service teachers design lessons in which pedagogical problems are solved with technology (Herring, Koehler & Mishra, 2016). Teachers make content that students have difficulty to learn more understandable by using their technological knowledge (Herring, Koehler & Mishra, 2016). LAT is an instructional design-based method; in-service teachers prepare lesson plans in steps defined by LAT. First, they define their learning goals, and then choose proper activities for them. At the end, corresponding technologies are determined in taxonomies in related content. This lesson plan design process especially helps TPACK development of in-service teachers (Herring, Koehler & Mishra, 2016).

2.7.1 Technology Mapping (TM)

Technology Mapping (TM) is a TPK-focused TPACK development strategy (Herring, Koehler, & Mishra, 2016). Teachers use technologies to overcome the difficult topics for teaching and learning in their lessons. In the TM process, teachers determine the topics, and they choose a pedagogically appropriate technological tool. TM studies are shaped by a specific technology. Short sessions are organized to teach how to use a technological tool. Teachers are asked to use the tool for the problematic topics that they have difficulty to teach. It is claimed that the process helps teachers to create authentic tasks for their teaching.

To exemplify, in one study that used the TM approach, the pre-service primary teachers were firstly taught how to use MS Office Excel in lessons. Excel was introduced as a tool which can be used for organization of information, for giving feedback, for creating a hypertext story, for performing calculations and for a modeling tool. Then they were asked to prepare lessons where MS Office Excel was used as a teaching tool (Angeli & Valanides, 2013).

2.7.2 Learning Technology by Design (LTDB)

Learning Technology by Design (LTBD) is a collaborative TPACK development strategy (Herring, Koehler & Mishra, 2016). It is used in teachers' TPACK development studies. In LTDB studies teachers are working in groups. They focus on one particular problem of practice. Creative ways to overcome the problem are studied. Teachers design tasks with technology that are addressing their problem.

In terms of focusing on problems LTDB is similar to TM, however, in LTDB rather than a specific technological tool, creative use of tools to solve the problems is the main issue. In LTDB studies teachers can be informed about technological tools but it is not the purpose of the study. The focus of the strategy is designing a task for a determined topic.

2.7.3 Learning Activity Types (LAT)

LAT is an instructional planning TPACK development approach to help in-service teachers in their instructional planning (Harris, Hofer, Schmidt, Blanchard, Young, Grandgenett, & Olphen, 2010). LAT is used for applying TPACK during preparing lesson plans.

LAT presents steps to prepare a technology integrated lesson plan (see Figure 2). First, they define their learning goals, and then choose right activities for them. At the end, corresponding technologies are determined for the related content. This lesson plan design process is especially helpful for in-service teachers' TPACK development (Herring, Koehler & Mishra, 2016).

There are six curriculum areas in the LAT approach. These are K-6 literacy, Mathematics, Science, Secondary English Language Arts, Social studies, and World

Languages. Each area has its own taxonomies which are varying according to the content.

LAT is especially helpful for in-service teachers who already have PCK. First, its process (see Figure 2) uses the process which in-service teachers already use to prepare lesson plans: teachers identify learning goals, define appropriate activities for learning goals in accordance with classroom context, learning styles and preferences. Secondly, it guides selecting appropriate technology (Herring, Koehler & Mishra, 2016). Beside these, there are also different types of assessment tools that can be used in LAT studies; observation and lesson plan evaluation rubrics. Thus, LAT is an appropriate technology integration approach for this study.

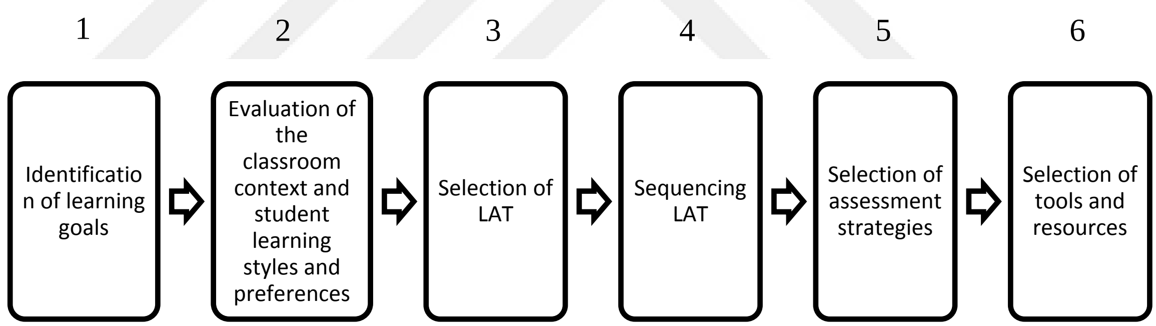


Figure 2. The LAT Process

2.8 Summary

It has been theorized that teachers should have TPACK for effective technology integration (Herring, Koehler & Mishra, 2016). Yet, different approaches for TPACK development have been suggested for effective technology integration.

LTDB, TM and LAT are different strategies for TPACK development (Herring, Koehler & Mishra, 2016). In LTDB studies in-service teachers work to design lessons which include technological solutions for problematic pedagogical issues in small groups (Herring, Koehler & Mishra, 2016). The process helps teachers for technology integration in pedagogy and development of TPACK (Herring, Koehler & Mishra, 2016). TM also focuses on pedagogical problems; in this approach, teachers are asked to make content that students have difficulty to learn more understandable by using technology (Herring, Koehler & Mishra, 2016). LAT is an instructional design-based method; in-service teachers prepare lesson plans in steps that are defined by learning activity types. First, they define their learning goals, and then choose appropriate activities for these. At the end, corresponding technologies are determined in taxonomies in related content. This lesson plan design process is believed to support TPACK development of teachers.

LAT approach differs from the other strategies in terms of structure and assessment methods. LAT presents predefined activities and technologies according to learning goals in different content areas. It helps teachers to use appropriate technologies with activities aligned with lesson objectives. Beside this structure, there are both quantitative and qualitative assessment instruments to use in LAT studies. This difference is crucial because TPACK is a complicated construct and different types of assessment strategies are necessary for evaluating TPACK development (Herring, Koehler & Mishra, 2016).

In Turkey teacher candidates take educational technology courses in university, but the technological knowledge of teachers is not satisfying (Gulbahar, 2008). There is compulsory in-service training in FATIH projects, but they mostly focus on software use skills (Saritepeci, Durak & Seferoglu, 2016; Öçal & Şimşek, 2017). Thus, teachers need training in which they can voluntarily participate (following the suggestions made in the discipline of andragogy) and learn how to use technology to support learning and teaching in their lessons. TPACK development can be assessed with both quantitative and qualitative tools in LAT studies (Herring, Koehler & Mishra, 2016). Hence, LAT is considered as the proper strategy to use in TPACK development studies for in-service teachers in this study.

The purpose of the current study is to examine the role of a LAT-based workshop in teachers' technology integration using three different assessment methods for TPACK development (based on teachers' self-report, their lesson plans, and their classroom teaching).

The research questions are:

1) Is there a difference between the TPACK framework components and the overall TPACK pre-test and post-test scores of the teachers who participated in the LAT-based workshop?

2) Is there a difference between the teachers' lesson plans, as evaluated by the Technology Integration Assessment Rubric, before and during the LAT-based workshop?

3) What is participants' technology integration level as evaluated by the TPACK-Based Technology Integration Observation Instrument after the LAT-based workshop?

The hypotheses of the study stated as:

1) There is an increase in the TPACK framework components and the overall TPACK pre-test and post-test scores of the teachers who participate in the LAT-based workshop.

2) There is an increase in the teachers' lesson plans, as evaluated by the Technology Integration Assessment Rubric, before and during the LAT-based workshop.

3) Most of the teachers' classroom teaching scores, as evaluated by the TPACK-Based Technology Integration Observation Instrument, after the LAT-based workshop are above the average.

CHAPTER 3

METHOD

3.1 Research design

The purpose of the current study is to examine the role of LAT approach in teachers' technology integration, as measured by the TPACK Survey (Hacıömeroğlu, Şahin & Arcagök, 2014), lesson plans and teaching in terms of their technology integration level, as measured by Technology Integration Assessment Rubric (Hofer et al., 2010) and TPACK-Based Technology Integration Observation Instrument (Hofer et al., 2010) respectively. This study used one-group pretest-posttest pre-experimental design (Campbell & Stanley, 1963). There was one group of teachers. They firstly received a pre-test, then participated in the LAT-based workshop. At the end of the workshop, they received a post-test, which was same as the pre-test. In addition, their lesson plans and teaching were evaluated.

3.2 Participants

There were 15 teachers from different branches and grade levels from a private K-12 school in Istanbul. There are kindergarten, science, mathematics, literature, language, social sciences, and psychological guidance teachers (see Table 1). The age range is 23 to 45 and they are mostly women.

3.3 TPACK survey

The original TPACK survey was developed by Schmidt, Baran, Thompson, Koehler, Mishra, and Shin (2009), and then it is updated in 2011 (see Appendix A). The last version of the survey has 46 items with 5 Likert scale (Totally Agree-Totally disagree). It is used to measure TK (6 items), CK (12 items), PK (7 items), PCK (4 items), TCK (4 items), TPK (9 items) and TPACK (4 items).

The original language of the instrument is English, however, the instrument (version 1.1) was adapted to Turkish by Hacıömeroğlu, Şahin and Arcagök (2014) (see Appendix B). There are some changes in the Turkish version; item 7 is added as a new item, item 36 in original survey is not included in Turkish version and TPACK domain of items 44, 45, 46, 47 are changed, they are taken into TPACK from TPK (Hacıömeroğlu, Şahin & Arcagök, 2014) (see Table 2).

Table 1. Demographics of participants

Participant	Gender	Branch	Age
1	Female	Social Science	28
2	Female	Social Science	26
3	Female	Science	26
4	Female	Psychological guidance	25
5	Female	Social Sciences	23
6	Female	Mathematics	42
7	Female	Kindergarten	26
8	Female	Mathematics	25
9	Female	Literature	25
10	Male	Social Sciences	32
11	Female	Social Sciences	25
12	Female	Language (English)	25
13	Female	Kindergarten	30
14	Female	Social Sciences	23
15	Female	Social Sciences	45

Table 2. Items and TPACK Domains

The Factors of The Items						
TK	CK	PK	PCK	TCK	TPK	TPACK
Item 1	Item 8	Item 20	Item 27	Item 31	Item 35	Item 40
Item 2	Item 9	Item 21	Item 28	Item 32	Item 36	Item 41
Item 3	Item 10	Item 22	Item 29	Item 33	Item 37	Item 42
Item 4	Item 11	Item 23	Item 30	Item 34	Item 38	Item 43
Item 5	Item 12	Item 24			Item 39	Item 44
Item 6	Item 13	Item 25				Item 45
Item 7	Item 14	Item 26				Item 46
	Item 15					Item 47
	Item 16					
	Item 17					
	Item 18					
	Item 19					

Source: Hacıömeroğlu, Şahin & Arcagök, 2014

The Turkish version of the survey is applied to 225 (93 male, 132 female) elementary pre-service teachers. The reliability scores of the factors were reported as: .89 (PK), .88 (TK), .75-.87 (CK), .88 (TPK), .81 (PCK), .82 (TCK) and .92 (TPACK) (Hacıömeroğlu et al.., 2014) (see Table 3). The total internal consistency of the instrument is .94 (Hacıömeroğlu et al.., 2014). The result of the study revealed that the instrument was valid and appropriate to use for assessment of TPACK development.

3.4 Technology Integration Assessment Rubric

Technology Integration Assessment Rubric (see Appendix C) (Hofer et al., 2010) was used to examine the level of technology integration as evident in teachers' lesson plans. The total score of the rubric is calculated by taking the sum of the scores of four categories: Curriculum Goals and Technologies, Instructional Strategies and

Technologies, Technology Selection(s) and Fit and the score of each factor varies from 1 to 4 (see Table 4).

Table 3. TPACK Survey Reliability Scores

TPACK Domain	Internal Consistency (alpha)
Technology Knowledge (TK)	.88
Content Knowledge (CK)	
Social Studies	.82
Mathematics	.83
Science	.78
Literacy	.83
Pedagogy Knowledge (PK)	.89
Pedagogical Content Knowledge (PCK)	.81
Technological Pedagogical Knowledge (TPK)	.88
Technological Content Knowledge (TCK)	.82
Technological Pedagogical Content Knowledge (TPACK)	.92

Source: Hacıömeroğlu, Şahin & Arcagök, 2014

3.5 TPACK-Based Technology Integration Observation Instrument

TPACK-Based Technology Integration Observation Instrument (see Appendix D) (Hofer et al., 2010) was used to examine the level of technology integration as evident in observation of teachers' teaching. The instrument was developed by Hofer, Grandgenett, Harris and Swan (2010). It has two sections. Descriptive information about the lesson was noted in first section of the instrument and last section was used for scoring the lesson. Observation was made according to six (Curriculum Goals and Technologies, Instructional Strategies and Technologies, Technology Selection(s), Fit, Instructional Use and Technology Logistics) criteria with a score ranging from 1 to 4 (see Table 5).

Curriculum Goals and Technologies is about the accordance of technology and curriculum. Instructional Strategies and Technologies is about the accordance of technology and instructional strategies. Technology Selection(s) is about the accordance of technology, curriculum, and instructional strategies. Fit is about accordance of curriculum, pedagogy, and technology. Instructional Use is about the purposeful use of technology. Technology Logistics is about competencies of technology in the lesson.

Table 4. Technology Integration Assessment Rubric

Criteria	4	3	2	1
Curriculum Goals & Technologies (Curriculum-based technology use)	Technologies selected for use in the instructional plan are strongly aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are partially aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are not aligned with any curriculum goals.
Instructional Strategies & Technologies (Using technology in teaching/ learning)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Compatibility with curriculum goals & instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Content, pedagogy and technology together)	Content, instructional strategies and technology fit together strongly within the instructional plan.	Content, instructional strategies and technology fit together within the instructional plan.	Content, instructional strategies and technology fit together somewhat within the instructional plan.	Content, instructional strategies and technology do not fit together within the instructional plan.

Source: Hofer et al., 2010

3.6 Data collection procedures

3.6.1 Permissions

The researcher obtained the permission from the board of the management of the school in which the study conducted and from the INAREK/SBB Ethics Sub-Committee.

3.6.2 Determining participants

The researcher informed all teachers in the school about the study by sending an e-mail including details of the study (purpose, process, and importance of the study) and asked their participation. All the teachers who were volunteers were included in the study. After identifying the participants, the researcher organized a meeting to explain the data collection procedures in detail.

3.6.3 Pre-test

Before the workshop, the participants took the adopted TPACK Survey with demographic information online on their own time as a pretest, which was prepared in Microsoft Forms.

3.6.4 The LAT-based workshop

The LAT-based workshop included four sessions (details are provided in Appendix E). Sessions were designed according to the modules of Harris and Hofer (see Appendix F) that were shared on their website. Harris and Hofer created five modules (1-5) for TPACK development.

In the LAT-based workshop, there were four 75-minute-long sessions. Session 1 included Module 1 and Module 2. Session 2 included Module 3 and Module 4. Session 3 included Module 5 and Session 4 included Module 5. In session 4, teachers were given a list of technological tools and asked to classify them according to the LAT taxonomies based on their major.

Objectives of the workshop sessions were taken from Harris and Hofer's LAT modules. (Harris & Hofer, 2018). At the end of the LAT-based workshop teachers are expected to: understand why technocentric approaches to use technology in teaching do not work; plan for students' learning using curriculum-based LAT and refresh an existing lesson or project using LAT approach; create a lesson or project using LAT approach; and purposefully select educational technology to support students' learning with the refreshed or new plan.

In session 1, the researcher asked participants to prepare a technology integrated lesson plan (LP1) for one of their lessons. Then the participants discussed these lesson plans, after that the researcher asked participants about technology integration. Lastly, the participants and the researcher discussed technology integration studies, technocentrism, TPACK and LAT.

Table 5. TPACK-Based Technology Integration Observation Instrument

	4	3	2	1
Curriculum Goals & Technologies (Matching technology to curriculum)	Technologies used in the lesson are strongly aligned with one or more curriculum goals.	Technologies used in the lesson are aligned with one or more curriculum goals.	Technologies used in the lesson are partially aligned with one or more curriculum goals.	Technologies used in the lesson are not aligned with one or more curriculum goals.
Instructional Strategies & Technologies (Matching technology to instructional strategies)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Matching technology to both curriculum and instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Considering curriculum, pedagogy and technology all together)	Curriculum, instructional strategies and technology fit together strongly within the lesson.	Curriculum, instructional strategies and technology fit together within the lesson.	Curriculum, instructional strategies and technology fit together somewhat within the lesson.	Curriculum, instructional strategies and technology do not fit together within the lesson.
Instructional Use (Using technologies effectively for instruction)	Instructional use of technologies is maximally effective in the observed lesson.	Instructional use of technologies is effective in the observed lesson.	Instructional use of technologies is minimally effective in the observed lesson.	Instructional use of technologies is ineffective in the observed lesson.
Technology Logistics (Operating technologies effectively)	Teachers and/or students operate technologies very well in the observed lesson.	Teachers and/or students operate technologies well in the observed lesson.	Teachers and/or students operate technologies adequately in the observed lesson.	Teachers and/or students operate technologies inadequately in the observed lesson.

Source: Hofer et al., 2010

In session 2, the participants revised their lesson plans according to the issues which were discussed in the first session. Then, a video about problematic use of a simulation game was watched and the researcher asked the teachers what was wrong in the lesson. After that, the researcher and participants discussed the LAT addressing in the video. Then, the researcher asked the participants to examine the LAT Guides. And, the researcher asked the participants to revise their previous lesson plan by using the LAT steps. Then, the participants watched another lesson video and talked about how learning activities could be. Afterwards, the participants revised their lesson plans, and they also talked about classroom conditions and made changes in their lesson plan (LP2).

In session 3, the researcher and participants examined the lesson plans of the participants and talked about the technology choosing as last step. Then, the participants listed all possible technology guided by LAT. And, the researcher asked the participants to compare their previous and current lesson plan. After that, the researcher asked the participants to list the selected technologies in their lesson plans according to the comparisons that the participants made. Then, the participants discussed the digital, and non-digital technologies were, and watched an example lesson video. And, the researcher asked the participants to revise their technologies in the lesson plans.

In session 4, the researcher and participants examined the lesson plans, and the researcher gave the participants a list of technological tools. Then, the researcher asked the participants to categorize the tools according to LAT. The researchers asked the participants to revise their lesson plans at the end and to choose one of the lesson plans of the participants and to present it. After that, the researcher summarized all sessions, and asked participants to evaluate their lesson plans which they prepared before and during the workshop. Lastly, the researcher informed the next process of the study that was about post-test and observation.

Collaboration of the participants were provided during the activities; the teachers from the same branches worked together to support their learning. A list of different technologies was presented to teachers during the sessions to support their TK. Workshop also included assessment during the sessions: the lesson plans of the teachers were continuously discussed in class and lesson plans were revised in every step.

3.6.5 Post-test

The participants took the same TPACK Survey online as a post-test which was prepared in Microsoft Forms.

3.6.6 Lesson plans and class observations

During the workshop, the two lesson plans (LP1 and LP2) prepared by the teachers were evaluated with Technology Integration Assessment rubric. Then, the lessons of the participants were observed by the researcher and another graduate student and they were scored with TPACK-Based Technology Integration Observation Instrument.

3.7 Data analysis

For the first question, data were collected with the TPACK Survey. To calculate the TPACK scores, guidance by Schmidt et al. (2009) was used. 1 was assigned for Strongly Disagree and 5 was assigned for Strongly Agree. And, mean score of the related questions were calculated to determine the sub-scale scores of TPACK.

For the second question, data were collected by Technology Integration Assessment Rubric. LP1 and LP2 were gathered by the researcher and they were rated by taking sum of four categories (Curriculum Goals and Technologies, Instructional Strategies and Technologies, Technology Selection(s) and Fit). The scores of the categories were ranging from 1 to 4, hence, the total score could be between 4 and 16. 20% of lesson plans (7 lesson plans) were shared with another rater (a graduate student) and she also rated the lesson plans according to the rubric. Then these scores were compared with the scores which the researcher rated and the correlation between them was high (.81).

For the third question, data were collected by TPACK-Based Technology Integration Observation Instrument. The researcher observed the lessons of the participants which they prepared during the workshop. The researcher rated the lessons by using the observation instrument. The scores were calculated by taking sum of each category (Curriculum Goals and Technologies, Instructional Strategies and Technologies, Technology Selection(s), Fit, Instructional Use and Technology Logistics) whose score was ranging from 1 to 4, the total score could be between 6 and 24. Twenty percent of lessons (3 lessons) was also observed by another observer (a graduate student). She scored the teachers' lessons by using the observation instrument, and then she shared the scores with the researcher. Then the researcher compared the scores and correlated them. The correlation was high (.98), thus there was no change between the scores which the researcher rated.

To answer the first question (Is there a difference between the TPACK framework components and the overall TPACK pre-test and post-test scores of the teachers who participate in the LAT-based workshop?) multiple one-way ANOVAs were used. To control the Type I error which might occur because of multiple ANOVAs, a Bonferroni adjustment was used (α = .007), which was calculated by dividing α value by the number of dependent variables (.05/7) (Pallant, 2007). Firstly, normality of each sub-scale (TK, PK, CK, TCK, TPK, PCK, TPACK) was tested. Except TK and PCK none of the scales was distributed normally. Hence, a non-parametric Wilcoxon Signed Ranks Test, was used for CK, PK, TPK, TCK, TPACK, and a paired-samples t-test was used for TK and PCK.

To answer the second question (Is there a difference between the teachers' lesson plans, as evaluated by the Technology Integration Assessment Rubric, before and during the LAT-based workshop?) firstly inter-rater reliability for the scores of lesson plans was calculated and the correlation was .81. Then normality test was conducted for pre and post lesson plans. They were distributed normally. Hence a paired-samples t-test was used to determine the statistical significance of the difference between the lesson plan scores.

To answer the third question (What is participants' technology integration level as evaluated by the TPACK-Based Technology Integration Observation Instrument after the LAT-based workshop?) firstly inter-rater reliability for the scores of lesson observations was calculated and the correlation was .98. Then, observation scores were examined.

CHAPTER 4

RESULTS

Research question 1: Is there a difference between the TPACK framework components and the overall TPACK pre-test and post-test scores of the teachers who participate in the LAT-based workshop?

Descriptive statistics showed that there is an increase in TK, CK, PCK, TCK, TPK and TPACK scores. The higher increase is in TCK scores. It is also seen that there is a slight decrease (.009) in PK scores.

To test if there are any statistically significant differences between the pre and post TPACK sub-scale scores (see Table 6), one-way MANOVA would be used; however, there were assumptions to be met for a MANOVA analysis. The data were not normally distributed based on the Shapiro-Wilk test (see Table 7) and the absence of multicollinearity assumption was not supported (see Table 8). To use the MANOVA, dependent variables must be correlated with each other. If the correlations are low or too high (almost greater than 0.9), separate ANOVAs are used. Hence, instead of MANOVA, as Pallant (2007) suggested, separate ANOVAs were used to analyze the data by controlling the Type I error rate with a Bonferroni correction (setting alpha level at .05/7 = .007).

Table 6. Descriptive Statistics for TPACK Domains

	N	Mean	Std. Deviation	Variance	Post-Pre
TK_PRE	15	3.4095	.63629	.405	.3238
TK_POST	15	3.7333	.72816	.530	
CK_PRE	15	3.3667	.48366	.234	.0333
CK_POST	15	3.4000	.63870	.408	
PK_PRE	15	4.1524	.83381	.695	-.0095
PK_POST	15	4.1429	.79172	.627	
PCK_PRE	15	3.2500	.79057	.625	.4333
PCK_POST	15	3.6833	.92324	.852	
TCK_PRE	15	2.8500	.68007	.462	.4833
TCK_POST	15	3.3333	.84867	.720	
TPK_PRE	15	3.6667	.69222	.479	.3666
TPK_POST	15	4.0333	1.1255	1,267	
TPACK_PRE	15	3.6250	.63033	.397	.0917
TPACK_POST	15	3.7167	.78414	.615	

Table 7. Shapiro Wilk Test Results for the TPACK Domains

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TK_PRE	.138	15	.200	.956	15	.625
CK_PRE	.141	15	.200	.955	15	.612
PK_PRE	.176	15	.200	.811	15	.005
PCK_PRE	.109	15	.200	.972	15	.883
TCK_PRE	.121	15	.200	.977	15	.947
TPK_PRE	.207	15	.083	.935	15	.328
TPACK_PRE	.167	15	.200	.943	15	.424
TK_POST	.243	15	.017	.904	15	.108
CK_POST	.191	15	.147	.849	15	.017
PK_POST	.295	15	.001	.762	15	.001
PCK_POST	.195	15	.128	.917	15	.173
TCK_POST	.245	15	.016	.881	15	.048
TPK_POST	.222	15	.046	.800	15	.004
TPACK_POST	.253	15	.010	.817	15	.006

Table 8. Collinearity Diagnostics

Variance Proportions													
(Constant)	pre_TK	pre_CK	pre_PK	pre_PCK	pre_TCK	pre_TPK	pre_TPAC	post_TK	post_CK	post_PK	post_TCK	post_TPK	post_TPACK
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.02	.00	.00	.00	.00	.00	.00	.00	.06	.00
.01	.03	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.02	.00
.00	.00	.00	.00	.03	.00	.00	.00	.00	.01	.00	.00	.01	.00
.02	.00	.00	.00	.05	.00	.00	.00	.00	.00	.00	.00	.13	.00
.00	.01	.00	.00	.02	.00	.00	.00	.01	.00	.00	.00	.01	.00
.00	.00	.02	.00	.01	.00	.01	.01	.01	.00	.00	.00	.01	.00
.07	.10	.01	.00	.00	.00	.00	.01	.05	.00	.00	.00	.22	.00
.06	.00	.06	.01	.08	.00	.00	.01	.01	.08	.01	.00	.33	.01
.00	.02	.03	.00	.01	.01	.04	.03	.01	.00	.02	.00	.02	.03
.17	.57	.16	.01	.05	.00	.01	.15	.01	.19	.03	.00	.14	.00
.65	.12	.01	.01	.01	.00	.01	.04	.48	.69	.05	.03	.03	.00
.02	.14	.71	.97	.72	.97	.93	.75	.42	.02	.89	.96	.02	.96

Technological knowledge development

There is an increase in the mean scores of the TK before (*M* = 3.40) and after (*M* = 3.73) the workshop (see Table 9). To test the significance of the increase paired sample t-test was used because the scores are distributed normally. The test showed that there is not a statistically significant increase in the scores for pre-TK scores (*M* = 3.40, *SD* = .63) and post TK scores (*M* = 3.73, *SD* = .72), t (14) = -3.012, $p > .007$ (see Table 10).

Table 9. Descriptive Statistics for TK

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	TK_PRE	3.4095	15	.63629	.16429
	TK_POST	3.7333	15	.72816	.18801

Table 10. Paired Sample Result for TK

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	TK_PRE - TK_POST	-.32381	.41638	.10751	-.55439	-.09323	-3.012	14	.009

gogical content knowledge development

There is an increase in the mean scores of the PCK before (*M* = 3,25) and after (*M* = 3,68) the workshop (see Table 11). To test the significance of the increase paired sample t-test was used because the scores are distributed normally. The test showed that there is not a statistically significant difference in pre PCK scores (*M* = 3,25, *SD* = .79) and post PCK scores (*M* = 3,68, *SD* = .92), *t* (14) = -1,867, *p* > .007 (see Table 12).

Table 11. Descriptive Statistics for PCK

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PCK_PRE	3.2500	15	.79057	.20412
	PCK_POST	3.6833	15	.92324	.23838

Table 12. Paired Sample Result for PCK

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PCK_PRE - PCK_POST	-.43333	.89874	.23205	-.93104	.06437	-1.867	14	.083

Content knowledge development

There is an increase in the mean score of the CK scores before (*M* = 3.26) and after (*M* = 3.40) the workshop (see Table 13). To test the significance of the increase Wilcoxon Signed Ranks test is used because the scores are not distributed normally. The test showed that there is no statistically significant difference between the CK scores z = -.220, *p* > .007 (see Table 14).

Pedagogical knowledge development

There is a little decrease in the mean score of the PK scores before (*M* = 4.15) and after (*M* = 4.14) the workshop (see Table 15). As it can be seen above, post

PK scores are lower than pre-PK scores. To test the significance of the increase Wilcoxon Signed Ranks test is used because the scores are not distributed normally. The test showed that there is not a statistically significant difference between the scores, $z = -.316$, $p > .007$ (see Table 16).

Table 13. Descriptive Statistics for CK Improvement

		N	Mean Rank	Sum of Ranks
CK_POST - CK_PRE	Negative Ranks	8[a]	6.13	49.00
	Positive Ranks	6[b]	9.33	56.00
	Ties	1[c]		
	Total	15		
a. CK_POST < CK_PRE				
b. CK_POST > CK_PRE				
c. CK_POST = CK_PRE				

Table 14. Wilcoxon Signed Rank Test Result for CK Improvement

	CK_POST - CK_PRE
Z	-.220[b]
Asymp. Sig. (2-tailed)	.826
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Technological content knowledge development

There is an increase in the mean score of the TCK scores before ($M = 2.85$) and after ($M = 3.33$) the workshop (see Table 17). To test the significance of the increase Wilcoxon Signed Ranks test is used because the scores are not distributed normally. The test showed that there is a statistically significant increase between the TCK scores, $z = -2.932$, $p = .003$ with a large effect size ($r = .80$) (see Table 18).

Table 15. Descriptive Statistics for PK Improvement

		N	Mean Rank	Sum of Ranks
PK_POST - PK_PRE	Negative Ranks	5[a]	7.00	35.00
	Positive Ranks	7[b]	6.14	43.00
	Ties	3[c]		
	Total	15		
a. PK_POST < PK_PRE				
b. PK_POST > PK_PRE				
c. PK_POST = PK_PRE				

Table 16. Wilcoxon Signed Rank Test Result for PK Improvement

	PK_POST - PK_PRE
Z	-.316[b]
Asymp. Sig. (2-tailed)	.752
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Technological pedagogical knowledge development

There is an increase in the mean score of the TPK scores before (M = 3.66) and after (M = 4.03) the LAT-based workshop (see Table 19). To test the significance of the increase Wilcoxon Signed Ranks test is used because the scores are not distributed normally. The test showed that there is not a statistically significant difference between the scores, z = -1.743, p > .007 (see Table 20).

Technological pedagogical content knowledge development

There is an increase in the mean score of the TPACK scores before (M = 3.62) and after (M = 3.71) the workshop (see Table 21). To test the significance of the increase Wilcoxon Signed Ranks test is used because the scores are not distributed normally. The test showed that there is no statistically significant difference between the scores, $z = -.599$, $p > .007$ (see Table 22).

Table 17. Descriptive Statistics for TCK Improvement

		N	Mean Rank	Sum of Ranks
TCK_POST - TCK_PRE	Negative Ranks	1[a]	2.00	2.00
	Positive Ranks	11[b]	6.91	76.00
	Ties	3[c]		
	Total	15		

a. TCK_POST < TCK_PRE

b. TCK_POST > TCK_PRE

c. TCK_POST = TCK_PRE

Table 18. Wilcoxon Signed Rank Test Result for TCK Improvement

	TCK_POST - TCK_PRE
Z	-2.932[b]
Asymp. Sig. (2-tailed)	.003

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Table 19. Descriptive Statistics for TPK Improvement

		N	Mean Rank	Sum of Ranks
TPK_POST - TPK_PRE	Negative Ranks	4[a]	4.25	17.00
	Positive Ranks	8[b]	7.63	61.00
	Ties	3[c]		
	Total	15		

a. TPK_POST < TPK_PRE

b. TPK_POST > TPK_PRE

c. TPK_POST = TPK_PRE

Table 20. Wilcoxon Signed Rank Test Result for TPK Improvement

	TPK_POST - TPK_PRE
Z	-1.743[b]
Asymp. Sig. (2-tailed)	.081
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

In summary, to answer the first question, separate ANOVAs were applied the data. Because there were only two measurements of the same group (pre and post) and the data were distributed normally, paired samples t-tests were used for TK and PCK scores. On the other hand, Wilcoxon Signed Ranks tests were used for CK, PK, TCK, TPK and TPACK scores because they were not distributed normally. As a result, there is an increase in TPACK Survey scores of the teachers except PK scores based on the descriptive statistics (see Table 23). TK, CK, TPK, PCK, TCK and TPACK scores are increased and there is a little decrease in PK scores. The highest increase is in TCK scores and the lowest increase in CK scores. The increase in TCK scores is also statistically significant. On the other hand, the difference between the TK, CK, PK, TPK, PCK and TPACK scores are not statistically significant.

Table 21. Descriptive Statistics for TPACK Improvement

		N	Mean Rank	Sum of Ranks
TPACK_POST - TPACK_PRE	Negative Ranks	6[a]	7.17	43.00
	Positive Ranks	8[b]	7.75	62.00
	Ties	1[c]		
	Total	15		
a. TPACK_POST < TPACK_PRE				
b. TPACK_POST > TPACK_PRE				
c. TPACK_POST = TPACK_PRE				

Table 22. Wilcoxon Signed Rank Test Result for TPACK Improvement

	TPACK_POST - TPACK_PRE
Z	-.599[b]
Asymp. Sig. (2-tailed)	.549
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Table 23. TPACK Gain Scores

Id	Branch	TK Gain	CK Gain	PK Gain	PCK Gain	TCK Gain	TPK Gain	TPACK Gain	Total Gain
13	Kindergarten	0.4	0.8	0.0	1.0	0.8	0.8	0.8	0.6
7	Kindergarten	0.7	0.5	1.0	1.0	0.5	1.5	0.8	0.9
12	Language (English)	0.6	0.1	0.4	0.3	0.0	0.0	0.1	0.2
9	Literature	0.9	-0.2	0.1	-0.5	0.3	0.8	-0.1	0.2
6	Mathematics	-0.1	0.6	-1.0	-0.5	0.5	-0.5	0.4	-0.1
8	Mathematics	0.1	-0.5	-0.1	0.0	0.0	-0.8	-0.5	-0.3
4	Psychological Guidance	0.1	-0.1	-1.0	-0.3	1.5	-0.3	0.0	0.0
3	Science	1.0	0.0	0.3	1.3	0.5	1.0	1.0	0.7
5	Social Science	-0.3	-0.8	0.3	0.0	0.3	1.5	-0.1	0.1
10	Social Science	-0.3	-0.2	0.0	0.5	-0.3	-1.0	-0.6	-0.3
1	Social Science	0.0	0.6	-0.4	0.8	1.5	0.8	0.5	0.5
2	Social Science	0.1	-0.3	-0.1	2.8	0.8	0.0	-0.9	0.3
14	Social Science	0.3	-0.1	0.1	1.0	0.5	0.0	0.1	0.3
11	Social Science	0.4	0.4	0.0	0.0	0.5	0.8	0.5	0.4
15	Social Science	0.9	-0.4	0.3	-0.8	0.0	1.0	-0.5	0.1

Research question 2: Is there a difference between the teachers' lesson plans, as evaluated by the Technology Integration Assessment Rubric, before and during the LAT-based workshop?

There is an increase in the mean scores of the first lesson plan scores (LP1) (M = 7.53) and the second lesson plan (LP2) scores (M = 11.26) (see Table 24 and Table 25) . To test the significance of the increase normality test was conducted for pre and post lesson plans. They were distributed normally (see

Table 26). Hence a paired-samples t-test was used to determine the statistical significance of the difference between the lesson plan scores.

The test showed that there is a statistically meaningful increase in the scores over time, t (14) = -5.385, p = .000, with a large effect size (d = 1.43) (see Table 27).

In addition to LP1 and LP2 scores, 6 participants' lesson plan gain scores (LP2-LP1) are also above the mean of the gain scores (4). 4 participants are Social Science teachers (scores = 5, 5, 7, 8) and Mathematics and Kindergarten (scores = 8, 5) teachers are other teachers (see Table 28).

Research question 3: What is participants' technology integration level as evaluated by the TPACK-Based Technology Integration Observation Instrument after the LAT-based workshop?

Table 24. Lesson Plan Scores

Id	LP1 Score	LP2 Scores	LP2-LP1 (Gain)
1	6	9	3
2	5	13	8
3	10	12	2
4	4	4	0
5	5	8	3
6	10	12	2
7	16	16	0
8	8	16	8
9	4	8	4
10	4	9	5
11	8	8	0
12	8	12	4
13	8	13	5
14	6	13	7
15	11	16	5

Table 25. Descriptive Statistics for Lesson Plan Scores

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE_LP	7.5333	15	3.29213	.85002
	POST_LP	11.2667	15	3.51460	.90746

Table 26. Shapiro Wilk Test Results for Lesson Plan Scores

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRE_LP	.177	15	.200*	.887	15	.060
POST_LP	.183	15	.191	.926	15	.235

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 27. Paired Sample Test Result for Lesson Plan Scores

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PRE_LP - POST_LP	-3.73333	2.68506	.69328	-5.22027	-2.24640	-5.385	14	.000

The mean of LP1 scores of the participants with respect to their area are 10 (for Mathematics and Science teachers), 11 (for Social Science teacher), and 16 (for Kindergarten teacher). It is also noticeable that 4 participants (1 Mathematics, 1 Science, 1 Social Science and 1 Kindergarten teachers) LP1 scores are above the mean (M = 8) (see Table 28).

On the other hand, 9 participants LP2 scores are above the mean of the LP2 scores (M = 11). 3 of the participants are Social Science teachers (scores =

13, 13, 16) and rest of them is Mathematics, Kindergarten, Science and Language (English) teachers (scores = 12, 12, 12, 16, 16, 13).

The mean of the observation scores is 16, and 8 of 15 (53%) participants' scores (1 Social Science, 1 Psychological Guidance, 2 Kindergarten, 2 Mathematics, 1 Science and 1 Literature teachers) are above of this average. Moreover, 6 participants' (2 Mathematics, 1 Science, 2 Kindergarten and 1 Social Science teachers) both LP2 and observation scores are above the average (see Table 29) and 3 (Mathematics, Kindergarten and Social Science teachers) of these 6 participants' lesson plan gain scores are also above the average (M = 4).

Table 28. Branch-based Lesson Plan Scores

Id	Branch	LP1 Score	LP2 Scores	Gain
1	Social Science	6	9	3
2	Social Science	5	13*	8*
3	Science	10*	12*	2
4	Psychological Guidance	4	4	0
5	Social Science	5	8	3
6	Mathematics	10*	12*	2
7	Kindergarten	16*	16*	0
8	Mathematics	8	16*	8*
9	Literature	4	8	4
10	Social Science	4	9	5*
11	Social Science	8	8	0
12	Language (English)	8	12*	4
13	Kindergarten	8	13*	5*
14	Social Science	6	13*	7*
15	Social Science	11*	16*	5*

*. Above the mean

Table 29. Lesson Plan and Observation Scores

Id	Branch	Post-Lesson Plan Scores	Gain	Observation Scores
1	Social Science	9	3	6
2	Social Science	13*	8*	6
3	Science	12*	2	20*
4	Psychological Guidance	4	0	17*
5	Social Science	8	3	16
6	Mathematics	12*	2	20*
7	Kindergarten	16*	0	18*
8	Mathematics	16*	8*	20*
9	Literature	8	4	24*
10	Social Science	9	5*	6
11	Social Science	8	0	16
12	Language (English)	12*	4	14
13	Kindergarten	13*	5*	22*
14	Social Science	13*	7*	13
15	Social Science	16*	5*	23*

*. Above the mean

CHAPTER 5

DISCUSSION AND CONCLUSIONS

The current study investigated the role of a LAT-based workshop in teachers' technology integration, as measured by the TPACK Survey (Hacıömeroğlu, Şahin & Arcagök, 2014), and lesson plans and their actual teaching in terms of their technology integration level, as measured by Technology Integration Assessment Rubric (Hofer et al., 2010) and TPACK-Based Technology Integration Observation Instrument (Hofer et al., 2010) respectively. The study used one-group pretest-posttest pre-experimental design (Campbell & Stanley, 1963), but also involved the collection of data in terms of lesson plans and classroom observations. The participants are 15 teachers from a private school in Istanbul. The results showed that a technology integration workshop based on the LAT approach helped improving the participants' technology integration level as measured by the lesson plans. Chai, Koh, and Tsai (2010) stated that in-service teachers get better results from technology integration studies compared to pre-service teachers because of their prior pedagogical knowledge so the result is expected in the study.

There are few studies examining TPACK development of teachers with self-reported survey, lesson plans and observations together. In the literature it is suggested to use different methods for analyses (Başak & Ayvacı, 2017; Chai, Koh & Tsai, 2010; Jang, 2010; Herring, Koehler & Mishra, 2016). Hence in addition to the survey, lesson plan scores and observations were analyzed in the current study.

It has come to attention that social sciences teachers and other teachers' TPACK, lesson plan and observation scores differ. Social Science teachers' lesson plan gain scores are higher than other teachers' teachers' (Science, Psychological Guidance, Mathematics, Kindergarten, Literature, and Language teachers) lesson plan gain scores (see Table 23). Other teachers' TPACK Survey gain scores and observation scores are higher than the Social Science teachers' TPACK Survey gain scores and observation scores. In literature, the teachers from different branches might differ in terms of getting benefit from technology integration training (Başak & Ayvacı, 2017; Vural &Ceylan, 2014) and mostly science teachers were included in technology integration studies (Baran & Canbazoğlu Bilici, 2015). In this study, it is noticeable that social science teachers' scores differ from other teachers' scores.

5.1 TPACK development on TPACK survey scores

The analyses revealed that the LAT-based workshop improved teachers' technology integration. There is an increase in TPACK Survey scores of the teachers except PK scores. Based on the descriptive statistics TK, CK, TPK, PCK, TCK and TPACK scores are increased and there is a little decrease in PK scores. The highest increase is in TCK scores and the lowest increase in CK scores. The increase in TCK scores is also statistically significant. On the other hand, the difference between the TK, CK, PK, TPK, PCK and TPACK scores are not statistically significant.

TCK, TPK, PCK and TPACK development is expected according to the LAT strategy because the LAT approach presents curriculum-based activities and technologies. Teachers make their instructional planning according to these activities. Hence, this planning process particularly supports TPACK development on TCK, TPK, PCK and TPACK domains.

The lowest development is on CK domain (See Table 6). This is an expected result because it is stated that the CK development is not specifically intended in the LAT approach (Harris & Hofer, 2010). However, curriculum-based activities in the LAT might support the CK development.

The increase in TK scores might occur because LAT presented technologies with activities and there was an activity in the workshop about technological tools which the teachers can use in their lessons. These probably helped increasing participants' TK scores.

However, the increase in the TK, CK, PK, TPK, PCK and TPACK scores are not statistically significant. This might occur because TPACK survey scores are high and the sample size is small. Except pre-TCK scores, the average of the scores are above the 3 out of 5. In the study of Chai, Koh, and Tsai (2010) they used TPACK survey with 889 pre-service teachers and there is statistically significant increase in TK, PK, CK and TPACK scores. So, bigger sample size might make the increase statistically significant.

PK scores slightly decreased. This is not an expected result, but the decrease is small. In the workshop, there is not any content which can directly change the PK level of the teachers. So, it might occur because of that TPACK is a self-report instrument, and the teachers' scores might change.

It is also noticeable that the mean of the social science teachers' TPACK survey gain scores (M = .20) are slightly lower than other teachers' TPACK survey gain scores (*M* = .28). The mean of the TPACK Survey scores of social science teachers are lower than other teachers' scores. It could be said that the development of the other teachers is higher than social science teachers because the observation scores of the other teachers are also higher than the scores of the social science teachers. However, lesson plan scores do not support the idea. Hence, the results are not totally support the idea that the TPACK development of the other teachers are higher than the social science teachers. So, it can be said that this might occur because other teachers do not apply the LAT steps in their lesson plans. Also, it might occur because TPACK is a self-report instrument and the sample size is small. This results also revealed that different types of assessment methods help making more comprehensive analysis in TPACK development studies.

5.2 TPACK development on technology integration assessment rubric scores

The results showed that the LAT-based workshop developed teachers' lesson plan scores. There are differences between the pre and post lesson scores of teachers and this difference is statistically significant. So, according to the lesson plan scores the teachers benefited from the workshop in terms of TPACK development.

There is a statistically significant increase in teachers lesson plan scores. In the LAT strategy there is a comprehensive and detailed lesson plan guide for teachers. It helps teachers to prepare technology-integrated lesson plans. Hence, this specific guidance might have caused the increase in the lesson plan scores.

There are 9 teachers whose LP2 scores are above the mean and LP1 scores of 5 of these participants are below the mean. However, their gain scores (LP2-LP1) are above the mean of gain scores of the lesson plans. The teachers who have lower LP1 scores get higher lesson plan gain scores. So, it can be claimed that the LAT-based workshop is more beneficial for the teachers who are not good at preparing lesson plans according to the lesson plan scores. This might occur because of that LAT presented structured steps for preparing lesson plans and these teachers' lack of lesson plan preparation knowledge might help the teachers to apply the steps easily in their lesson plans and get higher scores. Hence, as Başak and Ayvacı (2017) stated, prior knowledge of the teachers might cause the differences of TPACK development on lesson plan scores.

The lesson plan scores are also supported by the observation scores of the teachers. 6 participants' both LP2 (M = 11,26) and observation scores (M = 16,07) are higher than the mean. This finding shows that the teachers who are able to implement the LAT strategy have higher lesson plan scores.

5.3 TPACK development on TPACK-Based Technology Integration Observation Instrument Scores

The observation of actual classes showed that most of the teachers followed their lesson plans. The lessons of the teachers which they prepared during the LAT-based workshop were observed. The mean of the observation scores is high (M = 16,07). The maximum possible score is 24. The scores of 8 participants (out of 15) are above the average.

The observation scores were compared with the results of LP2 scores. The purpose of the class observations was to investigate how the teachers applied the lesson plans in their actual lessons. As Harris and Hofer (2010) stated, the technology integration of the teachers which applied LAT process in their plans and lessons are developed. The results which are in line with the literature (Harris and Hofer, 2010) showed that most of the participants (8 participants) followed their lesson plan, their observation scores are above the mean. The lesson plans and observation scores support each other, participants' both observation and lesson plan scores are above the average.

Although they had high lesson plan scores, some of the teachers did not follow their lesson plans in their lessons, so their scores are low. Moreover, there are some teachers who did not apply LAT process properly in their lesson plans and consequently their observation scores are low.

Nine participants LP2 scores are above the mean, 5 of these participants lesson plan gain scores are above the mean and only 3 of these five participants' observation scores are above the mean. It shows that the LAT-based workshop helps TPACK development but TPACK development is not easy process, it requires more work to apply it in lessons. In the study teachers use a list of technological tools which was given by the researcher in the workshop. There are technologies in LAT taxonomies according to the selected activities, however the teachers need usable and more familiar tools for their lessons, the list helps them in this way. Moreover, the researcher provided mentoring during and after the workshop, she answered questions and gave feedback for lesson plans, which also helped the participants. As Başak and Ayvacı (2017) and Zhao and Bryant

(2006) stated the LAT-based workshop itself helps TPACK development but to make it more effective there should be more support for the teachers.

According to the observation scores and TPACK survey scores other teachers are better than social science teachers. It seems like that other teachers benefited more from the workshop than other teachers, but the lesson plan scores do not support the idea. Social science teachers received higher lesson plan scores than other teachers. This result shows that TPACK survey and observation scores are not enough to make a comprehensive analysis for analyzing TPACK development. Even if observation and TPACK survey scores show that the LAT-based workshop is more beneficial for teachers in terms of getting higher scores it is not supported by the lesson plan scores.

On the other hand, TPACK development is not an easy process, only 3 teachers received higher TPACK survey, lesson plan and observation scores in the study. This shows the difficulty of applying TPACK in lessons.

This result also supports the importance of the different types of assessment methods in a study (Başak & Ayvacı, 2017; Chai, Koh & Tsai, 2010; Jang, 2010; Herring, Koehler & Mishra, 2016). The results on the TPACK survey scores do not show statistically significant development on technology integration, however lesson plan and lesson observation analysis showed that there is a significant TPACK development. Thus, using different types of assessment methods helped a more comprehensive analysis in the current study as suggested in the literature (Başak & Ayvacı, 2017; Chai, Koh & Tsai, 2010; Jang, 2010; Herring, Koehler & Mishra, 2016).

5.4 Recommendations and the implications for future research

The current study makes some contributions to the literature. Firstly, there are a few studies, if none, which use the LAT strategy for TPACK development in Turkey. LAT is a proper strategy to use in TPACK development studies in Turkey because it provides step by step guidelines for technology integration (Herring, Koehler & Mishra, 2016). In the current study the LAT-based workshop was conducted, and it supported that the LAT-based workshop helped developing teachers' technology integration levels.

Secondly, the study also reveals the importance of using mixed assessment methods together. There are many studies which emphasize the importance of different assessment methods in TPACK development studies (Başak & Ayvacı, 2017; Chai, Koh & Tsai, 2010; Jang, 2010). There are few studies examining TPACK development of teachers with self-reported survey, lesson plans and observations together. In the current study in addition to the survey, lesson plan scores and observations were used to support the lesson plan scores were analyzed. The results on the TPACK survey scores do not show a statistically significant development on technology integration however lesson plan and lesson observation analysis show that there is a development on teachers' technology integration. Therefore, using these three types of assessment methods provide a more comprehensive analysis in the current study as supported in the literature. So, it suggests that for a comprehensive results different types of assessment methods should be included in the TPACK development studies.

Lastly, social sciences teachers are also included in the current study. In literature mostly, science and mathematics teachers are included in TPACK development studies.

For future research, a longer-term the LAT-based workshop with a bigger sample size can be studied in different schools. Also, curriculum-based TPACK development of the teachers from different branches can be analyzed if the size of participants is increased. In the current study the number of the teachers from same subject domain was not enough to make a reliable comparison.

5.5 Limitations of the study

There might be some limitations of the study. First one might be time limitation. Development of TPACK requires a long process as Kritz and Shonfeld (2010) and Zhao and Bryant (2006) suggested. However, the LAT-based workshop in this study was conducted in only four 75-minute long sessions. Yet, this workshop was designed according to Harris and Hofer's recommendations. Besides, the researcher is the responsible for the technology integration in the participating school and she will arrange new sessions for TPACK development in the future.

Second limitation might be related to adult learning and sample size. In the current study the participants were adults. This made the volunteering essential for the research. Hence, only the volunteer teachers participated in the study, which affected the number of participants and the generalizability of the findings. More participants can be included in future studies.

APPENDIX A

TPACK SURVEY

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
TK (Technology Knowledge)					
1. I know how to solve my own technical problems.					
2. I can learn technology easily.					
3. I keep up with important new technologies.					
4. I frequently play around the technology.					
5. I know about a lot of different technologies.					
6. I have the technical skills I need to use technology.					
CK (Content Knowledge)					
Mathematics					
7. I have sufficient knowledge about mathematics.					
8. I can use a mathematical way of thinking.					
9. I have various ways and strategies of developing my understanding of mathematics.					
Social Studies					
10. I have sufficient knowledge about social studies.					
11. I can use a historical way of thinking.					
12. I have various ways and strategies of developing my understanding of social studies.					
Science					
13. I have sufficient knowledge about science.					
14. I can use a scientific way of thinking.					
15. I have various ways and strategies of developing my understanding of science.					
Literacy					
16. I have sufficient knowledge about literacy.					
17. I can use a literary way of thinking.					
18. I have various ways and strategies of developing my understanding of literacy.					

PK (Pedagogical Knowledge)					
19. I know how to assess student performance in a classroom.					
20. I can adapt my teaching based-upon what students currently understand or do not understand.					
21. I can adapt my teaching style to different learners.					
22. I can assess student learning in multiple ways.					
23. I can use a wide range of teaching approaches in a classroom setting.					
24. I am familiar with common student understandings and misconceptions.					
25. I know how to organize and maintain classroom management.					

PCK (Pedagogical Content Knowledge)					
26. I can select effective teaching approaches to guide student thinking and learning in mathematics.					
27. I can select effective teaching approaches to guide student thinking and learning in literacy.					
28. I can select effective teaching approaches to guide student thinking and learning in science.					
29. I can select effective teaching approaches to guide student thinking and learning in social studies.					
TCK (Technological Content Knowledge)					
30. I know about technologies that I can use for understanding and doing mathematics.					
31. I know about technologies that I can use for understanding and doing literacy.					
32. I know about technologies that I can use for understanding and doing science.					
33. I know about technologies that I can use for understanding and doing social studies.					

TPK (Technological Pedagogical Knowledge)					
34. I can choose technologies that enhance the teaching approaches for a lesson.					
35. I can choose technologies that enhance students' learning for a lesson.					
36. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.					
37. I am thinking critically about how to use technology in my classroom.					
38. I can adapt the use of the technologies that I am learning about to different teaching activities.					
39. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.					
40. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.					
41. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.					
42. I can choose technologies that enhance the content for a lesson.					

TPACK (Technology Pedagogy and Content Knowledge)					
43. I can teach lessons that appropriately combine mathematics, technologies and teaching approaches.					
44. I can teach lessons that appropriately combine literacy, technologies and teaching approaches.					
45. I can teach lessons that appropriately combine science, technologies and teaching approaches.					
46. I can teach lessons that appropriately combine social studies, technologies and teaching approaches.					

Models of TPACK (Faculty, PreK-6 teachers)					
47. My mathematics education professors appropriately model combining content, technologies and teaching approaches in their teaching.					
48. My literacy education professors appropriately model combining content, technologies and teaching approaches in their teaching.					
49. My science education professors appropriately model combining content, technologies and teaching approaches in their teaching.					
50. My social studies education professors appropriately model combining content, technologies and teaching approaches in their teaching.					
51. My instructional technology professors appropriately model combining content, technologies and teaching approaches in their teaching.					
52. My educational foundation professors appropriately model combining content, technologies and teaching approaches in their teaching.					
53. My professors outside of education appropriately model combining content, technologies and teaching approaches in their teaching.					
54. My PreK-6 cooperating teachers appropriately model combining content, technologies and teaching approaches in their teaching.					

APPENDIX B

TPACK SURVEY (TURKISH)

Teknoloji Bilgisi (TB)	Kesinlikle katılmıyorum (1)	Katılmıyorum (2)	Kararsızım (3)	Katılıyorum (4)	Kesinlikle katılıyorum (5)
1-Teknik problemleri nasıl çözeceğimi biliyorum.	(1)	(2)	(3)	(4)	(5)
2-Teknolojiyi kolayca öğrenebilirim.	(1)	(2)	(3)	(4)	(5)
3-Yeni teknolojileri takip ederim.	(1)	(2)	(3)	(4)	(5)
4-Teknoloji ile sıklıkla uğraşırım.	(1)	(2)	(3)	(4)	(5)
5-Farklı birçok teknolojiyi biliyorum.	(1)	(2)	(3)	(4)	(5)
6-Teknoloji kullanmak için gerekli teknik becerilere sahibim.	(1)	(2)	(3)	(4)	(5)
7-Farklı teknolojilerle çalışmak için yeterli olanağa sahip oldum.	(1)	(2)	(3)	(4)	(5)
Alan Bilgisi (AB) - Matematik					
8-Matematik hakkında yeterli bilgiye sahibim.	(1)	(2)	(3)	(4)	(5)
9-Matematiksel düşünme yolunu kullanabilirim.	(1)	(2)	(3)	(4)	(5)
10-Matematiği anlamamı geliştirecek çeşitli yollara ve stratejilere sahibim.	(1)	(2)	(3)	(4)	(5)
Alan Bilgisi (AB) - Sosyal Bilimler					
11-Sosyal bilimler hakkında yeterli bilgiye sahibim.	(1)	(2)	(3)	(4)	(5)
12-Tarihsel düşünme yolunu kullanabilirim.	(1)	(2)	(3)	(4)	(5)
13-Sosyal bilimleri anlamamı geliştirecek çeşitli yollara ve stratejilere sahibim.	(1)	(2)	(3)	(4)	(5)
Alan Bilgisi (AB) - Fen					
14-Fen hakkında yeterli bilgiye sahibim.	(1)	(2)	(3)	(4)	(5)
15-Bilimsel düşünme yolunu kullanabilirim.	(1)	(2)	(3)	(4)	(5)
16-Feni anlamamı geliştirecek çeşitli yollara ve stratejilere sahibim.	(1)	(2)	(3)	(4)	(5)
Alan Bilgisi (AB) - Okuma-Yazma					
17-Okuma-Yazma hakkında yeterli bilgiye sahibim.	(1)	(2)	(3)	(4)	(5)
18-Okuma-Yazmaya ilişkin düşünme yolunu kullanabilirim.	(1)	(2)	(3)	(4)	(5)
19-Okuma-Yazmayı anlamamı geliştirecek çeşitli yollara ve stratejilere sahibim.	(1)	(2)	(3)	(4)	(5)
Pedagoji Bilgisi (PB)					
20-Öğrencilerin sınıftaki performanslarını nasıl değerlendireceğimi biliyorum.	(1)	(2)	(3)	(4)	(5)
21-Öğrencilerin neyi anladıkları veya neyi anlamadıklarına göre öğretimimi uyarlayabilirim.	(1)	(2)	(3)	(4)	(5)
22-Farklı öğrenenler için öğretim şeklimi uyarlayabilirim.	(1)	(2)	(3)	(4)	(5)
23-Öğrencilerin öğrenmelerini çeşitli yollar ile değerlendirebilirim.	(1)	(2)	(3)	(4)	(5)
24-Sınıf ortamında, geniş kapsamlı öğretim yaklaşımlarını kullanabilirim.	(1)	(2)	(3)	(4)	(5)
25-Öğrencilerin anlamaları ve kavram yanılgılarını bilirim	(1)	(2)	(3)	(4)	(5)
26-Sınıfı nasıl düzenleyeceğimi ve sınıf yönetimini nasıl sağlayacağımı biliyorum.	(1)	(2)	(3)	(4)	(5)

Pedagojik Alan Bilgisi (PAB)					
27-Etkili öğretim yaklaşımlarını öğrencilerin matematiksel düşünme ve öğrenmesine rehberlik etmek için seçebilirim.	(1)	(2)	(3)	(4)	(5)
28-Etkili öğretim yaklaşımlarını öğrencilerin okuma-yazma dersine ilişkin düşünme ve öğrenmesine rehberlik etmek için seçebilirim.	(1)	(2)	(3)	(4)	(5)
29-Etkili öğretim yaklaşımlarını öğrencilerin fen dersine ilişkin düşünme ve öğrenmesine rehberlik etmek için seçebilirim.	(1)	(2)	(3)	(4)	(5)
30-Etkili öğretim yaklaşımlarını öğrencilerin sosyal bilimler dersine ilişkin düşünme ve öğrenmesine rehberlik etmek için seçebilirim.	(1)	(2)	(3)	(4)	(5)
Teknolojik Alan Bilgisi (TAB)					
31-Matematiği anlamak ve öğretmek için kullanabileceğim teknolojileri biliyorum.	(1)	(2)	(3)	(4)	(5)
32-Okuma-Yazmayı anlamak ve öğretmek için kullanabileceğim teknolojileri biliyorum.	(1)	(2)	(3)	(4)	(5)
33-Feni anlamak ve öğretmek için kullanabileceğim teknolojileri biliyorum.	(1)	(2)	(3)	(4)	(5)
34-Sosyal Bilimleri anlamak ve öğretmek için kullanabileceğim teknolojileri biliyorum.	(1)	(2)	(3)	(4)	(5)
Teknolojik Pedagojik Bilgi (TPB)					
35-Ders için öğretim yaklaşımlarını geliştirecek teknolojileri seçebilirim.	(1)	(2)	(3)	(4)	(5)
36-Derste öğrencilerin öğrenmelerini artıracak teknolojileri seçebilirim.	(1)	(2)	(3)	(4)	(5)
37-Öğretmen yetiştirme programı, sınıfta kullanacağım öğretim yaklaşımlarımı teknolojinin nasıl etkileyebileceği konusunda derinlemesine düşünmeme sebep oldu.	(1)	(2)	(3)	(4)	(5)
39-Öğrendiğim farklı öğretim etkinliklerine teknoloji kullanımını uyarlayabilirim.	(1)	(2)	(3)	(4)	(5)
Teknolojik Pedagojik Alan Bilgisi (TPAB)					
40-Matematik, teknoloji ve öğretim yaklaşımlarını uygun bir şekilde birleştirerek ders anlatabilirim.	(1)	(2)	(3)	(4)	(5)
41-Okuma-yazma, teknoloji ve öğretim yaklaşımlarını uygun bir şekilde birleştirerek ders anlatabilirim.	(1)	(2)	(3)	(4)	(5)
42-Fen, teknoloji ve öğretim yaklaşımlarını uygun bir şekilde birleştirerek ders anlatabilirim.	(1)	(2)	(3)	(4)	(5)
43-Sosyal bilimler, teknoloji ve öğretim yaklaşımlarını uygun bir şekilde birleştirerek ders anlatabilirim.	(1)	(2)	(3)	(4)	(5)
44-Ne öğrettiğimi, nasıl öğrettiğimi ve öğrencilerin ne öğrendiğini geliştirecek teknolojileri sınıfımda kullanmak için seçebilirim.	(1)	(2)	(3)	(4)	(5)
45-Aldığım derslerde öğrendiğim stratejileri alan, teknoloji ve öğretim yaklaşımlarını birleştirmede kullanabilirim.	(1)	(2)	(3)	(4)	(5)
46-Alan, teknoloji ve öğretim yaklaşımlarını kullanmayı koordine etmede okulumda ve diğer okullardaki kişilere rehberlik edebilirim.	(1)	(2)	(3)	(4)	(5)
47-Dersin içeriğini geliştirecek teknolojileri seçebilirim.	(1)	(2)	(3)	(4)	(5)

APPENDIX C

TECHNOLOGY INTEGRATION ASSESSMENT RUBRIC

Criteria	**4**	**3**	**2**	**1**
Curriculum Goals & Technologies (Curriculum-based technology use)	Technologies selected for use in the instructional plan are strongly aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are partially aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are not aligned with any curriculum goals.
Instructional Strategies & Technologies (Using technology in teaching/ learning)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Compatibility with curriculum goals & instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Content, pedagogy and technology together)	Content, instructional strategies and technology fit together strongly within the instructional plan.	Content, instructional strategies and technology fit together within the instructional plan.	Content, instructional strategies and technology fit together somewhat within the instructional plan.	Content, instructional strategies and technology do not fit together within the instructional plan.

[1] Harris, J., Grandgenett, N., & Hofer, M. (2010). Testing a TPACK-based technology integration assessment instrument. In C. D. Maddux, D. Gibson, & B. Dodge (Eds.). *Research highlights in technology and teacher education 2010* (pp. 323-331). Chesapeake, VA: Society for Information Technology and Teacher Education (SITE).

[2] Adapted from: Britten, J. S., & Cassady, J. C. (2005). The Technology Integration Assessment Instrument: Understanding planned use of technology by classroom teachers. *Computers in the Schools, 22*(3), 49-61.

APPENDIX D

TPACK-BASED TECHNOLOGY INTEGRATION OBSERVATION INSTRUMENT

Observer ______________________________ Teacher ______________________________ Date_____________

Grade Level(s) _______ Subject Area(s) ____

Primary Learning Goals ____

Directions:
We have tried to key the components of this instrument to different aspects of teachers' knowledge for technology integration. Please note, however, that the instrument is *not designed to assess this knowledge directly*. It is designed to focus upon the use of technology integration knowledge in observable teaching. Please record the *key curriculum topics addressed*, *instructional strategies/learning activities observed*, and *digital and non-digital technologies used* by the teacher and/or students in the lesson.

Curriculum Topic	Key Instructional Strategies/Learning Activities	Digital[1] & Non-Digital[2] Technologies

What, if anything, do you know about influences upon what you have observed in this lesson? Examples might include students' learning needs, preferences, and challenges; access to technologies; cultural, language and/or socioeconomic factors.

[1] Computer-based (e.g., software, Web-based resources, video or audio recorder, document camera, calculator)
[2] Not computer-based (e.g., overhead projector, textbook, whiteboard, pen/pencil/marker)

Directions: Referring to the notes you made on the previous page, including your responses to the question about influences, please complete the following rubric, considering the lesson as a whole.

	4	3	2	1
Curriculum Goals & Technologies (Matching technology to curriculum)	Technologies used in the lesson are strongly aligned with one or more curriculum goals.	Technologies used in the lesson are aligned with one or more curriculum goals.	Technologies used in the lesson are partially aligned with one or more curriculum goals.	Technologies used in the lesson are not aligned with one or more curriculum goals.
Instructional Strategies & Technologies (Matching technology to instructional strategies)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Matching technology to both curriculum and instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Considering curriculum, pedagogy and technology all together)	Curriculum, instructional strategies and technology fit together strongly within the lesson.	Curriculum, instructional strategies and technology fit together within the lesson.	Curriculum, instructional strategies and technology fit together somewhat within the lesson.	Curriculum, instructional strategies and technology do not fit together within the lesson.
	4	**3**	**2**	**1**
Instructional Use (Using technologies effectively for instruction)	Instructional use of technologies is maximally effective in the observed lesson.	Instructional use of technologies is effective in the observed lesson.	Instructional use of technologies is minimally effective in the observed lesson.	Instructional use of technologies is ineffective in the observed lesson.
Technology Logistics (Operating technologies effectively)	Teachers and/or students operate technologies very well in the observed lesson.	Teachers and/or students operate technologies well in the observed lesson.	Teachers and/or students operate technologies adequately in the observed lesson.	Teachers and/or students operate technologies inadequately in the observed lesson.

Comments:

APPENDIX E

SESSIONS

SESSION 1

TIME-DURATION	**TEACHERS**	**STUDENTS**	**Instructional strategies /tools/ artifacts**
0-5	Introduce herself	-	
5-25	Ask students to prepare a technology integrated lesson plan	Prepare a technology integrated lesson plans (individually)	Create a lesson plan OneNote (tool)
25-35	Examine some of lesson plans with students	-	
35-40	Ask students what is technology integration?	Tell what is technology integration	
40-50	Talk about technology integration studies (with graphs, numbers etc.).	Ask why is the result like these?	
50-55	Talk about TECHNOCENTRISM		Module 1 (resources)
55-75	Talk about “Good technology integration is not about technology” Talk about TPACK Talk about LAT	Ask students what does “Good technology integration is not about technology” mean?	TPACK and LAT articles (resources)

SESSION 2

TIME-DURATION	**TEACHERS**	**STUDENTS**	**Instructional strategies /tools/ artifacts**
0-5 min	Talk about mistakes in lesson plans teachers prepared	-	
5-10	Watch the simulation game using in lesson video and ask what is wrong? Emphasize balance between technology-pedagogy-content	Find the mistakes in the lesson in video	Simulation game video (resources)
10-25	Talk about LAT	Examine LAT (last 5 min.)	
25-35	Talk about LAT guides	Examine LAT guides (last 5 min.)	LAT Lesson Planning Guide, Example LAT Lesson Planning Guide (tools)
40-55	Ask to refresh their lesson plan they prepared previous lesson • List the learning goals • Find the relevant LAT taxonomies • Choose the LATs • Revise LATs (some of them can be taken in others)	• List the learning goals • Find the relevant LAT taxonomies • Choose the LATs • Revise LATs (some of them can be taken in others)	
55-60	Watch the example lesson and talk about learning activities. (how it can be)	Discuss how it can be	Example Lesson video (resource)
60-65	Ask to refresh LAT and sequence them in the relevant column in the guide	Refresh LAT and sequence them	LAT Lesson Planning Guide, Example LAT Lesson Planning Guide (tools)
65-70	Talk about take in consideration of classroom conditions (Look at Module 3-13)		
70-75	Ask to refresh LAT and sequence them in the relevant column in the guide	Refresh LAT and sequence them	LAT Lesson Planning Guide, Example LAT Lesson Planning Guide (tools)

SESSION 3

TIME-DURATION	**TEACHERS**	**STUDENTS**	**Instructional strategies /tools/ artifacts**
0-5 min	Examine students lesson plans and talk about technology choose as final step	-	
5-40	Ask students to write the technologies related with their lesson plans they prepared previous lesson according to LATS	Choose the related technology for their lesson plans (individually)	
40-50	Ask students to talk about their lesson plans by comparing previous lesson plans	Talk about their lesson plans by comparing previous lesson plans	
50-60	Ask students to write 3rd column in the guide the related technology	Choose related technology and list them in the guide corresponding LATS	LAT Lesson Planning Guide, Example LAT Lesson Planning Guide (tools)
60-65	Talk about digital and non-digital technologies Talk about example lesson		
65-75	Ask students to revise technologies	Revise technologies	

SESSION 4

TIME-DURATION	TEACHERS	STUDENTS	Instructional strategies /tools/ artifacts
0-5 min	Examine students lesson plans	Some students explain what they did	
5-20	Give students a list of technological tools and ask to categorize them according to related LATs	Categorize technologies according to related LATs	
20-40	Ask to revise their lesson plans (refreshed and created) according to these technologies	Revise their lesson plans (refreshed and created) according to these technologies	LAT Lesson Planning Guide, Example LAT Lesson Planning Guide (tools)
40-55	Ask to choose one of the lesson plans and present it.	Choose and present a lesson plan	OneNote (tool)
55-65	Summarize lessons Technology is last step Technocentrism Balance between technology-pedagogy-content TPACK LATS LATS' Guides		
65-70	Ask to evaluate their first lesson plan and last lesson plan and write a general lesson evaluation	Evaluate their first lesson plan and last lesson plan and write a general lesson evaluation	OneNote (tool)
70-75	Talk about next process Test Observations Mentoring		

APPENDIX F

HARRIS AND HOFER'S MODULES

Module 1: Introduction

Slide#	Script	Visual(s)
1	*Does your principal want you to use technology more often in your teaching? Have you seen a new tool that you know that your students would enjoy using, but you are not sure how it would fit within your curriculum? Are there more tools in your school than you know what to do with? *Believe it or not, good technology integration ISN'T about technology.	- Series of quickly-appearing images of classroom technologies -- additive (increase speed as the series continues).  - Abrupt stop with final quote (on left) popping out in the middle
	Hi! * I'm Mark Hofer (*and I'm Judi Harris). We are faculty members in the *School of Education at the College of William & Mary in eastern Virginia in the United States. In this short course, we will share an approach to curriculum-based technology integration that we have developed, researched, and tested. *What's distinctive about this approach is that it focuses on planning for students' learning rather than planning for technology integration. Here's why.	- Images of Mark & Judi & school logo. - Image: TeacherPlanning-LookingOverShoulder
2	** Twenty-nine different software packages were recognized nationally several years ago for *their potential to quote transform student learning end-quote. In a recent follow-up study, *most had no impact on student learning outcomes. *Only those titles that required redesigning courses or school-wide buy-in showed moderate positive effects on student learning.	Means, et al.. (2016) - 29 software titles - "transform student learning" - Most: No impact - For impact: Large-scale change
3	* By contrast, in a comprehensive review of research about *one-to-one computer initiatives in schools,	Zheng, et al.. (2016) - 1:1 computer initiatives - Increased learning in science,

Slide#	Script	Visual(s)
	multiple studies documented *increased student achievement in science, writing, math, and English. *They also reported teachers using more student-centered, individualized, and project-based approaches. *Many of the studies also noted increased student engagement in learning.	writing, math, and English - More student-centered, individualized, project-based - Better student engagement
4	*What about computer use with young children? The results are mixed.* Story comprehension and vocabulary have been positively affected by *the use of electronic books with *animated illustrations and sound. *However, interactive elements like hotspots and games did not help to improve literacy. *Economically disadvantaged children were more sensitive to both positive and negative effects.	Tackas, et al.. (2015) - Young children: Comprehension and vocabulary - Electronic books and stories - Helped: Animations; sound - Didn't help: Interactive elements - More for children at risk
5	*In another mixed-results review of more than 350 studies about *using technologies to learn foreign languages, the authors concluded that *quote evidence of efficacy is limited end-quote. *However, computer-supported pronunciation training and *using chatting tools for communication in target languages were associated strongly with learning gains.	Golonka, et al.. (2012) - Technology in foreign language learning - "Evidence of efficacy is limited" - Helped: Computer-supported pronunciation - Helped: Online chatting in target languages
7	* Why are there such large differences among these syntheses of research about educational technology use? *A meta-analysis of research about computer use with elementary students attributed large differences in reported effect sizes to *differences in content being learned, *type of technology use, *length of technology use, and *variable learning environments.	Chauhan (2017) - Computer use with elementary-level students - Curriculum differences - Hardware and software differences - Length of use - Learning environment differences
6	*As you can see, while some research findings about educational technology's impact on learning have been promising, others have reported little or mixed impact.	Image of a teacher/professional who is frowning? Puzzled?

Slide#	Script	Visual(s)
		
7	*The learning gains reported in these research syntheses have something important in common, however. *What is it?	- Display the five abbreviated citations from above, distributed on the screen, at different angles -Superimpose a question mark in the middle (image: question mark made of question marks)
8	In the *studies cited here that documented student learning gains, the approaches used emphasized *CURRICULUM-based *teaching and learning STRATEGIES. Those strategies made productive *USE of educational technologies, *but didn't focus on them.	- Begin with question mark & study citations still on-screen - Remove question mark only. - Delete study citations. - Display filled-in circle with "Curriculum" inside it. Use same color as Content circle in the module that explains TPACK. - Display filled-in circle (different color) with "Teaching/Learning Strategies" inside it next to the Curriculum circle. Use same color as Pedagogy circle in the module that explains TPACK. - Display filled-in circle (different color) with "Technologies" inside it at the top, centered. Use same color as Technology circle in the module that explains TPACK. - Move the three circles together, foreshadowing TPACK. Intersections should be the same colors as TPACK diagram in later module. [Brief pause.]
	*Sadly, for about 40 years, even though we've been trying HARD to integrate technologies into teaching and learning, although we've made some progress, many would argue that the gains are not proportional to the amount of *time, *energy, and *money that we've spent.	Clean screen. Images, appearing one at a time: flat-line graph, then not-equal-to sign, then clock, light bulb, dollar sign 

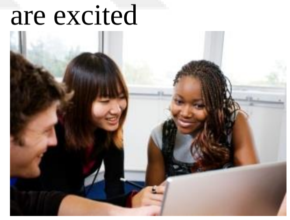
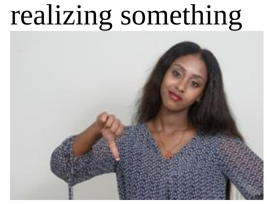
Slide#	Script	Visual(s)
	*We strongly suspect that this is due to the technology-focused nature of most educational technology efforts, including professional development for teachers. MIT's Seymour Papert coined a term for this more than 30 years ago: technocentrism.	"Gadget Guy" – like image  - Video clip of Papert explaining technocentrism
	*You've experienced technocentric thinking, whether you know it or not. How many blog posts, tweets, conference sessions or professional development workshops have you seen that focus on technologies, rather than teaching?	- Animated session titles that are clearly technocentric, e.g., "50 Ways to Use Twitter" going in different directions and piling on top of each other
	*So, what's a teacher to do? If you want to learn to use technologies effectively in your teaching, how can you do this without focusing TOO much on the technologies? How can you learn to integrate technologies in CURRICULUM- and STUDENT-centered ways?	Clean screen. Multiple images of students using digital tools in different ways. (Different ages of students.)  
	*What's needed here is an approach to technology integration that emphasizes CURRICULUM and PEDAGOGY over technology. That's what this course is all about.	Clean screen. Multiple images of curriculum content (from past presentation slides) 

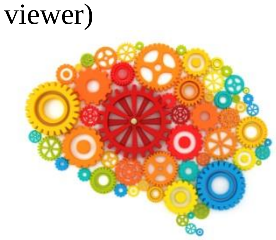
Slide#	Script	Visual(s)
	*Of course it's important to learn what technologies are available, and how to use them in your classroom, but it's much simpler and quicker to learn to USE technologies than to learn *HOW to use them with STUDENTS. So, this course WILL include technology, but will emphasize curriculum and learning.	Split screen: on left, image or muted video of software tutorial; on right, image or muted video of teacher working with students with technologies - https://www.youtube.com/watch?v=24KEMgwoHZA
	*Spoiler Alert! We argue that when planning instruction, you should choose the technologies LAST.	Graphic of "spoiler alert." Replace with: "Choose the technologies LAST."  Brief pause. Video of someone saying "WHAT?!" – changed to text because of fuzzy image
	*In this course, we will share a set of free materials that you can use to help you to plan lessons, units and projects that will integrate technologies without being technocentric. *First, we will introduce the materials and how to use them in your planning. *Then, you will have an opportunity to practice using them with some of your favorite lessons or projects. *Then, you can either create a new lesson or project OR refresh one of your existing plans to incorporate educational technologies. *And finally – last but not least – you'll choose the technologies to use in these plans. Along the way and after the course ends, you'll have unlimited access to all of the materials to download, customize, and share, plus many examples of their use in different classrooms.	Animate in a list of the modules (number and titles) with a graphic symbol for each that's also used in the module, displayed with the title (e.g. "Module 1: Introduction") and the graphic symbol on every screen in the same position. Graphics: Introduction - Compass  The LAT Approach – Jigsaw puzzle pieces partially connected  Exploring Taxonomies – Gears Brain Planning – Flowchart on glass Tech Selections – Bouquet of cables

Slide#	Script	Visual(s)
		with connectors
	*The course is organized into sequential modules. We suggest that you complete them in order. Each module will begin with a brief list of its contents. If you already have extensive experience with some of the content of a module, you may want to skip ahead to the parts that are new to you, or even skip the module all together. You can always go back to review parts of the modules as necessary. *Are you someone who likes to plan ahead? Click on the folder cleverly named “Learning First Documents” to download documents that you will be using in this short course.	 Image: Compass Video: (muted) scrolling through one of the later modules, skipping to and back from segments within the module. Image of binder with colored tabs
	*Ready? Let’s go. In the next module, you will learn about connecting content, *pedagogy, and *technology in planning. You might be tempted to skip ahead, but we encourage you to give the next module a look. It contains important ideas that you will use throughout the course. See you in Module 2.	Animated image: Content, pedagogy, and technology circles moving together, then context dotted circle at end. Then display “TPACK.”
		Underneath the video window on webpage: Include links (APA citations) to studies in two groups (limited and positive impact); download any that are public domain

Module 2: The Learning Activities Types (LAT) Approach

<table>
<tr><th>Slide#</th><th>Script</th><th>Visual(s)</th></tr>
<tr><td>1</td><td>*Ms. Jones, a middle-school social studies teacher, came back from her state educational technology conference very excited about a session on game-based learning. The presenter mentioned some research that found that *middle school students' problem-solving skills improved when they played simulation games in their history classes. *Always focused on her students' learning, Ms. Jones was inspired to try this with her class.</td><td>- Image of conference presentation with (second) text about particular problem-solving skills that improved.

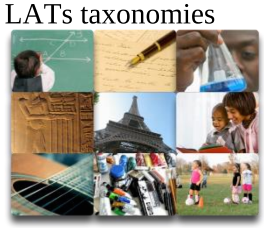
- "Ideas loading" image superimposed</td></tr>
<tr><td>2</td><td>As soon as she returned home, Ms. Jones searched on the Web for *history simulation games for her students to use. She found one that seemed like it would be engaging for them and the content was related to the social studies curriculum. She planned to introduce the game during the next week.</td><td>- Screen grab of a vaguely historical, but clearly game-based simulation
</td></tr>
<tr><td>3</td><td>*Her students were as excited about playing the game as she was. Unfortunately, as they used precious class time to play the game, Ms. Jones realized that not only were they struggling with the vocabulary; the students were focusing more on playing the game than on the historical content that Ms. Jones had hoped that they would learn. *While they clearly enjoyed the experience (and asked to play the game again in class), Ms. Jones was unsure about whether the history that they learned and the problem-solving that they experienced were worth it.</td><td>- Image of students working in groups with computers who are excited

- Image of a professional woman who is questioning or confused (superimposed upon the excited kids image)</td></tr>
<tr><td>4</td><td>*In reflecting back on this experience integrating this particular technology into her students' learning, Ms. Jones realized that she had gotten so excited about the game-based, engaging experience that the simulation provided that she hadn't fully considered how well playing the game would connect with her curriculum. *She also questioned whether the way she encouraged the students to play the game truly helped to improve their problem-solving.</td><td>- Another image of the same teacher just used in slide 3, realizing something

- Then show "Was it worth it?" added to the slide.</td></tr>
<tr><td>5</td><td>*As this scenario illustrates, even with the best intentions, it can be challenging to integrate use of educational technologies in ways that</td><td>- Image of old-school level with a bubble</td></tr>
</table>

	are well-aligned with both **curriculum goals and **teaching approaches. It’s far too easy to become technocentric when we think that our students will enjoy using a particular technology. **In this module, then, we will share a way of planning instruction that helps to ensure that technology, content, and pedagogy are balanced and fit together well.	 - Add text underneath: technology (left), curriculum goals (right), teaching approaches (center) - Level with techs appears first, then curric goals teaching approaches as we say them - As we add the text on the ends, make the level lean in that direction, then end with it level (at “ensure”)
6	*If the goal is balance among curriculum, teaching approaches, and technology use, how is this accomplished? Since 2005, educational technology researchers have been exploring this question. We have learned that there is a complex but essential type of knowledge that teachers need to be able to integrate educational technologies successfully into curriculum-based teaching. This type of knowledge is known as *“technology, pedagogy and content knowledge,” or TPACK.	- Repeat briefly the level with 3 labels image - Level image disappears. Image of brain made of gears (animated, if possible) with TPACK imposed on top of it as a second  step.
7	While the knowledge needed is complex, the concept is simple, especially for experienced teachers. *As an experienced teacher, you already know how important it is to know your curriculum. *You also know how helpful it can be to have a broad range of different teaching strategies available to draw upon so that you can reach as many students as possible. *Experienced teachers draw upon these two types of knowledge simultaneously when they plan effective instruction. The knowledge needed to align curriculum goals with appropriate teaching strategies becomes more complicated, however, when	- Still image of gears-brain with TPACK superimposed upon it. Transition type: explode (coming toward the viewer)  - As each element is discussed, make the circles appear. Tech should be underneath content and pedagogy (aligned). Circles appear separately and with colors that will mix in overlapping parts. - Illustrate PCK with circles

	we attempt to integrate use of *digital tools and resources. *And all of this happens within the complex contexts of the classroom, such as language differences, types of technology access, and school culture. *When a teacher uses all of these types of knowledge together, we say that the teacher is using TPACK. *How can teachers develop their TPACK?	overlapping when "two types of knowledge" is said. - Tech circle appears here. - Move tech circle when "…attempt to integrate…" is said - Contexts dotted circle appears here. - Animate in a largish 'TPACK' label underneath the circles.
8	*One way to do this is to introduce teachers to different technologies that can be used in their teaching. Unfortunately, this approach can be technocentric, putting too much emphasis upon finding ways to incorporate use of technologies in instruction. We have discovered another, more organic, way to help teachers to develop their TPACK: *through instructional planning.	- First image: just add a question mark to TPACK. - Image of little guy with big hammer surrounded by nails.  - Cube transition, then planning book image with "Instructional Planning" underneath it.
9	*Here's what we know about how experienced teachers plan instruction. Researchers have found that teachers' planning is focused upon curriculum-based *learning goals and objectives, and is sensitive to *students' learning needs and preferences. Also (and importantly), experienced teachers' plans are structured with a sequence of learning activities for their students. So, how can we use what we know about how teachers plan instruction to help build TPACK?	- Image of professional working on something at her  desk - Bullets: - Learning goals - Students' needs/preferences - Learning activities
10	*One way is to consider all of the different learning activities that are available within particular curriculum areas, and appropriate technologies that can enhance each.	Same slide as above Circle "learning activities" Teacher image disappears with a

	*What if any teacher could use a comprehensive list of types of learning activities and corresponding technologies to help plan effective learning experiences for their students? *There are taxonomies of these learning activity types – or LATs – freely available online that teachers around the world use in their planning. Beginning in the next module, you will have opportunities to explore these taxonomies and later learn to use them in your teaching practice. During this process, you will build your TPACK and identify effective ways to integrate technologies into your teaching and your students' learning.	cube transition. Keep circled learning activities text. Add image of a long list with nonspecific text on it - - Screen shot of LATs website 

Module 3: Exploring Taxonomies

Slide#	Script	Visual(s)
- 1	- *All lessons, units, and projects are structured by sequences of learning activities. - - - - *Watch this video and note what types of learning activities you identify. *(play video) -	- Show three puzzle pieces in a row, separated. Then animate them to fit together.  - New slide: Add video window with a blurb about content, grade level, citation link
2	*Here are the learning activities that we saw in this video. ❖ Watch a presentation ❖ Brainstorm and select issues ❖ Generate problem solutions ❖ Develop a concept map in collaborative groups ❖ Research an issue ❖ Propose a solution ❖ Discuss and develop an action plan ❖ Create a video ❖ Post videos and comment How does our list compare to yours?	- List of LATs in video
3	*Different teachers have different ways of thinking about the types of learning activities that they use in their teaching. So, your list is likely to be at least a bit different from ours.	Images of different professionals/teachers appearing on the screen at slightly different times (Find a white person thinking to insert.)
4	*It's <u>because</u> there are so many different ways to think about types of learning activities that we created the Learning Activity Types taxonomies. We worked with curriculum specialists to create taxonomies of <u>all</u> of the different types of learning activities within each curriculum area.	Brady Bunch image of different curriculum areas addressed by LATs taxonomies 
5	*We have created LATs taxonomies in nine curriculum areas to date: ❖ K-6 Literacy ❖ Secondary English/Language Arts ❖ Mathematics ❖ Science	Brady Bunch image exploded so that there is white space in-between the squares. Add text to identify the different curriculum areas as we say them.

	❖ Social Studies ❖ World Languages ❖ Physical Education ❖ Music ❖ Visual Arts *…and a taxonomy of teaching strategies to support English Language Learners. We will return to this later.	Image of a group of students from different countries. 
6	*Let's explore the taxonomies in relation to your classroom practice. To do this, we'd like you to choose one of your favorite lessons or a short-term project that your students do. We will ask you to write some notes about the essential features of this learning experience.	Image of a class actively learning  OR 
7	*On a sheet of paper or on your computer, *please list the learning goal(s) for the lesson or project. *Then list all technologies that you and your students currently use in that lesson or project.	Image of the class as a semi-transparent background. Add bullet point (as a check box) for "Note learning goals." and "Identify technologies."
8	*Find the LAT taxonomy that is most relevant to the content of the lesson or project. If there is more than one content area addressed, you may want to look at additional taxonomies at the same time.	Add to list: "Find taxonomy/ies."
9	As you review the taxonomies, *make a list of all of the LATs that are incorporated into your lesson or project in the order that they occur. Keep this list handy; we'll return to it in the next module.	"List all LATs in sequence."
10	*In the next module, we will ask you to either *refresh an existing lesson or project or *build a new one. Before moving on, please take some time to explore any of the LATs taxonomies that are of interest to you.	Two images, side-by side: Renovating a kitchen Building a kitchen Under one: "Refresh" and the other "Build." Have 10 active links to all of the taxonomies on the screen for all of modules 3 & 4.

Module 4: Planning with Learning Activity Types

Slide#	Script	Visual(s)
1	*Planning for teaching is a little like preparing to cook a meal. We can use tried and true recipes, we can try new ones that others share with us, or we can invent new dishes.	- Chef smiling at the camera
2	*As an experienced teacher, we know that you don't just follow other teachers' recipes for lessons, projects, and units. Like a chef, you might *refresh a recipe by substituting or changing ingredients or learning materials, techniques or combinations. Or you might *create an entirely new dish, but even that would be based upon your past cooking experiences.	- 2 cooking images: one that's more organized and traditional and the other messy 
3	*In this module, we will ask you to either *refresh one of your favorite lessons or short projects or *create a new one. In either case, you will have an opportunity to consider a range of different types of learning activities, and later, choose appropriate technologies for them. Please choose the option now—refresh or create--that works best for you and scroll down to find the appropriate video.	- Use images of kitchen spray painting and architectural plans for kitchen cabinets; add "Refresh" and "Create" underneath - Three videos on webpage: intro, refresh, create, R and C labeled.
		-
4	REFRESH To begin, choose a favorite lesson or short project to work with. It can be the same one that you chose in Module 3 or a new one. *Please take a moment to download and open the Refresh with LATs Guide, which will help you to keep track of your design decisions. The link appears below this video.	- Teacher thinking image (without a white background)  - Image of the Refresh Guide
5	In the Refresh with LATs Guide, *please list the learning goal(s) for your lesson or project at the top of the page. *Please pause the video while you record these in the Guide.	Have a screen shot of the Guide on-screen. Highlight first the space for the learning goals. -Replace with pause button
6	*Using the links that appear below this video, find and review the LAT taxonomy that is	- Brady Bunch image of

	most relevant to the content of the lesson or project that you are refreshing. If there is more than one content area addressed, you may want to look at additional taxonomies at the same time.	content areas  - Have links to all 10 taxonomies on screen for this module.
7	*As you review the taxonomies, find and list all of the LATs that are currently incorporated into your lesson or project in the order that they occur, in the lefthand column of the Refresh Guide. *Later, we will ask you to use a column on the right to build the refreshed version of your lesson or project. *Please pause the video while you list the existing LATs in the lefthand column.	- Back to the screen shot of the template, highlight the lefthand column first, - - - - then the righthand column. - Replace with the pause button. -
8	*To begin the refresh process, *identify one-third to one-half of the existing LATs that could be changed to other LATs. Highlight these in the Refresh Guide. *Pause the video while you do this.	- Screen shot of sample guide filled out with some highlighted (from upcoming video) - Pause button.
9	*The next step of the refresh process is to revisit the taxonomy to find other LATs that could substitute for the ones that you highlighted. We'll share an example.	- Image of a taxonomy with some LATs highlighted (from Foreign Language taxonomy)
10	* Here's a middle-school science lesson on introducing students to plate tectonics. Let's take a look at how the teacher structured the project. Afterwards, we'll consider how to refresh the learning experience with different LATs. Please watch the video and note the learning activities you see. * * Here are the learning activities that we saw in this video: Attend to presentation Take notes Observe Explore a topic Present	- Video on-screen waiting to be played. - Display list of 5 LATs all at once with a faded background of plate tectonics.

	If the teacher wanted to take more of an inquiry approach to his students' learning about plate tectonics, he could change several of the LATs listed here. * First, he could eliminate the initial presentation and instead, students could participate in an online simulation of plate movement. * This would also eliminate the need for the Observe LAT. In this refreshed version of the lesson, when students * Explore a Topic, they can extend their learning from the simulation by reading and viewing both digital and paper-based information resources about plate tectonics. To end the refreshed lesson, students could * build a physical or virtual model to demonstrate their understanding that they built.	- Draw red line through Attend to Presentation and add Participate in a Simulation to the right. - Draw a line through Observe. - Make "Explore a Topic" pulse and then return to normal text. - Draw a line through Present and add Build a Model to the right.
11	*Now it's time for YOU to find and make substitutions for the LATs that you highlighted earlier. *Please record the possible substitutions in the second column on the Refresh Guide. *Please pause this video while you do so.	- Image of the Refresh Guide with substitution LATs added in the second column (example from video) - Pause button
12	*Finally, it's time to decide which LAT substitutions make sense and sequence them accordingly. Note that when LATs are substituted, sometimes the sequence needs to be adjusted. *Please pause the video again and record the refreshed sequence of LATs in the third column, including the ones that you decided to substitute.	- Image of the Refresh Guide with substitution LATs added in the third column (example from video) - Pause button
13	*No matter how carefully a lesson or project is planned, it will not work well unless it takes into account relevant contextual factors in the classroom, school, and beyond. There are so many different contextual factors that experienced teachers incorporate into their planning that often this process is unconscious. But when using new techniques or tools, contextual factors need to be considered, at least at first.	- Make images of contextual factors (labeled) appear – TPACK contexts slide
14	*We have created several continua and a series of questions that represent some of the most important contextual considerations that can be used in instructional planning. *The	- Refresh Guide continua and questions - As we name each, highlight them in boxes

	first group includes different pedagogical decisions to consider, including students' prior experience with the learning goals, the amount of time you can allot to the experience, and student groupings. *The second group includes additional items you may wish to consider, including available resources and relevant district and school-wide initiatives. These are reproduced on the second page of the LATs Refresh Guide.	
15	*Now, considering the new sequence of LATs that describe your refreshed lesson or project, please mark the continua and respond to the prompts as needed based on the contexts of your classroom, school, and community. *Please pause the video while you do this.	- Show a completed continua and questions page from the Refresh Guide. - Pause button -
16	*Given the contextual factors that you have just noted, review the refreshed sequence of LATs to see if any adjustments to them are necessary. *Please pause the video to make any changes needed.	- Image of Refresh Guide with the third column highlighted - Pause button -
17	*So have you been wondering where the technologies are in this short course about curriculum-based technology integration? We didn't forget about them. Now that you have refreshed a specific lesson or project, and confirmed its "fit" to your students and your classroom, *it's finally time to select appropriate technologies to assist this learning experience. We'll do this in the next module.	- Image of an absent-minded professor(s) - Disappear professor(s) - Brain with gears image  -
		-
18	CREATE To begin, *please choose one or more learning goals for a lesson or short project that you will likely use with your students in the future. *Please take a moment to download and open the Create with LATs Guide, which will help you to keep track of your design decisions. The link appears below this video.	- Teacher thinking image (without a white background)  - - Image of the Create Guide
19	*In the Create with LATs Guide, please list the learning goal(s) for your lesson or project at the top of the page. *Please pause the video while you record these in the Guide.	Have a screen shot of the Guide on-screen. Highlight first the space for the learning goals. - -Replace with pause button -
20	*Using the links that appear below this video,	- Brady Bunch image of

	find and review the LATs taxonomy that is most relevant to the content of the lesson or project that you are creating. If there is more than one content area addressed, you may want to look at additional taxonomies at the same time.	content areas  - Have links to all 10 taxonomies on screen for this module.
21	*As you review the taxonomies, list all of the LATs that could reasonably be incorporated into a lesson or project with the learning goals that you specified. *Please write these in the first column of the Create Guide. Please note that you probably won't use all of these LATs in the final version of this plan. Later, we will ask you to use a *column on the right to build the final version of your lesson or project. *Please pause the video while you list the possible LATs in the first column.	- Image of a taxonomy with some LATs rows highlighted - - Back to the screen shot of the template, highlight the first column first, - then the third column. - Replace with the pause button.
22	*The next step will be to narrow the possible LATs into the ones that will structure the new lesson or project. Here's an example of how you might decide which LATs to eliminate and which to keep.	- Screen shot of sample guide filled out with some crossed out (from upcoming slides)
23	*Consider for example, a lesson focused on helping students to identify the goals and key features of the thirteen original American colonies. *Here are several knowledge building activities from the social studies taxonomy that could help students to meet these learning goals. One way to select the best LATs for a lesson, project, or unit is to eliminate those that don't fit as well. To begin, we suggest that you focus on the lesson's content. Which of the possible LATs that you identified don't match the content focus that well? For example, because the 13 original American colonies were founded in the 17th and 18th centuries, there are no audio recordings created at that time available to use in the lesson, *so it makes sense to eliminate the "listen to audio" LAT.	-

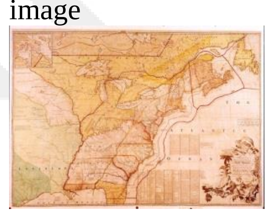
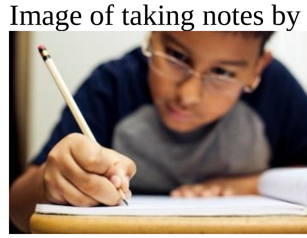
	Note that the content of this learning goal is conceptualized at an introductory level. Games and simulations often require more background knowledge than this learning goal represents. *Therefore, the game or simulation LATs would not be appropriate choices for this particular learning goal. Finally, given the early American history focus of the learning goal, *it makes sense to eliminate the conduct-an-interview LAT, unless early American historians are available for the students to interview. The number of possible learning activities on your list can be further reduced by considering the types of learning that you want your students to experience. If you are seeking to help them to be more self-directed in their learning, you might consider *eliminating having them view a didactic presentation. You might also *consider eliminating a compare/contrast LAT that is similarly teacher-directed.	
24	*Please pause the video and choose the LATs from your list that will structure your new lesson or project. Add them to the second column in the Create Guide.	- Image of the Create Guide with narrowed LATs added in the second column (example from video) - Pause button
25	*The final step (for now) is to sequence the LATs that you've chosen. *Please pause the video, then add the LATs to the third column in the sequence that will best assist your students' learning.	- Image of the Create Guide with sequenced LATs added in the third column (example from video) - Pause button -
26	*No matter how carefully a lesson or project is planned, it will not work well unless it takes into account relevant contextual factors in the classroom, school, and beyond. There are so many different contextual factors that experienced teachers incorporate into their planning that often this process is unconscious. But when using new techniques or tools, contextual factors need to be considered, at least at first.	- Make images of contextual factors (labeled) appear – TPACK contexts slide
27	*We have created several continua and a series of questions that represent some of the most important contextual considerations that can be used in instructional planning. * The	- Create Guide continua and questions - -

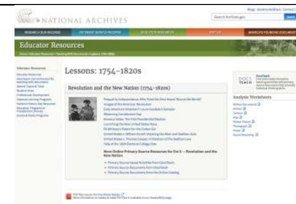
	first group includes different pedagogical decisions to consider, including students' prior experience with the learning goals, the amount of time you can allot to the experience, and student groupings. *The second group includes additional items you may wish to consider, including available resources and relevant district and school-wide initiatives. These are reproduced on the second page of the LATs Refresh Guide.	- As we name each, highlight them in boxes
28	*Now, considering the sequence of LATs that describe your new lesson or project, please mark the continua and respond to the questions as needed based on the contexts of your classroom, school, and community. *Please pause the video while you do this.	- Show a completed continua and questions page from the Create Guide. - Pause button -
29	*Given the contextual factors that you have just noted, review the sequence of LATs to see if any adjustments to them are necessary. *Please pause the video to make any changes needed.	- Image of Create Guide with the third column highlighted - Pause button -
30	*So have you been wondering where the technologies are in this short course about curriculum-based technology integration? We didn't forget about them. *Now that you have created a new lesson or project, and confirmed its "fit" to your students and your classroom, it's finally time to select appropriate technologies to assist this learning experience. We'll do this in the next module.	- Image of an absent-minded professor(s) - Disappear professor(s) - Brain with gears image 

Module 5: Technology Selections

Slide#	Script	Visual(s)
1	*We know that you've been waiting a long time to get to the technology part of this short course. It's finally time to choose the tools. *Remember this little fellow from module 1? To someone with a new hammer, everything looks like a nail. We have purposely waited until now to introduce technology selections, after learning goals and activities have been determined. We did this so that we're not making the technocentric mistake of finding ways to use technologies, instead of using them in ways that will best support students' learning. *This is why suggestions for different educational technologies are listed for each type of learning activity in the taxonomies. It's important to select and sequence the LATs first according to learning goals, and then select corresponding technologies that will best support the goals with LATs.	- Image of teacher rolling her eyes or looking exasperated  - Guy with hammer surrounded by nails  - Image of stepping stones
2	*Review the sequence of LATs that you created and recorded in the third column of your Refresh or Create Guide. Revisit the taxonomy or taxonomies from which you selected these LATs. *Consider the recommended technologies listed for each of the LATs that you incorporated into your sequence. *Please pause the video while you review the technology suggestions in the taxonomy.	-Image of third column of sample R or C Guide highlighted - Image of corresponding taxonomy with LATs highlighted - Image of the same taxonomy with the techs column highlighted -Pause image 

3	*Please note that the technologies suggested for each learning activity type in the taxonomies are not meant to be exhaustive lists. Instead, we hope that they will provide you with ideas for the types of tools and resources that may be available in your school. You probably will not (in fact, probably should not) select a technology to support **each** LAT within your plan. Sometimes, for some learning goals and LATs, using non-digital tools and resources is more efficient and effective. *If there are tools listed in the taxonomies that are not familiar to you, please consider clicking on the links provided to learn more about them. While you are exploring the tools, you may realize that one or more are not the best fit for your plan. *Please list the technologies that you're considering using in your plan in the fourth column of your Refresh or Create Guide. Try to align each with its corresponding LAT. *Please pause the video while you do this.	Picture of teacher thinking - Screen shot from website  - Show image of 3rd & 4th columns with techs and LATs aligned -Pause image
4	Once you have some technological options recorded, it's time to make selections. Consider the *relative advantage and *fit of each tool in your plan. To what extent does using a particular tool add more value to a learning experience for students than using a different tool? Also, which tools' characteristics "fit" best what you want your students to do during the lesson or project that you're planning? *Your colleagues may be helpful in talking through the challenges and opportunities of different technological options.	- Image of art tools and lines that they're painting - Superimpose "relative advantage" and "fit" onto the image, added as we say the two questions. - Image of group of colleagues talking 
5	*Let's look at an example. If you chose the Create option for module 4, you'll recognize this.	- Image of Colonial American flag

	*In a social studies project about the key features of the 13 American colonies, the students first view teacher-selected images of life in the 13 colonies. They then read maps and charts along with text excerpts that the teacher selected. At each of these points, students are prompted to take notes. Finally, they consider the evidence they have selected to identify the purposes and key features of each of the 13 colonies. There were a number of technology possibilities to consider for each of these LATs. *In the View Images activity, presentation software was used to show the students several high-quality images of historical drawings and paintings. This was intended to challenge some of their previously held assumptions. *During the Read Maps activity, students did access digital resources. This was because the teacher realized the relative advantage of using curated historical Web sites. These sites offered the most illustrative and understandable maps for the lesson. *The students read text as they researched the purposes and key features of the colonies. While texts were available digitally, for efficiency, the students used their social studies textbooks, supplemented with photocopied paper documents. *During the lesson, students took notes in their paper notebooks, rather than with digital tools. In this example, the students used an analog tool instead because not all of them had easy access to a laptop, tablet or other digital device. *In the Consider Evidence activity, the students were challenged to find primary source documents that represent multiple perspectives and viewpoints. A digital archive can help make this process of locating documents more authentic, but	 - Chart of LATs and corresponding technologies for this project - Use animations from previous slides. Chart that changes on the left, with images of students doing what is described on the right. - Need: presentation image - Need: historical map image  - Need: read text images  - Image of taking notes by hand  - Need: primary source documents (e.g., National Archives)

	still efficient enough for the students to use as part of their learning in the classroom.	
6	*As this example demonstrates, choices of analog and/or digital tools are dependent on many factors. As you consider different technology possibilities, you can use a simple self-test to help you to decide which types of tools and resources to use in your plan. We call it the "Is It Worth It?" test. Ask yourself three questions about each tool that you are considering: • *Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it? • *Will this tool or resource help students to do something in a better way? • *Is the use of this tool or resource feasible, given contextual conditions? If your answers to all of these questions are "no," then the technology choices should be reconsidered. If one or two of the answers is "no," then reconsideration may be necessary.	Image of "is it worth it?" question  Add: Necessary? Better? Practical? (Put these with the longer questions at the bottom of the second page of the Refresh and Create Guides.)
7	*Using what you've realized using the Is It Worth It? test, please finalize your selections of the specific tools and resources that you plan to incorporate in your plan. *Please pause the video while you note these selections in your Guide.	- Show moving image of deleting or changing some tech possibilities, with a list remaining.

8	*In this course, you have learned: • why technocentric approaches to using technology in your teaching don't work. • how to plan for students' learning using curriculum-based learning activity types (LATs). • to refresh an existing lesson or project, or create a new one, using the LATs approach. • how to purposefully select educational technologies to support students' learning with the refreshed or new plan. *We hope that completing these modules has helped you to know how to integrate technologies effectively into curriculum-based lessons and projects. *Now please take a moment to reflect on what you will take away from this short course. What are the most important ideas that you will incorporate in your practice? If we had to choose, we would emphasize *fit, *balance, and *choosing technologies last. *Remember, as we said in module 1: "Good technology integration ISN'T really about technology." *In the end, it's all about your students' learning.	- Title of short course at top. Add these images on separate slides, with title remaining at top of screen: 1. Image of guy with hammer 2. Image of gears brain 3. Image of smiling chef 4. Image of "is it worth it?" Clear screen except for title. Add three images from SITE 2017 slides, labeled, one at a time. - Wipe screen except for the title. Add image of learners of all ages

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