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PRE-SERVICE PRIMARY TEACHERS' TPACK IMPROVEMENT THROUGH LISTENING ACTIVITIES: DESIGN, OBSERVE AND EVALUATE

Nilgün GÜNBAŞ
Faculty of Education, Kafkas University, Kars, Turkey
ORCID: https://orcid.org/0000-0003-2578-3083
ng2248@tc.columbia.edu

Meral GÖZÜKÜÇÜK
Faculty of Education, Manisa Celal Bayar University, Manisa, Turkey
ORCID: https://orcid.org/0000-0002-1620-5073
meralyaprak@gmail.com

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Abstract

Pre-service teachers are mostly trained with traditional methods in their institutions and as a result, they do not become competent in technology integration in education. To successfully integrate technology in education, it is necessary for teachers to have knowledge of the content and the pedagogical techniques to teach this content with technology (TPACK). The purpose of this study was to contribute to pre-service primary school teachers' TPACK. For this purpose, the content was selected as listening, the most ignored skill taught in language education. In a qualitative framework, a case study approach was utilized. Eight pre-service primary teachers were selected with convenience sampling from a public university in Turkey. For eight weeks, the pre-service teachers learned block-based visual programming and designed visual and audio listening texts in pairs. Their projects were undertaken with fourth grade students, and they observed the students' interactions with these projects. Upon the completion of this process, a semi-structured interview form, prepared by the researchers, was used to gather the pre-service teachers' views. Results showed that they increased their technological pedagogical content knowledge in the TPACK framework. They also developed a better sense of entertaining, active, and individual learning environments.

Keywords: TPACK, design-based activities, listening, pre-service primary teachers, teacher education

INTRODUCTION

Technology has become an indispensable component in the education field. As the implementers of technology in education, teachers' beliefs, attitudes, goals, will, and knowledge in technology are highly related with successful technology integration (Chen, Looi & Chen, 2009; Sang, Valcke, Van Braak & Tondeur, 2010; Vitanova, Atanasova-Pachemska, Iliev & Pachemska, 2015; Farjon, Smits & Voogt, 2019). However, when teachers' knowledge, attitudes, motivation, and skills towards technology are not at an adequate level, technology integration may not be successfully ensured (Malinina, 2015). Teachers' lack of training and skills impedes their effective use of technology (Alghasab, Alfadley & Aladwani, 2020). Their capability to use technology positively affects their technology integration (Instefjord & Munthe, 2017). Teachers' confidence with technology helps both their teaching and their students' learning (Lehiste, 2015). Before starting their professions as teachers, pre-service teachers need to receive training in technology at teacher education institutions. However, teacher education institutions do not take the advantage of technology and are inactive in this regard (Grudin, 2018), and teacher educators struggle with successful technology integration (Voogt & McKenney, 2017). Pre-service teachers need role models for technology use such as teacher educators (Tondeur, Scherer, Siddiq & Baran, 2020) and need training on technology to be included in their instruction (Instefjord & Munthe, 2017).

The International Society for Technology in Education (ISTE) (2008) standards recommend that teachers "design, develop and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context" (p. 1). Pre-service teachers' designing of technology-integrated lessons and educational instruments improves their level of technology competence along with their beliefs in technology in education (Lee & Lee, 2014; Chien, Chang, Yeh & Chang, 2012; Munday, Windham & Stamper, 1991). Teachers' self-efficacy has a positive impact on their technology integration in classrooms (Koh, 2011). Teachers' evaluation of technology-based learning environments (Kim, Xie & Cheng, 2017) requires them to have high technology self-efficacy.

Teachers who believe in the benefits of technology for students' learning are confident about their technology skills. These teachers are also the ones with the highest technological pedagogical content knowledge (TPACK) (Saubern, Urbach, Koehler & Philips, 2020). Moreover, teachers' TPACK affects their technology integration in education (Raygan & Moradkhani, 2020). TPACK necessitates teachers to have content knowledge, and pedagogical techniques to teach this content with technology's possibilities (Mishra & Koehler, 2006). TPACK does not consider content, pedagogy, and technology separately, but rather, interactions among these three components are necessary (Koehler & Mishra, 2009). Technology is used to design, implement, and evaluate instruction in the TPACK framework (Niess, 2011). Thus, teachers' knowledge improvement in technology is required to meet this necessity, and it can be gained in higher education institutions while they are in their pre-service years. Pre-service teachers who receive support in their teacher training institutions have strong self-efficacy, attitude and TPACK (Tondeur, Scherer, Siddiq & Baran, 2017). Yet pre-service teachers mostly fall behind in technology-related areas (Valtonen et al., 2017). For this reason, teacher education programs must educate student teachers for technology-integrated teaching environments (Zinger, Tate & Warschauer, 2018). Hereby, the need for successful implementation of technological practices can be fulfilled.

It is required for pre-service teachers to combine different knowledge types in their future profession (Ekmekçi, 2018), such as content, pedagogy, and technology (TPACK). The current study was conducted to contribute to pre-service primary teachers' TPACK. To achieve this goal, we selected *listening*, which is the most ignored language skill taught (Emiroğlu & Pinar, 2013; Tuzel & Keles, 2013; Sejdiu, 2017). To the best of our knowledge, only a small number of studies have worked on the listening subject in the TPACK framework. Designing technology-based learning activities, collaboratively working with peers, applying their knowledge in real classroom settings, having field experiences, and receiving continuous feedback have been suggested for improving pre-service teachers' TPACK (Dawson, 2007; Tondeur, Scherer, Siddiq & Baran, 2020). In this study, these recommendations were put into practice in the listening subject.

Based on the related literature, the research question is "What do pre-service primary teachers' designing, observing, and evaluating of TPACK activities tell us about their TPACK improvement?"

LITERATURE REVIEW

Technological pedagogical content knowledge (TPACK)

Teacher's' knowledge should include the following: "Content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners and their characteristics, knowledge of educational contexts, and knowledge of educational ends, purposes, and values, and their philosophical and historical grounds" (Shulman (1987, p.8). From this list, Shulman (1987) underlined pedagogical content knowledge (PCK), in which content and pedagogy are combined to understand the arrangement of special topics and issues for learners with various interests and potentials, and are presented for instruction. PCK includes classroom management and organization and their combinations of teachers' knowledge, and it differentiates expert teachers from novice teachers. Teaching does not simply enhance students' understanding but it includes teachers having pedagogical content knowledge, the combination of knowing what to teach and how to teach (Shulman, 1987). Mishra and Koehler (2006) have added another component, technological knowledge, to Shulman's pedagogical content knowledge framework, in which technology has been coming to the

forefront. They included the technology component in the pedagogical content knowledge in their framework. The three components of TPACK are content, pedagogy and technology (Koehler, Mishra & Cain, 2013). Teachers' TPACK is formed based on the interactions among these three components. Specifically, teachers' technological pedagogical knowledge (TPK), pedagogical content knowledge (PCK), technological content knowledge (TCK), and TPACK are argued to be equally important.

TPACK has become an important model to understand whether teachers use technology successfully in teaching content supported with pedagogy (Sofyan et al., 2023). Saubern, Urbach, Koehler and Philips (2020) determined five levels of TPACK proficiencies for teachers. Teachers with the lowest level of TPACK proficiency have little or no confidence that they have the skill to assist students' learning with technology. Teachers with the middle level of TPACK proficiency are very confident that they have the skill to teach content by using technology. Teachers with the highest level of TPACK proficiency are extremely confident that their skills are enough to support students' deep learning by using technology. Teachers at this level believe that technology is extremely useful. As a result, teachers with the highest level of TPACK proficiency believe more in supporting students' deep learning by using technology than any other group of teachers.

Several strategies exist to improve pre-service teachers' TPACK (Tondeur, Scherer, Siddiq & Baran, 2020). First, teacher educators should be a role model in their classes. Second, pre-service teachers should discuss the roles, advantages and disadvantages of technology use. Third, they should design learning materials with technology to learn technology integration. Fourth, they should work together with their peers to create technology-based materials. Fifth, they need to apply their TPACK in a classroom environment. Finally, they need to be provided with continuous feedback on their understanding of TPACK. Using the strategies above, the present study provided a learning environment to improve pre-service teachers' TPACK. This aim was put into practice by having pre-service teachers design technology-based language materials in collaboration with their peers, trial these materials in classroom settings, and receive feedback during the whole process.

Hypermedia, multimedia, and communication media have been shown to be useful for teaching a language. However, language pedagogy combined with technology (Hoopingarner, 2009) and teachers' competency in creating such technology (Derewianka, 2003) are necessary. Audio-visual aids help students to effectively acquire language-related skills (Mathew & Alidmat, 2013). Moreover, such aids can be beneficial for both teachers' teaching and learners' learning of language-related skills (Al Mamun, 2014; Asadi & Berimani, 2015). Animated learning activities including audio-visual aids can be an alternative for teaching language skills. Some research even indicates that when teachers design animated activities for teaching, their attitude towards technology improves (Erümit, 2020). Thus, pre-service primary teachers in this study designed animated learning environments to improve their technology attitudes. They used static and animated visuals, which were representative of the listening texts, and story characters with audio-visual aids to design their stories. They specifically used a block-based visual programming language to create their listening activities.

Elementary school teachers, who rated themselves on their level of TPACK, had lower self-efficacy in terms of selecting and making use of appropriate technology to teach their content than secondary school teachers. Their self-evaluation for technological content knowledge (TCK) had the lowest score (Lehiste, 2015). In this respect, an improvement is needed especially in their pre-service education years. Pre-service teachers must develop both their TPACK and the pedagogical reasoning behind using technology in education (Voogt et al., 2018). In this sense, to strengthen their pedagogical views on technology integration, they should witness teachers using technology in classrooms. Classroom experiences are helpful specifically for pre-service teachers to gain familiarity in terms of the connections among technology, pedagogy, and content. Pre-service teachers can plan and implement technology-based courses with the support of these experiences (Mouza & Karchmer-Klein, 2013). Pre-service teachers' participation in technologically enriched classroom experiences while taking an educational technology course may increase their awareness of technology use in educational settings (Lux & Lux, 2015). Teachers' classroom experiences affect their educational beliefs and knowledge,

and vice versa (Levin & Wadmany, 2006). Improvement in beliefs and knowledge in technology is highly related to technology integration (Chen, Looi & Chen, 2009; Sang, Valcke, Van Braak & Tondeur, 2010; Munawar & Nasreen, 2022), which brings about pedagogical change in classrooms (Heath, 2017).

In language teaching, very limited amount of research in TPACK has been found in the literature. These studies focus on foreign language teaching (Aisyah, Setiawan & Munir, 2021; Baser, Kopcha & Ozden, 2016; Erten, 2022) or oral communication skills in second language teaching (Debbagh & Jones, 2018). Pre-service teachers receive training in creating technology-based language learning environments, such as augmented reality, to improve their TPACK (Belda-Medina & Calvo-Ferrer, 2022) in these studies. Native language teaching in a TPACK framework for pre-service teachers (Cheng, 2017) is very limited. In this study we selected language as the content in the TPACK framework. As one of the language skills, listening skill is important (Hoopingarner, 2009), yet teaching of listening skill is mostly ignored (Sejdiu, 2017; Tuzel & Keles, 2013). To the best of our knowledge, only a small number of studies looked at English language teachers' level of TPACK in teaching listening skills, and these found that teachers' level of TPACK was very low (Alnajjar & Al-Jamal, 2019; Rustanto, Nur & Mitriana, 2020). In these studies, teachers were either observed in their classrooms on TPACK or given surveys to obtain a better understanding about their TPACK level. None of these studies trained teachers or pre-service teachers to improve their TPACK in listening content. As a result, it is necessary to conduct studies training pre-service teachers to improve their TPACK by taking listening as the content.

This study aimed to advance pre-service primary teachers' TPACK in language teaching. We specifically wanted to fulfill this purpose with the technological instruments they created to give them a sense of ownership of the learning environment. In this regard, they learned about designing pre-, while- and post-listening activities based on the fourth-grade level within the scope of content knowledge. They designed these activities with technology to gain technological knowledge. While designing these technological materials, they focused on how students learn within the scope of pedagogical knowledge. As a result, all the three components of TPACK (i.e., technology, pedagogy, and content) were combined. During this process, they received continuous feedback from the researchers. Their technological materials were then trialed with fourth grade students in their classrooms. The research question in this study was "What do pre-service primary teachers' designing, observing, and evaluating of TPACK activities tell us about their TPACK improvement?"

METHOD

Research model

In colleges of education, student teachers receive training in their content areas. During this education, they are mostly trained with traditional methods. Although pre-service teachers' educators should be role models in technology use (Tondeur, Scherer, Siddiq & Baran, 2020), teacher educators already struggle with productive technology use and technology integration (Voogt & McKenney, 2017). Instructors mostly use technology to continue their traditional teaching methods, rather than using technology as a replacement for traditional teaching tools or supporting existing practices (Cuban, 2001). This situation might be a result of the educators' lack of knowledge or attitudes towards the use of technology. Even if pre-service teachers may feel comfortable with technological tools, they are not capable of successfully integrating technology in education (Martin, 2018). Accordingly, student teachers are unaware of the effect of technology in education.

We observed that in their classroom presentations and assignments during their education in college, pre-service teachers rarely or unsuccessfully take advantage of technology. For this reason, we wanted to provide the pre-service teachers with a learning environment to develop technology-based listening materials and witness students' learning with technology in classroom environments. With this purpose, a case study approach was utilized in this study. A case study describes and investigates a system and focuses on a case, program, or fact in detail (Merriam, 2009). It is based on real events, takes a phenomenon into account, and presents a variety of perspectives. According to Merriam (2009), a theoretical framework must be placed in qualitative research and be the basis of all studies, although

many claim the opposite. In this respect, we took the TPACK framework into account when designing our study. Using a case study approach, we trained pre-service primary teachers to improve their TPACK.

Procedure

The pre-service teachers received training utilizing the TPACK framework throughout an eight-week study period. In the TPACK framework, in the scope of content knowledge they first learned how to teach fourth grade students' listening skill, which is one of the language skills. This training was completed in a Language Teaching course. They learned how to design pre-, while- and post-listening activities in the fourth-grade level. In the scope of pedagogy content of the TPACK framework, they learned how students learn with the most appropriate strategies. In the scope of technology content, they learned how to design technology-based listening materials with the use of visuals, sounds and animated objects to support students' learning. This whole training period was completed concurrently to better support pre-service teachers' TPACK. They designed technology-based listening texts, which were then undertaken with students. Upon the completion of the training period, fourth grade students completed these listening activities in an individual learning environment, where pre-service teachers observed the students' learning activity. The researchers also observed the learning experiences of the pre-service teachers. Their views were then gathered with open-ended interview questions. The study procedure can be summarized as below:

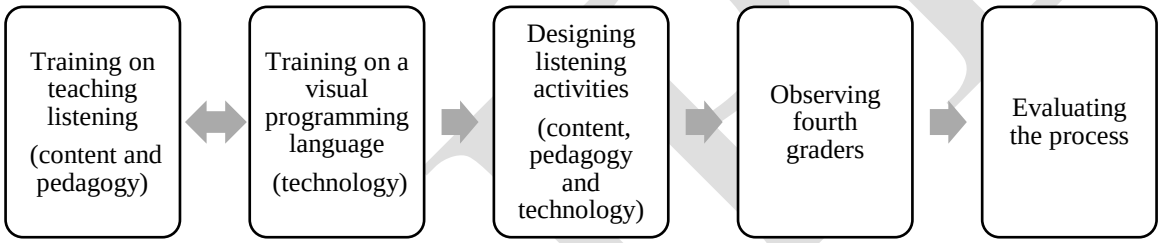

Figure 1. The procedure of the study

Participants

The pre-service teachers (n = 8) were in their third year at the Department of Primary Education in a public university. We used convenience sampling to select the participants attending the university where the research was conducted. The participants were selected on a volunteer basis. The pre-service teachers took the Turkish Language Teaching course for the very first time. Accordingly, learning how to teach listening using appropriate pedagogical methods was a very new concept for them. Also, they received training in designing technological materials for the first time. As a result, their TPACK level was expected to be very low. Their names are not disclosed in the study. They are instead named PTs (an abbreviation of pre-service teachers). Their demographic information is as follows:

Table 1. Demographic information of the participants

Variables	Categories	n	%
Gender	Female	3	37.5%
	Male	5	62.5%
GPA	2.00 – 2.49	-	-
	2.50 – 2.99	4	50%
	3.00 – 3.49	4	50%
	3.50 – 4.00	-	-
Perceived technology confidence level	Very poor	-	-
	Poor	-	-
	Neither poor nor good	4	50%
	Good	4	50%
	Very good	-	-

Training

The training and designing of the projects were completed in eight weeks. During this eight-week period, the pre-service teachers took the Language Teaching course from one of the researchers who is an expert in language teaching. In this course, they learned how to teach listening skills to primary school students along with pedagogical methods. To help them design their technology-based listening materials, the pre-service teachers were taught block-based visual programming by one of the researchers who is an expert in programming and instructional technology. In the eight-week long training process, the pre-service teachers learned the basics of the programming language and completed small homework assignments based on what was covered in each class. They then built their technology-based listening activities with visual block-based programming for fourth grade students. The listening texts were chosen from a textbook prepared by the Ministry of National Education (MNE, 2015). During their creation of the digital listening material, we provided help and feedback on their projects. Upon the completion of their projects, the projects were checked and edited for content, workability and appropriateness issues and then trialed with fourth grade students.

Materials

Technology-based listening materials

The pre-service teachers designed listening activities with a visual block-based programming language. For this, they created pre-, while- and post-listening activities including static and animated visuals illustrating the listening texts. The while-listening activities included not only animated and static pictures but also pre-service teachers' voice recordings of the texts. An animated character asked text-related questions and an answer button was provided for students to respond to these questions in the pre- and post-listening activities. In these activities, by considering its positive outcomes for learning (Hattie & Timperley, 2007; Pérez-Segura, Sánchez Ruiz, González-Calero & Cózar-Gutiérrez, 2020; Wisniewski, Zierer & Hattie, 2020), each listening activity included individual feedback for students.

Interview form

The researchers prepared a semi-structured interview form to gather the pre-service teachers' views about the process. This form included items related to participants' demographic information and open-ended interview questions revealing their views about the process: Their genders, ages, GPAs etc., their experiences with designing listening activities, the implementation of the activities, their evaluation of the projects, and their future project plans. Before administering this form to participants, the views of two experts in the field of language and instructional technology were obtained on the questions used in the form. Based on the views of the experts, the form was given its final shape.

Data analysis

The findings from the interview questions were analyzed with descriptive analysis. For this, two individual coders created codes, categories, and themes. The themes were grouped under "training in coding", "implementation", and "evaluation and future projects". We calculated the inter-rater reliability between coders with the formula suggested by Miles and Huberman (1994): "Number of Agreements / (Number of Agreements + Disagreements)". The reliability score was .85.

RESULTS

The pre-service teachers designed their own technology-based listening materials for fourth grade students in this study. They were trained on campus with block-based visual programming to create their listening materials, which were administered to the students. The aim was to enhance the TPACK of pre-service teachers and give them a better understanding of how technology is used in classrooms. In the TPACK framework, they were trained in content, pedagogy, and technology in this study. Initially, they learned about teaching listening skills consisting of pre-, while- and post-listening activities. For these activities, they learned about pre-listening activities (e.g., guessing the content of a text from the visuals), while-listening activities (e.g., predicting the remaining events of a listening text after pausing at some parts) and post-listening activities (e.g., answering text-related questions). Then, they learned how fourth grade students learn with effective teaching strategies (e.g., drawing students'

attention to learning activities for educational purposes). Finally, they learned about designing technology-based listening activities to improve their technological knowledge (e.g., computer programming, selecting, creating, and using static and animated visuals, and adding sounds). As a result, they combined their skills within this framework to create their technology-based listening activities. These activities were then trialed with fourth grade students. In classroom settings, the pre-service teachers observed the students interacting with the listening materials. At the end of the process, we interviewed the pre-service teachers. The results are summarized in the following tables.

Theme 1: Training in Coding

Table 2. Pre-service teachers' positive and negative thoughts about the coding training

THEME: TRAINING IN CODING		
1st Category	**Codes**	**PT#**
	Entertaining learning	PT3, PT6, PT7, PT8
	Technology-age appropriateness	PT1, PT8
	Technology competency	PT2, PT5
	Concretization	PT4, PT6
Positive	Being active	PT1
Thoughts	Practical/Creative thinking skills	PT2
	Easily applicable	PT8
	Experience	PT3
	Feedback	PT7
	Motivation	PT7
	No negative thoughts	PT3, PT5, PT8
	Must be improved	PT1
Negative	Coding error	PT2
Thoughts	May take teachers' role	PT4
	Technological issues	PT6
	Time-consuming	PT7

Some of the pre-service teachers' positive thoughts about the training in coding were entertaining learning, technology-age appropriateness, increasing technology competence, and concretization. Based on this, some of the quotes from the interviews were as follows:

> PT1: Coding is a must for technology-age children. It is helpful for those whose aim is to produce knowledge, to be more active.
>
> PT2: Thanks to the coding training, I learned how to use computers better. Most importantly, I gained new skills in practical and creative thinking.
>
> PT4: It is a new and interactive way to reflect the imagination in a virtual world.
>
> PT7: It was very good that the students obtained feedback by directly interacting with the listening texts. The best part of it was that they were entertained and they learned.

Their negative thoughts about the training in coding were that it must be improved, coding errors were difficult to handle, and it decreased the value of professional worth. However, three pre-service teachers thought that there was no negative side to this training. Based on this, some of the quotes from the interviews were as follows:

> PT1: It is necessary to improve block-based visual programming and make better use of it.
>
> PT2: We struggled with having coding errors at the very beginning.
>
> PT6: I think it will be a problem if we don't have enough computers when we apply it to our students.
>
> PT8: I have no negative thoughts. Everything I acquired from the coding training was very effective and good.

Table 3. Pre-service teachers' thoughts about individual and professional contributions

THEME: TRAINING IN CODING		
2nd Category	**Codes**	**PT#**
Individual Contributions	Develops creativity	PT4, PT8
	Coding skills qualification	PT3
	Learnt to be patient	PT5
	Increasing technology use skills	PT6
Professional Contributions	Entertaining education	PT5, PT6, PT7, PT8
	Coloring my professional life	PT1, PT8
	Computer-based learning	PT1
	Getting to know students	PT2
	Individual teaching	PT4

The pre-service teachers' thoughts about the individual and professional contributions of the training were that it develops creativity, supports entertaining education, helps in getting to know students and improves coding skills. Based on this, some of the quotes from the interviews were as follows:

> PT3: The training has especially contributed a lot to my profession. I can share this knowledge with the people around and design good activities with my students. This knowledge may give me the opportunity to implement much better-quality education.
>
> PT4: Coding is a field where I can entertain myself and develop my creativity. Professionally, it can effectively support my students' individual learning.
>
> PT5: I think it contributed a lot both individually and professionally. We learned a lot from the coding training. First, we worked very hard and learned how to be patient. We can make our learning activities entertaining thanks to the training we received.
>
> PT6: Thanks to the training, I can teach classes in an entertaining way. Individually, I have started taking advantage of technology better.

Theme 2: Implementation

Table 4. Pre-service teachers' feelings during implementation

THEME: IMPLEMENTATION		
3rd Category	**Codes**	**PT#**
Feelings during implementation	Happiness	(PT2, PT3, PT4, PT5, PT6)
	Excitement	(PT4, PT5, PT6, PT8)
	Sense of professional worth	(PT1, PT7)
	It feels great	(PT1)
	Tiring	(PT3)
	Proud	(PT4)

We asked the pre-service teachers what they felt when their projects were put into practice. Most of them said they were happy and excited. Some of their comments were as follows:

> PT1: It was a great feeling for me. I realized that what I was doing was very precious after receiving positive comments from the students. I hope I'll experience similar feelings when I become a teacher.
>
> PT3: It was a long and tiring process to prepare the projects. However, after seeing that the students completed the tasks with joy, we became happy.
>
> PT5: We were very excited when the students completed our projects because we had worked very hard. Seeing the students' excitement and happiness made us happy.

Table 5. Pre-service teachers' thoughts about the benefits of the implementation for students

THEME: IMPLEMENTATION		
4th Category	**Codes**	**PT#**
Benefits	Active learning	PT1, PT2, PT4
	Individual learning	PT1, PT7, PT8
	Better comprehension	PT2, PT5, PT8
	Learning with technology	PT3, PT4, PT6
	Enjoying the activities	PT3, PT5, PT6
	Contributing to the imagination	PT3
	Out of routine	PT6
	Permanent learning	PT7

The pre-service teachers observed students during the implementation process of their projects. According to their comments, the benefits of this practice were as follows:

> PT2: It is definitely a very useful activity because students become more active and comprehend the listening texts better.
>
> PT6: I certainly think that it is beneficial for students. It provides students with an out-of-routine learning activity. Students enjoy the activities in an untraditional learning environment. Moreover, we will be engaging with technology more and I think this is important.
>
> PT7: I think that the students learned willingly in an individual learning environment. Since they interacted with technology in an interactive learning process, learning can be permanent.
>
> PT8: I think it is useful for students. Because they answer questions from what they have listened to individually, it will increase their learning and success levels.

Table 6. Pre-service teachers' thoughts about the most impressive experience during the implementation

THEME: IMPLEMENTATION		
5th Category	**Codes**	**PT#**
The most impressive experience	Students' excitement/happiness	PT3, PT6, PT7, PT8
	Students' admiration	PT2, PT6
	Students' wish to recomplete the activities	PT2, PT8
	Students not familiar with computers	PT4
	Students' interest in technology	PT5
	Figure, music, and speech synchronization	PT1

The impressions of the pre-service teachers during the implementation process were students' excitement and happiness, how they admired the listening materials, their "Can I do it again?" questions, and a student with autism who also benefited from this learning environment. Based on this, some of the comments were as follows:

> PT1: Block-based visual programming provides visual, music and speech work together. It impressed me that all these things worked mutually for the students' learning.
>
> PT8: I observed that the students enjoyed it and became excited when working on our projects, responded to the questions carefully, and were willing to recomplete the activities.

Theme 3: Evaluation and Future Projects

We asked the pre-service teachers which one of the projects other than theirs was the most effective and why. Our reason for this was to learn how they would evaluate a good project under the same conditions as for those who are the creators of a technology-based teaching environment.

Table 7. Peers' project evaluation

THEME: EVALUATION AND FUTURE PROJECTS		
6th Category	**Codes**	**PT#**
Peers' project evaluation	Visuals	PT2, PT6, PT8
	Animations	PT2, PT3
	Reflecting the text into coding	PT4, PT5
	Entertaining	PT6
	Extensive activity	PT8
	Concretization	PT1
	Gamification	PT2

Their comments were as follows:

> PT2: It was rich in terms of visuals and animations. The exercises were prepared in a game format.
>
> PT4: Everything was in detail. The text was very well reflected in the block-based visual programming.
>
> PT6: It was completed visually well and effectively. The exercises were entertaining.
>
> PT8: The visuals and the exercises were quite extensive and effective.

Table 8. Prospective projects

THEME: EVALUATION AND FUTURE PROJECTS		
7th Category	**Codes**	**PT#**
Prospective projects	Text exercises	PT3, PT4, PT5
	Supporting practical thinking	PT2, PT4
	Supporting active learning	PT2
	Game activities	PT3
	Arousing curiosity for learning	PT1
	Increasing reading speed	PT4
	Difficult subjects	PT7
	Supporting permanent learning	PT8

We asked the pre-service teachers what type of technology-based teaching activities they would create in the future. Some of the quotes from the interviews were as follows:

> PT3: I will design activities based on students' interests. I think students will learn more with games. For this reason, I can develop game activities. Additionally, text exercises can be designed so that students may become more active.
>
> PT5: I think we can design almost all the texts with this programming tool. I can especially design entertaining and instructive text exercises.
>
> PT7: I can design difficult and challenging subjects.

DISCUSSION, CONCLUSION and SUGGESTIONS

Adding the technology component to Shulman's (1987) pedagogical content knowledge (PCK) framework, Mishra and Koehler (2006) suggested teachers' TPACK including the interacting knowledge of pedagogy, content and technology. What to teach and how to teach in combination with technology are at the core of the TPACK framework. Tondeur, Scherer, Siddiq and Baran (2020) recommended strategies to support teachers' TPACK: Having a role model for using technology, discussing the pros and cons of technology, designing technology-based instruments, having peers' support, applying TPACK in real settings, and receiving continual feedback. Using most of these strategies, this study has attempted to increase pre-service primary teachers' level of TPACK. They learned the listening subject, pedagogical methods to teach this content, and integrating technology with content and pedagogy. They designed technology-based listening instruments for students. They

received feedback during this process. Their projects were trialed with fourth grade students in their classrooms, and they reflected on their experiences and observations regarding the process.

Based on our observations, pre-service teachers' ability in selecting visuals, searching for lesson plans, preparing presentations, and combining technology-based resources is mostly at a very low level in general. This situation might be a result of having a mostly traditional education and technologically low-skilled teacher educators. That is because teacher educators mostly lack technology knowledge and their attitudes towards technology integration is not at an adequate level (Martin, 2018). In the TPACK framework, teacher educators' technology knowledge is lower than their content and pedagogical knowledge (Sutrisno et al., 2023). Yet teacher educators with a high level of technological competency induce pre-service teachers to have more self-efficacy to expand students' learning (Nelson & Voithofer, 2022). Thus, pre-service teachers' technology skills will be increased with the help of their teacher educators in their institutions so that they know how to use technology resources effectively for educational purposes. Additionally, they will be able to design technology-based educational instruments, as mentioned in the literature (e.g., Chien, Chang, Yeh & Chang, 2012; Lee & Lee, 2014; Tondeur, Scherer, Siddiq and Baran, 2020). In the present study, pre-service primary teachers' comments about designing technology-based learning instruments shed light on whether designing such materials and observing students' interactions with these materials will be beneficial for their technology skills. The five levels of TPACK for teachers proposed by Saubern, Urbach, Koehler and Philips (2020) range from not being confident to being extremely confident to support students' learning with technology. The pre-service teachers' confidence in technology increased in the sense that they believed that their technology competencies, technology use skills, coding skills and belief in technology-based learning increased. Accordingly, based on the related literature, we can claim that pre-service teachers' TPACK level can be improved in the same way as in the present study.

Audio-visual supports are helpful for students' learning and teachers' teaching of language skills (Mathew & Aidmat, 2013; Al Mamun, 2014). While designing their technology-based listening materials, the pre-service teachers used static and animated visuals, and audio. For them, in a non-traditional learning atmosphere, such technological elements worked together to support student learning in an entertaining way. An effective technology-based listening material must include static and animated visuals. This is promising, since the pre-service teachers recognized the benefits of technological features in terms of learning support. This result is consistent with Erümit's (2020) study revealing that when teachers design animated activities for teaching, their attitude towards technology improves. Using these elements supports students to effectively gain language-related skills. In conclusion, pre-service teachers can recognize the effective elements of technology-based listening materials such as animation and visuals by being involved in classroom settings, where their projects are implemented. Thus, their technological knowledge (TK) within the TPACK framework can be supported with the process used in the present study.

The interviews revealed that this environment promotes active, permanent, and individual learning. It is out-of-routine, helps better comprehension and contributes to the imagination. The pre-service teachers were mostly impressed by students' high interest in the technology-based listening materials they created. The pre-service teachers' reactions are consistent with our observation. The fourth grade students paid full attention to the listening activities presented each week. They wanted to continue even more activities and asked whether they would complete similar activities. Being involved in the whole process helped the pre-service teachers get to know the students better and learn how to support students' learning before even starting their professions. As recommended by some studies in the literature (e.g., see Voogt et al., 2018), the pre-service primary teachers recognized the pedagogical benefits of the use of technology in classrooms. In addition, they learned how technology could be used to focus on students' level and interest. As a result, we can claim that such an action supports pre-service teachers' pedagogical knowledge (PK) and technological pedagogical knowledge (TPK) within the TPACK framework.

In the related literature it was stated that relying on readily available materials could be detrimental for pre-service teachers' creative thinking skills (Agyei & Voogt, 2015). Mishra and Koehler (2006) advocate that teachers must accommodate themselves to new technologies and not only take advantage of available tools. In the present study, the pre-service teachers used a block-based visual programming language to create their own listening materials. Mostly such learning platforms are easy to learn for all ages with their user-friendly interfaces (Hu, Chen & Su, 2021). The pre-service teachers believed that designing learning materials with coding improved their practical and creative thinking skills. As a result, we can claim that pre-service teachers' creating their own teaching materials can be supportive for their creative thinking skills rather than using available technological tools. Teacher education programs should use such learning platforms and design activities for pre-service teachers to support their thinking skills.

Will is the strongest predictor of technology integration among the *will*, *experience*, *skill*, and *tool* elements (Farjon, Smits and Voogt, 2019). The pre-service primary teachers had the will to create and incorporate technology in their future classrooms. They had the intention of creating activities supporting practical thinking skills, improving students' reading speeds, supporting active and permanent learning, teaching specifically difficult subjects, and using games. These examples show their willingness to incorporate technology in their future classrooms. Moreover, they felt professional worth by implementing technology-based listening activities for students. This process taught them a teaching method which they believed would color their professional lives in the future. They gained confidence and developed positive feelings for technology. Teachers' attitude toward technology is a crucial element in improving their TPACK (Yulisman, Widodo, Riandi and Nurina, 2019). Teachers' technology integration can be predicted from their TPACK and attitudes (Raygan & Moradkhani, 2020). As a result, we can claim that the pre-service teachers' TPACK improved.

The ISTE (2008) standards recommend that teachers "design, develop and evaluate authentic learning experiences and assessments incorporating contemporary tools" (p.1) so that they can increase the level of learning in context. Additionally, it is essential for teachers to evaluate technology-based resources to decide what suits their classes best (Kim, Xie & Cheng, 2017). In this study, the pre-service primary teachers designed, developed, and evaluated students' use of technology-based projects in an actual learning environment. They regarded the good projects as the ones having good visuals and animations, being in a game format, having audio-visual synchronization, and successfully reflecting texts into technology-based learning. They commented on these features as the ones improving students' active learning, interaction with the learning environment and willingness to learn. As a result, we may conclude that the pre-service teachers reached the stage of evaluating technology in education.

In sum, the pre-service teachers designed, developed, and evaluated their own technology-based listening materials. For this, they learned coding with a blocked-based visual programming tool. They then observed the students, who completed the listening materials they had designed. In conclusion, they believed that they increased their technology use skills (TK), developed awareness of how students learn (PK), learned how to teach pre-, while- and post-listening activities (CK), and acquired a sense of professional worth. They confirmed that designing such a learning environment was easy and that they could develop new projects in the future. More importantly, they believed that students' willingness to learn can be increased with such a learning environment. Their confidence in teaching in the TPACK framework increased. Thus, we may conclude that their technology pedagogy content knowledge (TPACK) increased. As consistent with Santos and Castro's (2021) study, the pre-service teachers developed their knowledge in the content of TPACK.

Finally, the following can be implied from the study:

- Pre-service teachers' confidence in technology may be increased and their TPACK may be improved by designing, observing, and evaluating technology-based learning environments.
- Teacher educators may consider providing pre-service teachers with the experience of applying technology in real classroom settings.

- Digital materials designed by pre-service teachers should be given feedback in terms of pedagogy, content, and technology in the TPACK framework so that they can familiarize themselves with the elements necessary to support learning.

Recommendations for Researchers

Students' learning of language skills that enable them to understand what they listen to and read, and to express themselves orally or in writing prepares them for life and affects their success in other courses. Considering primary school students are mostly digital learners, it is important to present language skills to students with technology-related materials. Teachers are the implementers of technology, and they need to be well prepared in technology-related skills. This study was about designing, developing, and evaluating technological materials for the listening skill in the TPACK framework for pre-service teachers. However, it is the subject of research to investigate whether such an action has a similar effect on other language skills. For this reason, it may be suggested to researchers to conduct other studies in TPACK to support pre-service teachers in designing, developing and evaluating their own language-related and technology-based materials.

Recommendations for Practitioners

We suggest similar actions for teacher educators. To be able to integrate technology into their future classrooms, pre-service teachers need assistance with technology-related skill development. Specifically, their intentions to integrate technology can be improved by having them witness the use of technology in classrooms. In the present study, we suggested such an action and observed positive results. Teaching technology as isolated facts does not help teacher candidates. Pre-service teachers must receive support in their TPACK for a successful technology integration before beginning their careers.

Limitations

This study was limited to the data gathered from eight pre-service primary school teachers, the listening skill, and an eight week-long training process.

Ethics and Conflicts of Interest

Research approval was obtained from the ethics committee of Kafkas University Ethics Commission dated 20.10.2021 and numbered 23. Participation in the study was completely voluntary. There is no conflict of interest to declare among the authors. The authors acted in accordance with the ethical rules. No funding was received for conducting the study.

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