Hacettepe Üniversitesi Eğitim Fakültesi Dergisi

Hacettepe University Journal of Education

e-ISSN: 2536-4758

Implementation of TPACK-Based Instructional Design Model in an Emergency Remote Course[*]

Funda ERGULEC[**], Esra EREN[***], Mehmet ERSOY[****]

Article Information	ABSTRACT
	The aim of this study was to examine pre-service teachers' Technological Pedagogical Content Knowledge (TPACK) utilizing the TPACK-Based Instructional Design Model (TPACK-Based IDM) as framework during the emergency remote teaching process. The study, which was designed with an exploratory case approach, was conducted with senior pre-service teachers attending the Computer and Instructional Technologies Education (CEIT) department. The content of the courses within the scope of the study was developed and adjusted to include the stages of the TPACK-Based IDM. The data consists of the lesson plans and course materials designed by the pre-service teachers, the videos and reports they prepared during the term and their answers to the interview questions. The evaluation of lesson plans, materials and videos were carried out by using TPACK based learning environments assessment rubric. Content analysis was used to examine the information gathered from the reports and interviews. As a result, the course, which was designed with the TPACK-based IDM, increased the TPACK levels of pre-service teachers by associating their technological, pedagogical and content knowledge. It is observed that pre-service teachers focused on the characteristics of the target audience, the usability of the material, social presence, providing clear and unambiguous lectures, stimulating and gaining attention, and designing individual interactive materials in the use of TPACK. Instructional design of distance education courses is a significant topic to educate pre-service teachers during their training at the school of education. However, educating them about TPACK use and its applications in distance education would help distance education progress in a more planned manner. **Keywords:** Technological pedagogical content knowledge (TPACK), distance education, emergency distance education, instructional design, pre-service teachers
	Article Type: Research Article

1. INTRODUCTION

The rapid development of technology is constantly changing our lives, work and the way we learn (Voogt & Roblin, 2012). In the information age society, we live in, individuals need to have the skills of critical thinking, problem solving, effective communication, cooperation, using various technologies, taking initiative and innovation, and be able to develop different perspectives on learning situations (Angeli & Valanides, 2009). To facilitate students' daily lives and prepare them for business life, supporting 21st century skills makes it necessary to transform the learning processes both within and outside of the school (Dede, 2010).

In the standards of educators prepared by different institutions and organizations in the world and in Turkey, pedagogical approaches that develop the 21st century competencies of learners are emphasized (ISTE, 2017; Ministry of National Education [MNE], 2019). This enforces educational institutions to revise their teaching methods in a way that will develop the skills and competencies needed by the knowledge-based society (Bates, 2020). Dede (2007) states that information and communication technologies shape education in three ways; (1) the knowledge and skills that society demands from its graduates, (2) diversification of research, teaching and learning methods with interactive media supporting innovative pedagogies and (3) the changing characteristics of students' use of technology outside of academic environments as it affects their learning styles and preferences.

[**] Dr., Eskisehir Osmangazi University, Faculty of Education, Department of Computer Education and Instructional Technologies, Eskisehir-TURKEY. e-mail: fundaergulec@gmail.com (ORCID: 0000-0002-7236-7894)

[***] Assoc. Prof. Dr., Eskisehir Osmangazi University, Faculty of Education, Department of Computer Education and Instructional Technologies, Eskisehir-TURKEY. e-mail: eeren@ogu.edu.tr (ORCID: 0000-0001-5949-0516)

[****] Assoc. Prof. Dr., Eskisehir Osmangazi University, Faculty of Education, Department of Computer Education and Instructional Technologies, Eskisehir-TURKEY. e-mail: ersoycimeyil@gmail.com (ORCID: 0000-0002-0724-2825)

With the coronavirus pandemic, which started at the end of 2019 and turned into a pandemic as of March 2020, in order to compensate for the interrupted education, emergency distance education method was used in the world by many educational institutions (Bozkurt, 2020). The current pandemic process leads us to question the education system again, and many schools have been considering innovative ways of teaching that are suitable for learner needs and focuses on purpose and meaning (Zhoa, 2020). This paradigm represents a transition from traditional, teacher-centered and lesson-based activities to more student-centered activities that include collaboration, discussions, and hands-on learning activities (Zhu & Liu, 2020).

The ever-evolving technology and paradigm shift require educators to have an analytical framework that would help them choose and use the most appropriate technologies for the teaching environment (Bates, 2020). The TPACK Model stands out as one of the most fundamental and researched theoretical frameworks within the scope of teacher education (Chai et al., 2013; Koehler & Mishra, 2009; Koh et al., 2015; Voogt et al., 2013). The TPACK Model, created by Koehler and Mishra in 2006, is the knowledge of using technology and instructional strategies in a meaningful way to teach a specific content effectively (Harris et al., 2009). The model outlines the skills that teachers need in the integration of information and communication technologies into the teaching and learning process (Koehler & Mishra, 2009). TPACK framework emphasizes Technology Knowledge (TK) of specific technological tools; Pedagogical Knowledge (PK) of how to teach and guide students; and Content Knowledge (CK) of a discipline or subject. These three key components come together to form Technological Pedagogical Knowledge (TPK) which defines the link between technologies and pedagogical practices; Pedagogical Content Knowledge (PCK) which describes the link between pedagogical practices and content knowledge, and Technological Content Knowledge (TCK) which describes the link between technologies and content knowledge. TPACK, which is the intersection of TPK, PCK and TCK, is related to the complex relationship of all knowledge areas and all of this information is a part of the context in which teachers are (context, classroom environment, other learning environments, etc.) (Koehler & Mishra, 2008; Koehler & Mishra, 2009; Mishra, 2019; Porras-Hernández & Salinas-Amescua, 2013; Rosenberg & Koehler, 2015).

Research on technology integration shows that TPACK has important effects on teacher education and professional development of teachers (Koehler et al., 2007). However, some researchers criticize the usefulness of the TPACK framework in practice (Angeli & Valanides, 2009) and point out that teachers have difficulties when designing technology-integrated lessons that support learners' 21st century skills (Cox & Graham 2009; Graham 2011). Thus, Teachers can utilize TPACK design models to assist them reflect on their existing pedagogical practice and take into account contextual demands, when formulating TPACK related teaching strategies (Koh, 2019). Design-Based Learning (DBL) is a model used by teachers to combine their theoretical knowledge with practice within the scope of the TPACK model (Angeli & Valanides, 2009; Lee & Kim, 2014a, b, 2017). This model has been proven in many studies to be an effective approach in developing technology integration competencies of teachers (Chai et al., 2013; Tondeur et al., 2018; Voogt et al., 2013). Enabling future teachers to create learning environments that support 21st century skills depends on being fully prepared for the pedagogical use of technology (Ottenbreit-Leftwich et al., 2018). Preparations for planning instruction or field experience within the scope of Design Based Learning include the opportunity for teacher candidates to plan and implement technology-integrated teaching for students in primary and secondary education institutions (Wilson et al., 2020).

To provide a practical and applicable framework for the development of teacher candidates' TPACK in teacher training programs, TPACK-based IDM was created by Lee and Kim (2014a, b, 2017). The model is used especially in the last stages of the learning process to facilitate the functional use of TPACK knowledge of pre-service teachers (Lee & Kim, 2017). The model was developed in three stages by Lee and Kim (2014a, b, 2017). In two studies conducted in 2014 (Lee and Kim, 2014a, b), the researchers applied two versions of the model in different courses. As a result of the first application, it was determined that pedagogical knowledge greatly affected pre-service teachers' TPACK acquisition and insufficient pedagogical knowledge prevented TPACK acquisition. Accordingly, it has emerged that every knowledge in TPACK, especially pedagogical knowledge, should be taught (Lee & Kim, 2014a). In the second application, a technology-integrated course was designed to increase the pedagogical knowledge of pre-service teachers. As a result, the pre-service teachers designed integrated lessons with technology which improved their pedagogical knowledge, but they carried out a teacher-centered teaching. In the second version of the model, the researchers emphasized the importance of developing more strategies that promote student-centered understanding of technology application to improve pre-service teachers' TPACKs (Lee and Kim 2014b). The model was updated in line with the experiences gained in previous versions and the third version was created (Lee & Kim, 2017).

TPACK-Based IDM consists of three stages. In the first stage, the TPACK model is introduced to teacher candidates. The main goal of this stage is for pre-service teachers to have a good understanding of the TPACK model and to be ready for the design they will create in the next phases. The second stage is when you get to try out the TPACK model. At this level, pre-service teachers engage in a variety of technological activities and get expertise with student-centered technology integration through "role playing," after which they learn more about the TPACK model by analyzing their experiences from a pedagogical standpoint. In the last stage, pre-service teachers apply the TPACK model. At this stage, it is aimed that pre-service teachers design and apply teaching materials so that they can obtain more detailed information about TPACK (Lee & Kim, 2017).

1.1. Study Purpose

The purpose of this research is to evaluate the applicability of the TPACK-Based IDM developed by Lee and Kim (2017) in distance courses and to examine the knowledge and experiences of teacher candidates in this context. The research questions of the study are as follows:

• How were the stages of the TPACK-Based IDM (understanding TPACK, experiencing TPACK, applying TPACK) carried out in distance courses in the teacher training program?
• How did the TPACK of teacher candidates develop in the application of the TPACK-Based IDM in distance education?
• How did the teacher candidates employ their TPACK in the implementation of the TPACK-Based IDM in distance education?
• How did the distance education process affect the TPACK-based instructional designs of pre-service teachers?

2. METHODOLOGY

An exploratory case study methodology was used in this study (Yin, 2014). A case study is a multi-perspective investigation of a specific project, program, or system (Simons, 2009). With this purpose, this study is aimed to do a thorough assessment of TPACK-Based IDM by applying the model to a distance course. In the study, a student-centered course which was enriched with innovative technologies and materials was designed. Then, the pre-service teachers were asked to create an instructional design for distance courses using their TPACKs.

2.1. Participants and Stages of the Study

The participants of the study consist of 20 senior pre-service teachers in the CEIT department. The content of the courses for which data was collected was created and organized to incorporate the steps of the TPACK-based IDM. The TPACK-based IDM formed the framework of the study. The first step of understanding the TPACK model was to give pre-service teachers with preliminary details about the TPACK model that they will use as a basis for their designs. Since the participants of the study were senior pre-service teachers of CEIT, they had attended classes on TPACK before during their teacher education and as a result they had prior knowledge. Before pre-service teachers began to construct their lesson plans and teaching materials, they were also informed about the TPACK model and about preparing TPACK-based lesson plans.

In experiencing the TPACK stage, which is the second stage of the model, pre-service teachers attended the lessons held in practice schools (where pre-service teachers practice teaching in actual classrooms) and observed expert teachers. Due to the COVID-19 pandemic process, the courses they attended in practice schools were given remotely. During the remote teaching, pre-service teachers took notes about their observations and the emotions they felt throughout the process. They submitted these notes to the course instructor as weekly reports. The submitted reports were discussed at their weekly meetings with the instructor and evaluated on the TPACK model. The pedagogical discussion of their experiences in the synchronous meetings during the COVID-19 pandemic enabled pre-service teachers to obtain more information about the model. Thus, they gained more detailed information by experiencing the TPACK model in an actual classroom rather than just understanding it.

In the third stage of the model, pre-service teachers began to integrate the model into their lesson plans and teaching materials. Pre-service teachers were asked to prepare lesson plans and resources based on the demands of secondary school instructors (the expert teachers). They also got help from the Computer Science teacher at the practice schools when needed. Before designing the course materials, the pre-service teachers met with the teacher at the practice school. They discussed needs of the students and classroom, the grade level, and the subject. The pre-service teachers worked individually on their instructional design. They designed the lesson plans and materials for the course which was delivered in distance. Considering the two synchronous course hours (30min+30min), they were asked to prepare 2 lesson plans, one in the middle of the term and the other at the end of the term. In addition to the lesson plans, for each lesson plan, they were also asked to prepare 3 course materials for the following 3 stages: (1) Introduction, (2) Application (3) Evaluation. In total, each pre-service teacher prepared 6 course materials.

The aim of the preparation of lesson plans and materials was that pre-service teachers gain the ability to create instructional design by using their TPACK. In this process, the course instructors at the university provided feedback to the pre-service teachers about their lesson plans and enabled them to improve their performance and productivity. During this stage, while the pre-service teachers prepared their instructional design individually, they worked in collaboration with the course instructors at the university and the teacher at the practice school. After the pre-service teachers completed their designs, they were asked to prepare a video in the form of a screen recording by giving a lecture on the materials they prepared. Considering the pandemic process, they were asked to present the lesson plans and materials they prepared as if they were explaining to the target student group through a video. At the end of the term, the pre-service teachers shared the course materials they prepared with the teachers in the practice school so that they could be used in the classroom environment.

2.2. Data Collection Tools

The research data consists of the lesson plans, course materials, and the videos designed by the participants, the reports they collected during the distance education process, and interviews. In the process, each pre-service teacher prepared two lesson plans, one in the middle of the term and the other at the end of the term. They also designed a total of 6 course materials, 3 for each plan. In addition to lesson plans and course materials, each pre-service teacher recorded lecture videos by using their own as if they are teaching the lesson to the target student group in a synchronous lesson environment. In addition, the weekly reports that participants took during the design process and distance education process were also collected as a data source for the study. These data collection tools were used to understand the instructional design experience of the participants. In addition, it was aimed to understand how the lessons were taught in the emergency distance education process and the views of the pre-service teachers on this matter.

In order to regularly monitor the development of TPACK, pre- service teachers were interviewed twice, once in the middle of the term and at the end of the term. The interview questions were formed with the help of the literature related to TPACK to understand the pre- service teachers' TPACK process. The interview questions were altered with the comments of three colleagues experienced in TPACK and instructional design. With the interview questions, the opinions of the participants on the following topics were determined: what needs are decisive when preparing the lesson plan and materials for the distance education process, how these needs affect their design, what do they do differently because the lesson plans and materials they prepared will be used in the virtual classroom environment, their experience in lecturing in a virtual classroom, and how they feel about teaching a non-face-to-face class and at which stages they have difficulty in this process.

2.3. Data Analysis

The data collected from the lesson plans, course materials, and videos were analyzed using a TPACK-based learning environment assessment rubric. The TPACK-based learning environments assessment rubric (Sadik & Ergulec, 2021) was adapted and used to assess the performance. The maximum score of the rubric is 100 and the minimum score is zero. High scores indicate that pre-service teachers' level of knowledge and practice of TPACK is above the average. In the evaluation of lesson plans, materials and videos prepared by pre-service teachers, two researchers scored the data separately using the TPACK-based learning environment rubric. Next, the researchers came together to compare the scores and rescore different ratings based on consensus.

The interviews and the weekly reports were examined using the content analysis method (Bauer, 2000). First, the answers to the questions were divided into meaningful sections by two researchers to conduct content analysis. Starting with the answers of the first pre-service teacher, the data were coded and continued by coding separately. When the codes of the two researchers did not match, these cases were coded together. After coding, codes representing a specific TPACK component were combined to form themes.

Multiple data collection tools, including interviews, lesson plans, course materials and video recordings prepared by pre-service teachers, were used to ensure the validity and reliability of the data. In addition, the data were analyzed by two researchers to ensure the reliability of the data. The findings were discussed in relation to each other and conclusions were drawn.

3. FINDINGS

3.1. TPACK Developments of Pre-service Teachers

The findings related to the TPACK development of participants are reported. According to the data obtained from the TPACK-based learning environments rubric, in which the lesson plans, materials and videos of the pre-service teachers are evaluated, the TPACK developments of the pre-service teachers are given in Figure 1.
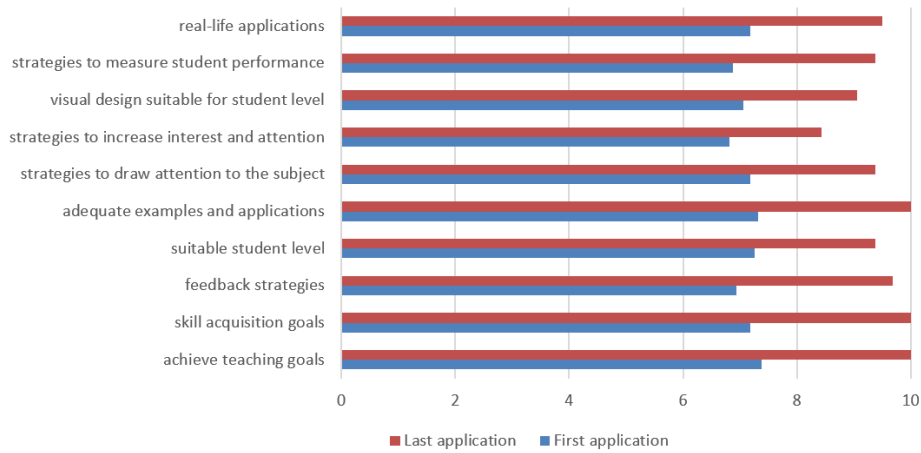
Figure 1. TPACK development of pre-service teachers

According to Figure 1, the first and last application scores of the pre-service teachers are evaluated, it is observed that their TPACK levels were above the average. The fact that the scores obtained from the last application are higher than the first application can be interpreted as the fact that the course structured according to the TPACK-based IDM has a positive contribution to the development of TPACK of teacher candidates.

The main themes emerged in the analysis of the data are as follows; "pre-service teachers' experience of using TPACK" and "pre-service teachers' reflections of the changing learning environment with the pandemic." In addition, the sub-themes were re-evaluated on the basis of the concepts they pointed out, and the appropriate concept for each was explained.

3.2. Pre-service Teachers' Experience of Using of TPACK

Pre-service teachers conduct microteaching activities in order to experience student-centered technology integration activities in the third year before the internship practices in their last year. In this process, they make applications in which they discuss possible student roles in practice schools, and they are also evaluated by other teacher candidates and faculty members. In the continuation of these practices, which match exactly with the phase of experiencing TPACK, a preparation process for teaching is experienced, which is kept alive with the feedback and reminders of both the teacher at the practice schools and the instructor at the university during the internship practices. Figure 2 includes the sub-themes within the theme of "pre-service teachers' experience of using TPACK."
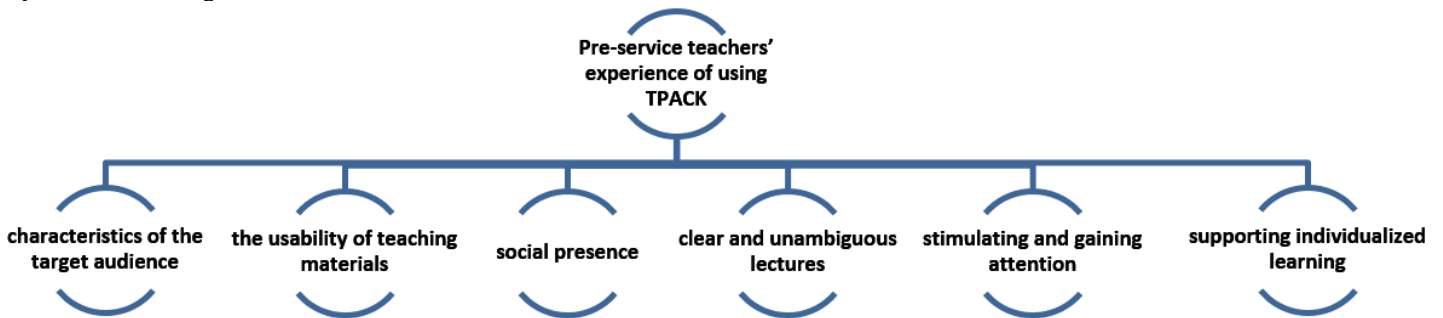

Figure 2. First main theme and accompanying sub-themes

The first sub-theme that emerged in the context of employing TPACK was the "characteristics of the target audience." Particularly, while designing materials, in the context of the characteristics of the target audience, the pre-service teachers expressed opinions pointing to the critical periods in the development of the students due to their age. In addition, pre-service teachers had the opportunity to see the characteristics of the target audience more closely during the synchronous lessons at the practice school they attended throughout the term. The views of a pre-service teacher who mentioned the importance of teaching by going down to the level of the student in this regard are as follows:

> "The best part of the job is sharing new information with kids and facilitating their discoveries. Having a course in which I manage this knowledge sharing is a very confident and at the same time exciting interaction process. Even if the curriculum is very important in this regard, we do not have to teach a boring and banal lesson, I understand this. It is exciting to befriend and learn with our students." (Participant A, interviews).

A difference was found between the first and last applications in the rubric scoring used to evaluate TPACK-based learning environments. The participants prepared the lesson plan and materials more appropriate for the level of the students in the last

application. It was found that the difficulty level of the materials developed in the last application was designed more appropriately for the level of the student. In particular, it was detected that they made the visual design more suitable for the level of the student. A pre-service teacher's comment about the design process supports the theme of the characteristics of the target audience.

> *"Since they are just starting to learn the concepts and I need to explain the information in a simple and understandable way according to their cognitive level, I tried to keep the game very simple and understandable, not to cause too much ambiguity and to explain it in a simple language"* (Participant H, interviews).

"The usability of teaching materials" is one of the important issues in the process of employing TPACK. Teaching materials can sometimes be designed only for attention, or it can be a material at the heart of the learning-teaching process. When the views of the pre-service teachers on the sub-theme of the usability of the material were examined, it was understood that they especially emphasized the usability of the material in the learning-teaching process. At the same time, the participants informed that they paid attention to the design of materials that will emphasize clarity, flexibility and feedback on a visual basis, which can be directly associated with the concept of usability. When the materials made by the pre-service teachers were examined with the TPACK rubric, it was found that they made visual designs suitable for the level of the students. Especially in the last application, it was observed that the visual design of the materials was developed in a clear and consistent manner suitable for the level of the student. However, some of the participants stated that they had difficulty in finding visual materials to be used in the synchronous lesson environment.

> *"I searched for a richer and more practical application for visual effects in the place of the products in your shop game, but I couldn't find it. Instead, I think it would be more realistic and useful if I prepared them as paper materials and applied them in a real classroom environment"* (Participant H, interviews).

The pre-service teachers frequently mention that they wanted students to feel themselves involved in the classroom. At first glance, this sub-theme can be considered under the second main theme of pre-service teachers' reflections of the changing learning environment with the pandemic. However, when the theme is reconsidered on the field base, it is categorized under the first main theme as "social presence" sub-theme. Considering that students will learn better by feeling themselves in the classroom, not only with a method specific to the pandemic, but also by feeling themselves to participate in the classroom in general, the situation of considering TPACK independent of the environment and student-centered arises. When the lesson plans and materials of the pre-service teachers were examined, it was found that they developed strategies that would draw the attention of the students to the subject, designed their materials in this direction, and demonstrated this more clearly in their last application.

Not only the material design, but also the pre-service teachers' approaches to the application of the materials they have prepared are also key in the use of TPACK. The course materials should be clear and understandable. The views of the pre-service teachers were gathered around the sub-theme of "clear and unambiguous lectures," in which they specifically questioned their own roles, how they would use the material, and how they would combine pedagogy and technological practices. Participant H shared one of the prominent views on this issue:

> *"The level of the students influenced my design as I had to prepare my course materials suitable for their level. Because conditional structures in programming (such as IF and ELSE) are very challenging subjects for 5th grade students. For this reason, I thought that the subject should be conveyed in a more playful way according to the level of the students and in a simple and understandable way. For this reason, their level influenced my design and lesson plan. I felt like the synchronous lesson should be delivered in a gamified way rather than through just a presentation. I spent more time on the game design as I wanted my students to learn by playing the game"* (Participant H, interviews).

Student participation has become a frequently studied topic along with motivation in recent years. As the role of technology in our lives has increased, the way it affects our learning processes has changed. The 5th and 6th grades, who take Information Technologies and Software courses, coincide with the beginning of the abstract operations period. It should not be forgotten that students enter a period in which their imagination expands, their images become clearer, and the value they attach to abstract concepts is increasing. The pre-service teachers were aware of this situation and took it into account both in their lesson plans and in their philosophical perspectives. The pre-service teachers' views on this are categorized under "stimulating and gaining attention" sub-theme. When the lesson plans and materials of the pre-service teachers were examined, it was seen that they developed strategies that would both stimulate the attention of the students and increase motivation during the lesson. It has been observed that the pre-service teachers developed strategies that draw students' attention to the subject at the beginning of the lesson and use strategies that will increase students' interest and attention during the lesson. Below is a quote supporting the sub theme of stimulating and gaining attention and another quote of how designing materials for distance education could be different from face-to-face learning.

> *"In the application part, instead of using a presentation prepared in PowerPoint, I created a book that I thought was more remarkable. I turned the evaluation part into more gamification. In the evaluation part, I extended the period as students will do it remotely. I asked the questions in an easier, clear, and understandable way. I helped them use*

technology as much as possible. Since the lessons are taught as distance education, I paid attention to the sharing of the materials" (Participant G, interviews).

"Distance education requires more effort than face-to-face education as we, as teachers, try to gain the students' attention and at the same time not to lose it. It is necessary to prepare more entertaining and attention-grabbing materials, it should be prepared in a way that appeals to every student as much as possible, and at the same time, it is necessary to use materials that will draw attention to the right place while attracting attention" (Participant I, interviews)*.*

In the first main theme, pre-service teachers' experience of using TPACK came forward. As a matter of fact, there were opinions emphasizing that the interaction elements in the course materials should have an aspect that "supports individualized learning." Pre-service teachers emphasize the necessity of designing materials so that students can evaluate and see their own progress together with the interaction elements provided by the material, in accordance with the principle of learning according to the individual pace of the students.

3.3. Pre-service Teachers' Reflections of the Changing Learning Environment with the Pandemic

The COVID-19 pandemic has changed human life in general, as well as changing educational environments. In this new way of learning environments, innovations are required for both teaching staff and students and it is necessary to put them to work immediately. In this process, where learning losses are inevitable, many distance education interventions that will support human learning have been discussed; those that can be put into practice have been implemented. Figure 3 includes the second main theme and its sub-themes that emerged regarding this situation in the study.
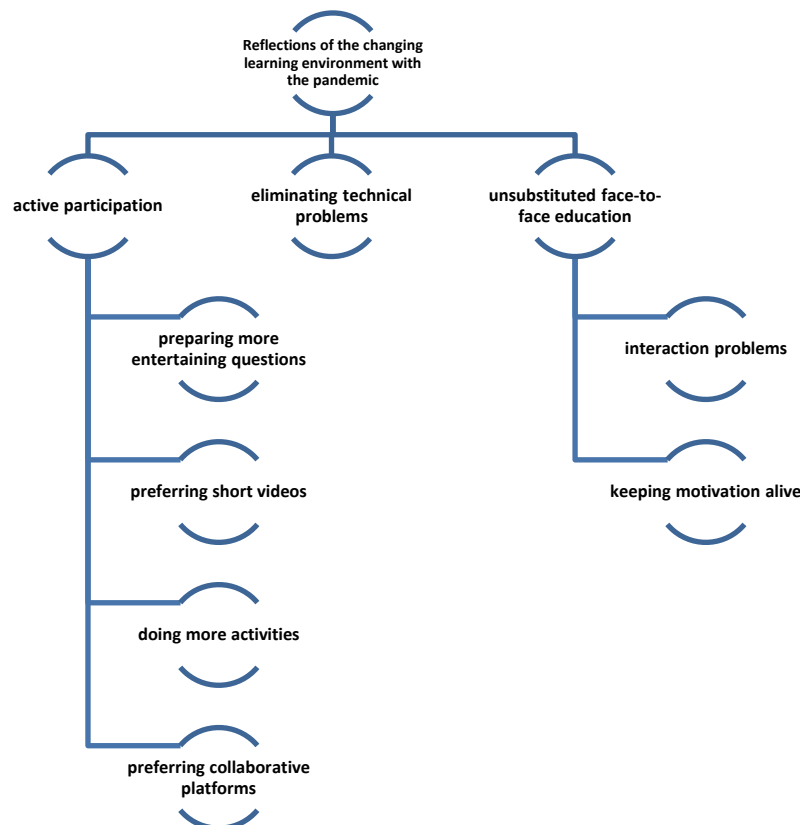

Figure 3. Second main theme and accompanying sub-themes

The sub-themes that arose in response to the views on "the reflections of the changing learning environment with the pandemic" are listed as preparing the lesson plan with active participation, time to eliminate technical problems, and unsubstituted face-to-face education. In the first of these sub-themes, there are opinions that focus on ensuring effective participation and preparing lesson plans especially open to participation-oriented innovations. The pre-service teachers mentioned the issues of preparing more entertaining questions, preferring short videos, doing more activities and preferring platforms that students can use collaboratively. It is noteworthy that common platforms are preferred in these subjects, where the concepts of entertainment, timing, repetition and social interaction are at the forefront. In the previous main theme, pre-service teachers, who emphasized individual interaction (interaction with the material) as much as possible, brought up sociality and interaction (interaction with the environment and peers) in their preferences of learning management system. Such an approach gains importance in terms of showing that the pre-service teachers can clearly distinguish between medium and learning environments. On the other hand, it can be said that choosing short videos in this sub-theme is the right approach to both

prevent boredom and reduce cognitive load. Preparing more entertaining questions and doing more activities are seen as important approaches to keep motivation alive. Sample quotes are as follows:

"As far as I have observed, the most lacking point is the inability of the students to interact. The chances of observing students who remained passive were low. Not being able to make eye contact with students one by one reduces the effectiveness of the distance education process" (Participant C, interviews).

"In the implementation of the lesson, the students have to be in an environment, namely the computer lab. Because when a student gets stuck in a part of the code, he can look at his friends next to him. He can ask them questions. Thus, they learn from their peers. Unfortunately, because it is distance education, group work, collaboration, peer learning, or other similar situations can't happen. As educators, we cannot see or control what students do and where they hang out. More precisely, it becomes difficult to do this" (Participant K, interviews).

The second sub-theme of unsubstituted face-to-face education was frequently mentioned by the pre-service teachers, although it did not include a separate topic mentioned in detail. In this sense, it can be said that both technical issues and potential problems and time management are seen as important elements in the reflections of the changing learning environments with the pandemic. A pre-service teacher mentioned this issue in his observation report.

"Due to the Internet and infrastructure problems, I noticed breakdowns during the synchronous lessons. While students were trying to answer the teacher's questions at the same time, the teacher could not understand what anyone was saying, I think a solution should be found for this problem" (Participant B, weekly reports).

Even though CEIT is the pre-service teachers' own field in this study, they are of the opinion that a digital technology-based environment will not replace face-to-face education in the long run. The pre-service teachers, who emphasized the collaborative platform that emphasizes the interaction of students with each other in the previous sub-theme, this time focus on the interaction to be established with the student and teacher. Another important issue is to keep students focused on the lesson. It is possible to see a significant part of the approaches that are the source of this view that the students are active due to their age and tend towards sociality. Although this is a behavior that can be expected from students who are bored due to the increase in time spent at home during the pandemic period, it is a situation that disrupts both classroom management and learning processes:

"I don't believe that distance education provides permanent learning, even for our own age group, I don't think that learning is permanent at all for 6th grade students. They listen carefully to the lessons on time, but it's actually the fun of apps that grabs their attention or seeing their friends in the synchronous lessons. In the first space, they write to each other from the chat, even if their microphones are on." (Participant E, interviews).

"I don't think distance education is very effective for learning. Older age groups are aware of their responsibilities and can study and learn by themselves, but younger age groups are not yet conscious of these responsibilities" (Participant A, interviews).

One of the important consequences of the new process realized with emergency remote teaching is the level and quality of the feedback to be given to the students. In a normal classroom environment, it is relatively easy for the teacher to go around the classroom and give feedback, and showing an example of the correct answer or correct progress with direct intervention can be an immediate and functional solution. Sometimes, the teacher can make an important intervention to the students by realizing that they do not understand an important point about the current activity. In this sense, materials designed in such a way that feedback can be given in a rich way come to the fore. One of the participants describes this situation as follows:

"Students can directly interact with the materials in the classroom environment and be more interactive. Despite this situation (emergency remote teaching), I designed the synchronous environment in such a way that the teacher can intervene in the materials" (Participant G, interviews).

In the second main theme in general, it is underlined that the participants are aware of the emergency remote teaching and its interventions addressed in the pandemic. As well as their views on the participation-enhancing lesson planning they brought on the basis of sub-themes, their views on the comparison of face-to-face education and emergency remote teaching, which are realistically pointed out by the reflections of possible problems and the processes they observed, are also remarkable.

4. RESULTS, DISCUSSION AND RECOMMENDATIONS

In this study, within the scope of two courses designed with the framework of TPACK-Based IDM, participants were instructed to design a lesson plan and course materials for distance education using TPACK. The study's primary goal was to look into the applicability of the model developed by Lee and Kim (2017) in distance courses and the experiences of pre-service teachers in this context. In the lessons designed to incorporate all the stages of the TPACK-Based IDM, the pre-service teachers designed lesson plans and course materials using TPACK. They also attended the lessons at the practice schools held during the pandemic.

Many studies have been conducted on this subject since the TPACK model was introduced in 2006. However, unlike other studies (Eren & Ergulec, 2020; Lee & Kim, 2017; Redmond & Lock, 2019) in which the TPACK Model was used together with the Design Based Learning Model, in this study participants were the designers of a course taught remotely where they use their TPACK. By applying the TPACK-based IDM in two courses, pre-service teachers were also provided to design instruction for distance courses in practice schools.

4.1. TPACK Developments of Pre-service Teachers

According to the findings of the study, the courses designed with the TPACK-based IDM had a positive influence on the pre-service teachers' teaching process and TPACK development levels. First of all, pre-service teachers had the opportunity to experience the relations between the courses they took for the teaching profession before this course. By associating technological, pedagogical and content knowledge, they were enabled to increase their TPACK levels. In addition, participants participated in the distance lessons that are taught in the practice schools. They were in the same environment with the students and experienced a real distance learning environment. Due to the pandemic, unlike previous terms, all courses in both the university and the practice schools were taught remotely. In this way, participants had the opportunity to see the difference of teaching in this new environment, preparing lesson plans and materials for this environment, and how they could use TPACK in this new environment. The themes that emerged within the study were determined as "pre-service teachers' experience of using TPACK" and "pre-service teachers' reflections of the changing learning environment with the pandemic."

4.2. Participants' Experience of Using of TPACK

The limited knowledge and experience of pre-service teachers on distance education influenced their instructional design and planning for this new learning environment for them. Even though they faced difficulties during the design process, the participants used TPACK in their lesson plans and course materials. According to the results of the study, the use of TPACK in the designs they made in the middle and at the end of the term differed. The designs at the end of the term contain more specific TPACK. The reason for this may be the feedback the pre-service teachers received from the instructors at the university and the teachers in the practice schools. Apart from this, the fact that the participants observed the distance lessons at the practice school until the end of the term may have contributed to their use of TPACK more effectively in this new environment.

Under the main theme of participants' experience of using TPACK, it was found that the pre-service teachers focus especially on the characteristics of the target audience, the usability of the material, social presence, providing clear and unambiguous lectures, stimulating and gaining attention, and designing individual interactive materials in the use of TPACK. The pre-service teachers stated that they made their designs by considering the characteristics of the target audience. At the same time, when their designs were examined, it was found that they developed materials suitable for the level of the target audience. Thus, it was found that the pre-service teachers presented abstract concepts that are difficult to understand by simplifying them, and designed visual materials and interesting content that the target audience can understand. It has been observed that participants also pay attention to the usability of the material and try to design materials that are clear, unambiguous, flexible and that will bring feedback to the fore.

Learning takes place in a social setting through the interactions of persons through active involvement, instructional assistance, and information exchange, according to the notion of social constructivism (Vygotsky, 1978). Social presence in distance education, on the other hand, can be thought of as students' feelings of being online and their ability to express themselves by feeling comfortable and safe (Anderson & Garrison, 1995; Gunawardena & Zittle, 1997). It was discovered that pre-service teachers emphasized the concept of social presence in the distance education process and paid attention to this in their designs. The pre-service teachers also claimed that they pay attention to the clarity of the materials by the students, make them interesting, and try to prefer interactive lecture methods. When the materials prepared by the participants are examined, it was found that online teaching is mostly done through interactive games. These designs, which are made to ensure student participation in the lesson, are considered important for students' learning and personal development (Hu & Kuh, 2002; Sun & Rueda, 2012). It was also observed that the participants made individual interactive material designs and emphasized that students should learn at their own pace. For this, the applications they mostly used in their designs were Zoom, Canva, Animaker, Wordwall, Menti, Padlet, Kahoot, Quizzes and LearningApps.

4.3. Pre-service Teachers' Reflections of the Changing Learning Environment with the Pandemic

According to what pre-service teachers stated about the lessons they attended during the pandemic; it was found that unexpected complications may occur during those lessons. Although instructional designs are made for the emergency remote teaching process, unexpected problems may arise during the lesson. Under the theme of the reflections of the changing learning environment with the pandemic, pre-service teachers first mentioned that it takes time to eliminate technical problems. This is consistent with the findings of the study of Tseng and colleagues (2019). Technical problems encountered in the distance education process can sometimes prevent teachers from fully implementing TPACK. Audio and video quality and Internet connection issues can be described as technical problems that are mostly beyond the control of teachers. As a result, such disruptions can make it difficult to employ TPACK in distance education.

Under the theme of the reflections of the learning environment that has changed with the pandemic, the pre-service teachers stated that distance education cannot replace face-to-face learning. In particular, the problems they stated under this concept were the inability to communicate adequately with the students and to keep them focused on the lesson. The reflections of the changing learning environment with the pandemic also affected the designs of pre-service teachers. As a solution to the above-mentioned problems, the participants tried to design their materials focused on active participation. They took care to keep students active during the distance education process by preparing more entertaining questions, choosing short videos, doing more activities, and preferring platforms that students can use collaboratively. As Garrison and colleagues (1999) stated, these solutions actually show the importance of encouraging students' social presence in online teaching and learning.

With the emergency remote teaching process carried out during the COVID-19 pandemic, the lessons in schools turned to synchronous learning and teaching. Thus, the designs that were made by the pre-service teachers were specifically designed for synchronous education. However, a well-designed distance education process should be supported by other online teaching and learning activities rather than focusing only on synchronous learning. It would be appropriate to explain that distance education does not only contain synchronous parts to both in-service teachers who are continuing the teaching profession and pre-service teachers who are trained in schools of education. The courses given in the emergency remote teaching process should not be seen as a long-term solution. A well-designed distance education and emergency distance education should be separated from each other. The distance education experienced by in-service and pre-service teachers in this process and their views on this subject will play an important role for the future of distance education after COVID-19 (Bozkurt & Sharma, 2020). Awareness on this issue can be created through the development of knowledge and professional inclination about distance education. The emergency remote teaching carried out during the COVID-19 has also compelled the schools of education that train teachers to suddenly face this new education system. However, considering that distance education is on the way to become a big part of our lives, it would be appropriate to add courses to the schools of education programs that are specifically about instructional design for distance education.

In order for pre-service teachers to develop their TPACK expertise in distance education and to experience how they can use this knowledge in practice, the application of the TPACK-based IDM in distance courses was appropriate within the scope of this study. The participants stated that the emergency remote teaching carried out during the COVID-19 made positive contributions to them. They stated that emergency distance education is not only a solution to the current situation, but also helped them understand the importance of distance education. This whole experience was considered as important for their professional development. For this reason, instructional design of distance education courses is indeed a significant topic to educate pre-service teachers during their training at the school of education. However, educating them about TPACK use and its applications in distance education would help distance education progress in a more planned manner.

5. REFERENCES

Anderson, T. D., & Garrison, D. R. (1995). Transactional issues in distance education: The impact of design in audioteleconferencing. *American Journal of Distance Education*, *9*(2), 27-45. https://doi.org/10.1080/08923649509526886

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, *52*(1), 154-168. https://doi.org/10.1016/j.compedu.2008.07.006

Bates, A. W. (2020). *Dijital çağda öğretim* (E. Öztürk ve Z. Tuman, Çev.). Editör: Zeki Tuman, Basım sayısı:2, Erişim adresi: https://pressbooks.bccampus.ca/tonybates Erişim tarihi: 17.03.2021

Bauer, M. (2000). Classical content analysis: A review. In M. Bauer & G. Gaskell (Eds.), *Qualitative researching with text, image and sound* (pp. 131–151). Sage publications.

Bozkurt, A. (2020). Koronavirüs (Covid-19) pandemi süreci ve pandemi sonrası dünyada eğitime yönelik değerlendirmeler: Yeni normal ve yeni eğitim paradigması. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi, 6* (3), 112-142. https://dergipark.org.tr/en/pub/auad/issue/56247/773769

Bozkurt, A., & Sharma, R. C. (2020). Emergency remote teaching in a time of global crisis due to CoronaVirus pandemic. *Asian Journal of Distance Education, 15*(1), i-vi.

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2013). A review of technological pedagogical content knowledge. *Education Technology and Society, 16*(2), 31–51.

Cox, S., & Graham, C. R. (2009). Using an elaborated model of the TPACK framework to analyze and depict teacher knowledge. *TechTrends, 53*(5), 60-69.

Dede, C. (2007). Reinventing the role of information and communications technologies in education. *Yearbook of the National Society for the Study of Education*, *106*(2), 11-38. https://doi.org/10.1111/j.1744-7984.2007.00113.x

Dede, C. (2010). Technological supports for acquiring 21st century skills. *International encyclopedia of education*, *3*, 158-166.

Eren, E., & Ergulec, F. (2020). Technological Pedagogical Content Knowledge Based Instructional Design Model: An Evaluation in the Scope of School-University Cooperation. *Journal of Kirsehir Education Faculty*, *21*(3), 1247-1290. https://doi.org/10.29299/kefad.853475

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The internet and higher education, 2*(2-3), 87-105. https://doi.org/10.1016/S1096-7516(00)00016-6

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education*, *57*(3), 1953-1960. https://doi.org/10.1016/j.compedu.2011.04.010

Gunawardena, C. N., & Zittle, F. J. (1997). Social presence as a predictor of satisfaction within a computer-mediated conferencing environment. *American Journal of Distance Education, 11*(3), 8-26. https://doi.org/10.1080/08923649709526970

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education, 41*, 393–416.

Hu, S., & Kuh, G. D. (2002). Being (dis) engaged in educationally purposeful activities: The influences of student and institutional characteristics. *Research in Higher Education*, *43*(5), 555-575. https://doi.org/10.1023/A:1020114231387

ISTE (2017). ISTE standards for teachers. Erişim adresi: https://www.iste.org/standards/for-educators, Erişim tarihi: 17.03.2021.

Koehler, M. J., & Mishra, P. (2008). Introducing TPCK. AACTE Committee on Innovation and Technology. *The handbook of technological pedagogical content knowledge (TPCK) for educators* (pp. 3–29). Lawrence Erlbaum Associates.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60-70. https://doi.org/10.1177/002205741319300303

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers & Education*, *49*(3), 740-762. https://doi.org/10.1016/j.compedu.2005.11.012

Koh, J.H.L., Chai, C.S., & Lee, MH. (2015). Technological Pedagogical Content Knowledge (TPACK) for pedagogical improvement: Editorial for Special Issue on TPACK. *The Asia-Pacific Education Researcher, 24*, 459–462 https://doi.org/10.1007/s40299-015-0241-6

Koh, J. H. L. (2019). TPACK design scaffolds for supporting teacher pedagogical change. *Educational Technology Research and Development*, *67*(3), 577-595. https://doi.org/10.1007/s11423-018-9627-5

Lee, C. J. & Kim, C. (2014a). An implementation study of a TPACK-based instructional design model in a technology integration course. *Educational Technology Research and Development, 62*(4), 437–460. https://doi.org/10.1007/s11423-014-9335-8.

Lee, C. J. & Kim, C. (2014b). The second prototype of the development of a TPACK-based instructional design model: An implementation study in a technology integration course. *Contemporary Issues in Technology and Teacher Education, 14(*3), 297–326.

Lee, C. J. & Kim, C. (2017). A technological pedagogical content knowledge based instructional design model: A third version implementation study in a technology integration course. *Educational Technology Research and Development, 65*(6), 1627-1654. https://doi.org/10.1007/s11423-017-9544-z

Milli Eğitim Bakanlığı [MEB]. (2019). 2023 Eğitim Vizyonu. Erişim adresi: http://2023vizyonu.meb.gov.tr/, Erişim tarihi: 17.03.2021

Mishra, P. (2019). Considering contextual knowledge: The TPACK diagram gets an upgrade *Journal of Digital Learning in Teacher Education, 35* (2), 76-78. https://doi.org/10.1080/21532974.2019.1588611

Ottenbreit-Leftwich, A., Liao, J. Y. C., Sadik, O., & Ertmer, P. (2018). Evolution of teachers' technology integration knowledge, beliefs, and practices: How can we support beginning teachers use of technology?. *Journal of Research on Technology in Education*, *50*(4), 282-304. https://doi.org/10.1080/15391523.2018.1487350

Porras-Hernández, L. H., & Salinas-Amescua, B. (2013). Strengthening TPACK: A broader notion of context and the use of teacher's narratives to reveal knowledge construction. *Journal of Educational Computing Research*, *48*, 223–244. https://doi.org/10.2190/ec.48.2.f

Redmond, P., & Lock, J. (2019). Secondary pre-service teachers' perceptions of technological pedagogical content knowledge (TPACK): What do they really think?. *Australasian Journal of Educational Technology*, *35*(3). https://doi.org/10.14742/ajet.4214

Rosenberg, J. M. & Koehler, M. J. (2015). Context and technological pedagogical content knowledge (TPACK): A systematic review. *Journal of Research on Technology in Education*, *47*(3), 186-210. https://doi.org/10.1080/15391523.2015.1052663

Sadik, O. & Ergulec, F. (2021). Design and implementation of an instructional design course based on the principles of backwards design model and flipped learning approach, *Inonu University Journal of the Faculty of Education, 22*(2), 1544-1596. doi: 10.17679/inuefd.963284

Simons, H. (2009). *Case study research in practice.* SAGE publications.

Sun, J. C. Y., & Rueda, R. (2012). Situational interest, computer self-efficacy and self-regulation: Their impact on student engagement in distance education. *British Journal of Educational Technology*, *43*(2), 191-204. https://doi.org/10.1111/j.1467-8535.2010.01157.x

Tondeur, J., Aesaert, K., Prestridge, S., & Consuegra, E. (2018). A multilevel analysis of what matters in the training of pre-service teacher's ICT competencies. *Computers & Education*, *122*, 32-42. https://doi.org/10.1016/j.compedu.2018.03.002

Tseng, J. J., Cheng, Y. S., & Yeh, H. N. (2019). How pre-service English teachers enact TPACK in the context of web-conferencing teaching: A design thinking approach. *Computers & Education, 128*, 171-182. https://doi.org/10.1016/j.compedu.2018.09.022

Voogt, J. & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies. *Journal of Curriculum Studies*, *44*(3), 299-321. https://doi.org/10.1080/00220272.2012.668938

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J. & van Braak, J. (2013). Technological pedagogical content knowledge–a review of the literature. *Journal of Computer Assisted Learning*, *29*(2), 109-121. https://doi.org/10.1111/j.1365-2729.2012.00487.x

Vygotsky, L. S. (1978). Mind in society. (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.) Mind in Society the Development of Higher Psychological Processes (p. 159). Harvard University Press.

Wilson, M. L., Ritzhaupt, A. D., & Cheng, L. (2020). The impact of teacher education courses for technology integration on pre-service teacher knowledge: A meta-analysis study. *Computers & Education*, *156*, 103941. https://doi.org/10.1016/j.compedu.2020.103941

Yin, R. B. (2014). *Case study research: design and methods* (5th ed.). Sage Publications.

Zhao, Y. (2020). COVID-19 as a catalyst for educational change. *Prospects,* 1-5. https://doi.org/10.1007/s11125-020-09477-y

Zhu, X. & Liu, J. (2020). Education in and after COVID-19: Immediate responses and long-term visions. *Postdigital Science and Education,* 1-5. https://doi.org/10.1007/s42438-020-00126-3