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The Effect of Digital Material Preparation Training on Technological Pedagogical Content Knowledge Self-Confidence of Pre-service Social Studies Teachers

Dijital Materyal Hazırlama Öğretiminin Sosyal Bilgiler Öğretmen Adaylarının Teknolojik Pedagojik Alan Bilgisi Öz-Güvenlerine Etkisi

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ABSTRACT: This study examines whether digital material preparation training provided to pre-service teachers' using instructional technologies affects their levels of Technological Pedagogical Content Knowledge (TPACK) Self-Confidence. The research is conducted using the Embedded Design, one of the Mixed Methods Research Designs. Study group consists of 24 pre-service social studies teachers. Data is collected using TPACK Self-Confidence Scale (TPACK-SCS) and Semi-Structured Questionnaire. Pre-service teachers were trained on different Web 2.0 tools throughout the implementation phase and thereafter were asked to prepare different digital materials specific to social studies. Quantitative data collected were analyzed using descriptive and predictive statistics. Content analysis of qualitative data was performed using MaxQda 2020 qualitative data analysis software. Research findings revealed a statistically significant difference between pre-test and post-test scores of pre-service teachers' TPACK self-confidence levels. Pre-service teachers' fear of failure, presumed failure, and reluctance to be part of the process turned into a perception of success and self-efficacy following the training, and their learned helplessness disappeared. Teachers should be supported with a practice-based training that will integrate technological, pedagogical and content knowledge for developing TPACK as a comprehensive answer to 21st-century teaching competencies.

Keywords: TPACK self-confidence, digital material, web 2.0.

ÖZ: Bu çalışmanın amacı, öğretim teknolojileri üzerinden sağlanan dijital materyal hazırlama eğitiminin öğretmen adaylarının TPACK öz-güvenleri üzerindeki etkisini incelemektir. Çalışmada karma araştırma yaklaşımı içerisinde yer alan gömülü desen kullanılmıştır. Araştırmanın çalışma grubunu 24 sosyal bilgiler öğretmen adayı oluşturmaktadır. Araştırmada Teknolojik Pedagojik Alan Bilgisi Öz Güven Ölçeği, yarı-yapılandırılmış görüşme formu veri toplama aracı olarak kullanılmıştır. Uygulama sürecinde öncelikle öğretmen adaylarına farklı Web 2.0 araçları eğitimi verilmiş daha sonra öğretmen adaylarına sosyal bilgiler öğretimine özgü farklı dijital materyaller hazırlatılmıştır. Öğretmen adaylarından toplanan nicel verilerde betimsel ve kestirimsel istatistikler kullanılmıştır. Nitel verilerin çözümlenmesinde ise MaxQda 2020 nitel veri analiz programı kullanılarak içerik analizi yapılmıştır. Araştırma sonucunda öğretmen adaylarının TPACK öz-güven düzeyleri ön test ve son test puanları arasında istatistiksel olarak anlamlı bir fark bulunmuştur. Öğretmen adaylarının başlangıçta taşıdıkları başarısız olma endişesi, ben yapamam ön kabulü, sürecin bir parçası olmaya gösterilen isteksizliğin verilen eğitim sonrasında başarabilirim, ben de yapabilirim algısına dönüştüğü, öğrenilmiş çaresizliğin ortadan kalktığı tecrübe edilmiştir. 21. yüzyılın öğretmen yeterliğine kapsamlı bir cevap olan TPACK'ın gelişimi için teknolojik, pedagojik, alan bilgisini bütünleştirmeye imkan sağlayan uygulamaya dayalı bir öğretmen eğitimine ihtiyaç olduğunu düşünülmektedir.

Anahtar kelimeler: TPACK öz-güven, dijital öğretim materyali, web 2.0.

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Developing at an extraordinary pace and featuring unlimited information, digital technologies have become an indispensable need of humanity and provide a return in the economy, health, transportation, agriculture, science, management and education, i.e. in all areas of need (Karakuş-Yılmaz, 2020). That being the case, it has become almost impossible to lag behind digital technologies or live without them. Rapid developments in technology have led to a significant digital transformation in education, as in all fields, and forced all stakeholders to keep up with this transformation. As an inevitable consequence of the widespread use of technology in society, the curriculum in teaching is oriented towards more comprehensive and innovative applications of technology (Smith & Broom, 2003). As a matter of fact, the century we are in forces the school to go beyond traditional boundaries by providing technological, informative and communication skills required by the students (Shapley et al., 2011). Today's productive classroom environments encourage, make use of and explore technology in order to develop a strong foundation for learning (Koehler & Mishra, 2009). In this way, students become familiar with technology and learn quickly (Schunk & DiBenedetto, 2016). Policymakers, business leaders and educators are aware of the widespread impact of technology on individuals' daily lives and its future opportunities (Friedman, 2005). Therefore, it is no coincidence that vast majority of 21st-century skills are directly or indirectly connected with digital technologies (Günüç et al., 2013). In other words, digital technologies are valuable and well-functioning teaching tools when used accurately in appropriate environments (Becker, 2000). However, not only the proper integration of technology into classroom environments but also students' ability to take advantage of a technology-enriched learning environment are entirely dependent on teachers (Kurt, 2014).

What seems necessary is that teachers should adopt a technology-integrated approach when it comes to organizing their teaching activities so as to enable their students to become ready for what a digital future could bring forth (Lachner et al., 2021). In this respect, teachers must adapt to digital technologies (Karakuş-Yılmaz, 2020). In fact, many researchers agree that teachers should have positive attitudes towards using technology to effectively engage it in classroom activity (Lawton & Gerschner, 1982; Woodrow, 1992). To be graded as qualified teachers, teachers should be able to acquire information by using appropriate technology strategies (Lin et al., 2013), besides improving themselves in the use of technology (Üredi & Ulum, 2020). Teachers should be willing to learn the use of technology in order to successfully incorporate technology into their interactions with students in the classroom (Kozma, 2003). As a matter of fact, efficiently taking advantage of using technology while teaching is an undeniable qualification as learning environments are affected by rapid developments in instructional technologies (Kapici & Akcay, 2020). Today, students use various Web 2.0 tools such as social networks, text messaging applications, media sharing, blogs and wikis for both communication and collaboration purposes; however, it is not that possible to say that teachers use these tools effectively enough (Pence, 2007; Roussinos & Jimoyiannis, 2013). Unfortunately, teachers often seem to lack sufficient or proper experience in professional terms, resulting in inadequate capacity to effectively employ digital technologies for teaching and learning purposes (Koehler et al., 2013). The fact that teachers do not possess the equipment to bring technology to their classrooms and the lack of self-confidence for using these

technological hardware (Ma, et al., 2005) are among the factors that prevent them from integrating technology into their classrooms (Collis & Moonen, 2008). Considering the critical roles of teachers, it is, therefore, necessary that they present not only positive attitudes but also adequate digital literacy skills so that they can successfully integrate teaching-related technology into their classroom environments (Hignite & Echternacht, 1992). From this standpoint, efforts to reorient teachers' attitudes could be a key solution to achieve technology integration (Marcinkiewicz, 1993).

In accordance with the experiences of countries that have already succeeded in efficiently and effectively incorporating technology in education, it is a basic prerequisite for teachers and pre-service teachers to be duly trained in this direction in order to use technology more effectively (Yücel et al., 2010). There will be differences between the teaching methods of a teacher who learns how to integrate technology into the current curriculum and a teacher who does not go through such a training (Christensen, 2002). Consequently, drawing on technology effectively for teaching purposes has clearly become one of the critical proficiencies of teachers in many countries around the world (Muhaimin et al., 2019; Thohir et al., 2020). In view of this, "providing teachers the necessary assistance to effectively incorporate technology into teaching and learning processes" is one of the crucial initiatives to be taken in an effort to turn the country's past and ongoing investments to advantage as regards instructional technologies (U.S. Congress, Office of Technology Assessment, 1995, p. 8). By considering the necessity of enabling prospective teachers to establish the connection between theoretical knowledge and practice in the Initial Teacher Education (ITE) process (Kessels & Korthagen, 2001), this study has drawn a roadmap to contribute to these steps. In this connection, an exemplary teaching process based on practice is aimed to be built by taking the TPACK model of Mishra and Koehler (2006) as a reference, which sets a framework for 21st century teacher competence. During the process building, we have aimed to eliminate the "lack of self-confidence" that prevents prospective teachers from integrating technology into teaching. Being one of the digital tools that teachers can reach and use in the easiest way, Web 2.0 tools (Karakuş-Yılmaz, 2020) have been included in this effort adopted by the researchers.

Theoretical Framework

Web 2.0 Tools

Using various teaching methods to make education qualified and integrate these methods into computer technologies is the need of the age that we live in (Avcı et al., 2019). Over the past decade, the nature of the Web has evolved, transforming from a rather passive group receiving information transmitted by a small group of experts (Web 1.0) into a Web environment (Web 2.0) where users are active, support collaboration and share ideas (Jimoyiannis et al., 2013). Web 2.0 tools have become widespread due to worldwide access to the Internet as well as standing out social skills and creativity (Crook, 2012). Web 2.0 tools refer to rather dynamic environments, where users can actively participate in, create, and share content (O'Reilly, 2009), allowing users to create their own Web products and read the content provided (Brown, 2012). Similarly, it represents the collaborative, interactive Internet that contributes to individuals' data and information sharing, creativity and universal perspective (Drexler et al., 2008). Web 2.0, also referred to as the second generation Web applications, allows individuals to

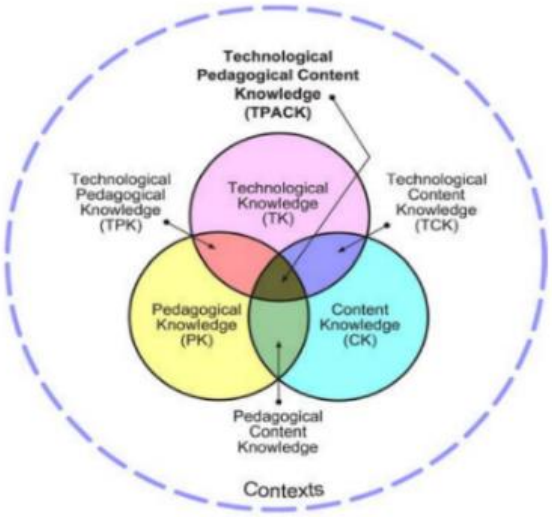
produce content, communicate, and collaborate by using digital images, videos, and texts besides consuming the data provided (Jimoyiannis, 2015). This indicates that the origins of Web 2.0 tools and the goals of the constructivist approach adopted in today's educational practices support each other (Lu et al., 2010). Digital materials with rich visual content, prepared using Web 2.0 tools, not only allow students to participate in the educational environment with multiple sense organs and support permanent learning (Elmas & Geban, 2012) but also ensure both students and teachers to exchange information interactively without being limited to the classroom environment (Çömez et al., 2021). Web 2.0 tools develop a new learning culture by supporting students' active participation, creativity, collaboration, communication and exchanging ideas (Jimoyiannis et al., 2013). Based on the multifaceted contribution of Web 2.0 tools to learning environments, these tools are considered a technological innovation that supports the transformation in the education system and is required to be integrated into educational environments (Elmas & Geban, 2012). Given that purpose of integration, Mishra and Koehler (2006) devised a model that integrated technology, pedagogy and content knowledge and named it the Technological Pedagogical Content Knowledge (TPACK) framework. In the same way, the educational Web 2.0 tools (Jimoyiannis, 2015), which ensure the integration of pedagogy and content knowledge with technology, overlap conceptually and contextually.

Technological Pedagogical Content Knowledge

Teacher training programs are constructed on two different concepts: content knowledge, which answers the teachers' question of what to teach; the other one is pedagogical knowledge, which provides the answer to how to teach (So & Kim, 2009). Shulman (1986) stated that pedagogical knowledge and content knowledge, considered two obsolete concepts, are interrelated; hence they should jointly be defined as Pedagogical Content Knowledge (PCK). Lundeberg et al. (2003) conducted a study with pre-service teachers who jointly examined pedagogy, content and technology whereas Mishra and Koehler (2006) further extended Shulman's concept of PCK, by including the technology sub-dimension therein. Accordingly, they introduced a new dimension into the literature by including technology and re-defined it as Technological Pedagogical Content Knowledge (TPACK). TPACK model developed by Mishra and Koehler (2006) and the basic components of this model are exhibited in Figure 1.

Figure 1

TPACK Model and Its Basic Components



Note. (Mishra & Koehler, 2006)

As exhibited in Figure 1, TPACK consists of three basic and interrelated components, namely Content Knowledge (CK), Pedagogical Knowledge (PK) and Technological Knowledge (TK). Beyond these three individual and basic components, TPACK has an intertwined structure. This structure consists of Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK) (Chee et al., 2017).

Despite the lack of a commonly acknowledged theoretical definition (Aktaş & Özmen, 2020), TPACK, which refers to the effective use of technology by teachers for the clear purposes of teaching and learning (Huang & Lajoie, 2021), denotes the purposeful integration of content knowledge with that of technology, as well as with teaching and learning (Niess, 2005; Timur & Taşar, 2011). For the purpose of this integration, the teacher uses current technologies to support students' learning by taking into account the needs of the student and the conditions of the classroom when planning, organizing, criticizing, and summarizing a topic (Niess, 2008). In other words, the main goal is to harmonize the technology with the subject and provide complementary teaching methods in learning (Mishra & Koehler, 2006). Referring to the understanding of how technology, pedagogy and content knowledge interact for achieving this goal (Rosenberg & Koehler, 2015), TPACK is regarded as an indispensable professional qualification for teachers considering their role in today's learning environments (Joo et al., 2018). Accordingly, teachers are required to associate the most convenient method that will ensure the implementation of TPACK with the content of the subject to be taught (Aktaş & Özmen, 2020). Throughout this integration, TPACK supports the teachers in organization, implementation, criticizing the results, summarizing detailed course plans and identifying students' needs while integrating the most convenient technology (Aisyah et al., 2021). A growing number of researchers suggest that teachers should be equipped with a well-developed technological pedagogical content knowledge (TPACK) so that they become capable of integrating

appropriate technological tools in teaching (Cox & Graham, 2009). Literature review on TPACK revealed a wide range of studies conducted in different fields such as *classroom training* (Bayrak & Bayrak, 2021; Makawawa et al., 2021; Üredi & Ulum, 2020); *preschool education* (Hartati & Fahrurrozi, 2021); *social studies education* (Bal & Karademir, 2013; Hammond & Manfra, 2009; Knapp, 2017; Mutiani et al., 2021; Torun, 2020); *Language Teaching* (Adipat, 2021; Aisyah et al., 2021); *Mathematics Teaching* (Araujo-Filho & Gitirana, 2022; Dikkartın-Övez & Akyüz, 2013) and *Science Teaching* (Aktaş & Özmen, 2021; Bahriah & Yunita, 2019; Ramnarain et al., 2021). Although there are many studies on TPACK in different fields, the focus of this study is particularly on social studies teaching. The social studies course, which emerged with the integration of different branches of social sciences (history, geography, sociology, political science, etc.) with an interdisciplinary approach (NCSS, 1994), makes teachers confront some problems in the teaching process (Russell, 2010). Problems such as a comprehensive content, the existence of abstract concepts and the difficulty of teaching them (Memişoğlu & Tarhan, 2016), as well as associating teaching as a monotonous and boring process (Heafner, 2004), and the difficulty of motivating students to the lesson (Çakmak & Aslan, 2016) have attracted social studies educators and prompted the search for an answer to the following question: "How can I build a more qualified learning process?" Since this study contributes practically to the development of prospective social studies teachers in terms of technological, pedagogical and content knowledge, it is of great importance in terms of offering an alternative solution to the problems that prospective teachers may encounter in the future.

An increasing number of educators agree that technology can no longer be considered a separate bulk of knowledge, abstracted from the pedagogical and content knowledge needed by teachers (Wang et al., 2018). In this regard, it has become inevitable to support pre-service teachers while they are still being trained to become teachers in terms of developing their TPACK to enable them to prepare their prospective students for a digital future (Lachner et al., 2021). Ongoing COVID-19 pandemic and the resulting mandatory distance education practices have made it mandatory to consider technology integration, technological competencies of teachers and the pedagogical methods to be applied in digital environments as a whole. In this context, it is essential to ensure pre-service teachers to develop a positive attitude towards technology before starting their profession (Çelik & Kahyaoğlu, 2007). Training the pre-service teachers on integrating Web 2.0 tools in their teaching activity throughout academic education or encouraging them to actively use these tools throughout these trainings will contribute significantly to the development of TPACK self-confidence. Literature review indicated that vast majority of the studies conducted aimed assessment. Furthermore, applied studies therein have been found to be limited. This research, which aims to contribute to this gap identified in the literature, covers a long process in which teaching, implementation, feedback and evaluation are intertwined and complementary. These considerations make this research different from other studies in the literature.

In consideration of the above-mentioned issues, we may define the goal of this paper as:

- To examine the effect of digital material preparation training provided through instructional technologies on pre-service teachers' TPACK Self-Confidence.

Method

Research Design

This research was conducted using the Mixed Methods Research Design, which was classified differently by different researchers. For the purpose of this research, The Embedded re-classified by Creswell and Plano-Clark (2007) [triangulation, embedded, explanatory and exploratory designs] was used (Creswell & Plano-Clark, 2007). In The Embedded Design, quantitative and qualitative data support each other (Creswell, 2009, 2012). Quantitative data of this research were supported by qualitative data. The quantitative dimension of the research was analyzed using a One-Group Pretest-Posttest Design (McMillan & Schumacher, 2014). Semi-structured interviews were conducted to support quantitative data with qualitative data. The Embedded Design of the Mixed Methods Research Design was used herein to determine the effect of digital material preparation training on TPACK self-confidence of pre-service teachers and explain the causes underlying this effect through the opinions of pre-service teachers.

Study Group

This study was conducted in the 2020-2021 academic year, with the participation of a total of 24 (22 female, 2 male) pre-service teachers (who attended the material design course in social studies teaching) determined in accordance with the convenience sampling of purposive sampling method among the 3rd-grade students studying at the Department of Social Studies Education of a state university. Qualitative dimension of the research was analyzed via interviews held with 9 participants selected among the pre-service teachers participating in the research. Interviewees were determined according to the maximum variation sampling of the purposive sampling method. Maximum variation of the interviewees is achieved by taking into account the levels of the materials prepared by the pre-service teachers (good, medium, poor).

Data Collection Tools

Technological Pedagogical Content Knowledge Self-Confidence Scale (TPACK-SCS)

Data is collected with Technological Pedagogical Content Knowledge Self-Confidence Scale (TPACK-SCS), constructed by Graham et al. (2009) and adapted into Turkish by Timur and Taşar (2011). The scale consisting of a total of 31 items and four sub-dimensions [Technological Pedagogical Content Knowledge (TPACK), Technological Pedagogical Knowledge (TPK), Technological Knowledge (TK) and Technological Content Knowledge (TCK)] is a five-point Likert-type scale. The Cronbach Alpha reliability coefficient for the whole scale and this research were calculated as .92 and .91, respectively.

Semi-Structured Questionnaire

The opinions of pre-service teachers, following the implementation phase, were evaluated by a semi-structured questionnaire. The prepared questionnaire was applied to 9 pre-service teachers. The participants were notified in advance of the interviews that the information collected would be processed only for research purposes, that their

personal data would be kept confidential and the interviewees' names be anonymized (PT./1, PT./2, PT./3... PT./9).

Implementation

The implementation was carried out with pre-service teachers attending "Material Design in Social Studies Teaching" course. The process aimed to ensure pre-service teachers to design digital materials suitable for teaching social studies using technological, pedagogical and content knowledge, which would further be integrated effectively in their teaching activities. For this purpose, Web 2.0 tools were introduced to pre-service teachers to improve their technological competencies. They were enabled to create digital teaching content using these tools. The research argues that it would be more practical and functional to design and use materials that may be integrated into a specific part of a course process and different stages. From this point of view and in order for the prepared material to be suitable for its intended purpose, pre-service teachers were provided the opportunity to develop digital materials using different Web 2.0 tools (Mentimeter, Canva, Powtoon and Kahoot) suitable for each step of the 5E instructional model (encompassing the phases Engage, Explore, Explain, Elaborate, and Evaluate), which is a *pedagogical approach* teachers used to execute the course process in a planned and programmed manner. For the purpose of the materials developed, the content knowledge was provided by the social studies course curriculum as of the 2018 academic year in addition to social studies textbooks. Thus, an implementation phase that allows joint use of three main components of TPACK (technological knowledge, pedagogical knowledge and content knowledge), whose framework was set by Mishra and Koehler (2006), was carried out. The implementation lasted for a total of 9 weeks with periods of 40+40 minutes. The implementation phase is presented in detail in Table 1.

Table 1

Implementation Phase

Timing of the Implementation (Week)	Instructional Tools	Instructional Model	Implementation Phase
13.11.2020 (1. Week)	Google Tools	Introduction	Pre-service teachers were informed about and introduced to several Google Tools. Then, Technological Pedagogical Content Knowledge Self-Confidence Scale (TPACK-SCS) was applied to pre-service teachers as a pre-test via Google forms.
20.11.2020 (2. Week)	Mentimeter https://www.mentimeter.com/	Preparing the Readiness Test, Generating Word Clouds Engage	Pre-service teachers were informed about various digital applications which they could use throughout their teaching lives to assess the readiness levels of their students with regard to the subject taught at the beginning of the course. The Mentimeter digital application was introduced to pre-service teachers. A sample Mentimeter implementation was executed with the participation of pre-service teachers. Then, pre-service teachers were asked to prepare a similar Mentimeter application for any learning area of the social studies course. Finally, the Word Clouds generated by pre-service teachers in the Mentimeter were collected via e-mail for evaluation.

27.11.2020 (3. Week)	Canva https://www. canva.com/	Preparing Infographics Explore	Word Clouds generated by pre-service teachers in the Mentimeter were evaluated and they were provided with feedback. Word Clouds generated was shared in an online platform with the attendance of pre-service teachers. Digital products prepared in accordance with the purpose were reviewed. Then; infographics, prepared using the Canva application in order to allow students to explore the topic being taught, were exhibited to prospective teachers. Sample implementations were executed with the participation of pre-service teachers. Pre-service teachers were asked to prepare a similar Infographic content for any learning area of the social studies course. Infographics generated were collected via e-mail for evaluation.
04.12.2020 (4. Week)	Powtoon https://www. powtoon.com/edu-home/	Creating Digital Stories Explain	Infographic digital products generated by pre-service teachers using Canva were evaluated and they were provided with feedback. Infographic content generated was shared in an online platform with the attendance of pre-service teachers. Digital products prepared in accordance with the purpose were reviewed. Then; they were introduced several digital applications to be used in order to explain the topic being taught. Powtoon application, an important Web 2.0 tool in this regard, was introduced herein. Sample Powtoon implementations were executed with the participation of pre-service teachers. Subsequently, pre-service teachers were taught what a digital story is and the processes of preparing a digital story. Then, teachers were asked to prepare a similar digital story content for any learning area of the social studies course. Following week, digital stories were reviewed. Pre-service teachers who made the necessary corrections were asked to prepare digital stories through Powtoon. Digital stories generated were collected via e-mail for evaluation.
11.12.2020 (5. Week)			
18.12.2020 (6. Week)	Powtoon https://www. powtoon.com/edu-home/	Creating Digital Stories Elaborate	Digital stories generated by pre-service teachers using Powtoon were evaluated and they were provided with feedback. Digital stories were shared in an online platform with the attendance of pre-service teachers. Errors in the generated digital stories were corrected, deficiencies were repaired. Digital stories prepared in accordance with the purpose were reviewed in detail with the attendance of pre-service teachers. Then, pre-service teachers were asked to prepare a similar digital story content for any learning area of the social studies course with a Web 2.0. tool, Powtoon application, in order to elaborate into the topic to be taught. Digital stories generated were collected via e-mail for evaluation.
25.12.2020 (7. Week)			
31.12.2020 (8. Week)	Kahoot https://kahoot.com/	Preparing an Assessment Test Evaluate	Digital stories generated by pre-service teachers using Powtoon were evaluated and they were provided with feedback. Digital stories were shared in an online platform with the attendance of pre-service teachers. Digital stories prepared in accordance with the purpose were reviewed in detail. Samples prepared in accordance with the purpose were watched online with the attendance of pre-service teachers. Afterwards; digital applications that can be used to measure how much students have learned throughout the course, in other words to evaluate the teaching process, were introduced. Focus was on Kahoot, which is one of these digital applications. A sample implementation was executed with the participation of pre-service teachers. Then, pre-service teachers were asked to prepare a similar Kahoot application for any learning area of the social studies course. Kahoot applications generated were collected via e-mail for evaluation.

07.01.2021 (9. Week)	Google Tools https://www.google.com.tr/?gws_rd=ssl	Process Evaluation	Sample multiple-choice tests prepared by the pre-service teachers with the Kahoot application were evaluated and they were provided with feedback. Sample Kahoot applications were shared on an online platform. Kahoot-supported evaluation tests prepared in accordance with the purpose were reviewed in detail. Then, Technological Pedagogical Content Knowledge Self-Confidence Scale (TPACK-SCS) was applied to pre-service teachers as a post-test via Google forms. Furthermore, the opinions of pre-service teachers about digital course material preparation teaching were also collected through the same application.

Below are examples of different digital materials generated by pre-service teachers throughout the implementation phase with regard to the learning outcomes in different areas of the social studies course.

Figure 2 exhibits sample Word Clouds prepared by pre-service teachers via Mentimeter (https://www.mentimeter.com/) at the beginning of the course to determine the readiness of students on the topic.

Figure 2

Mentimeter Application Samples

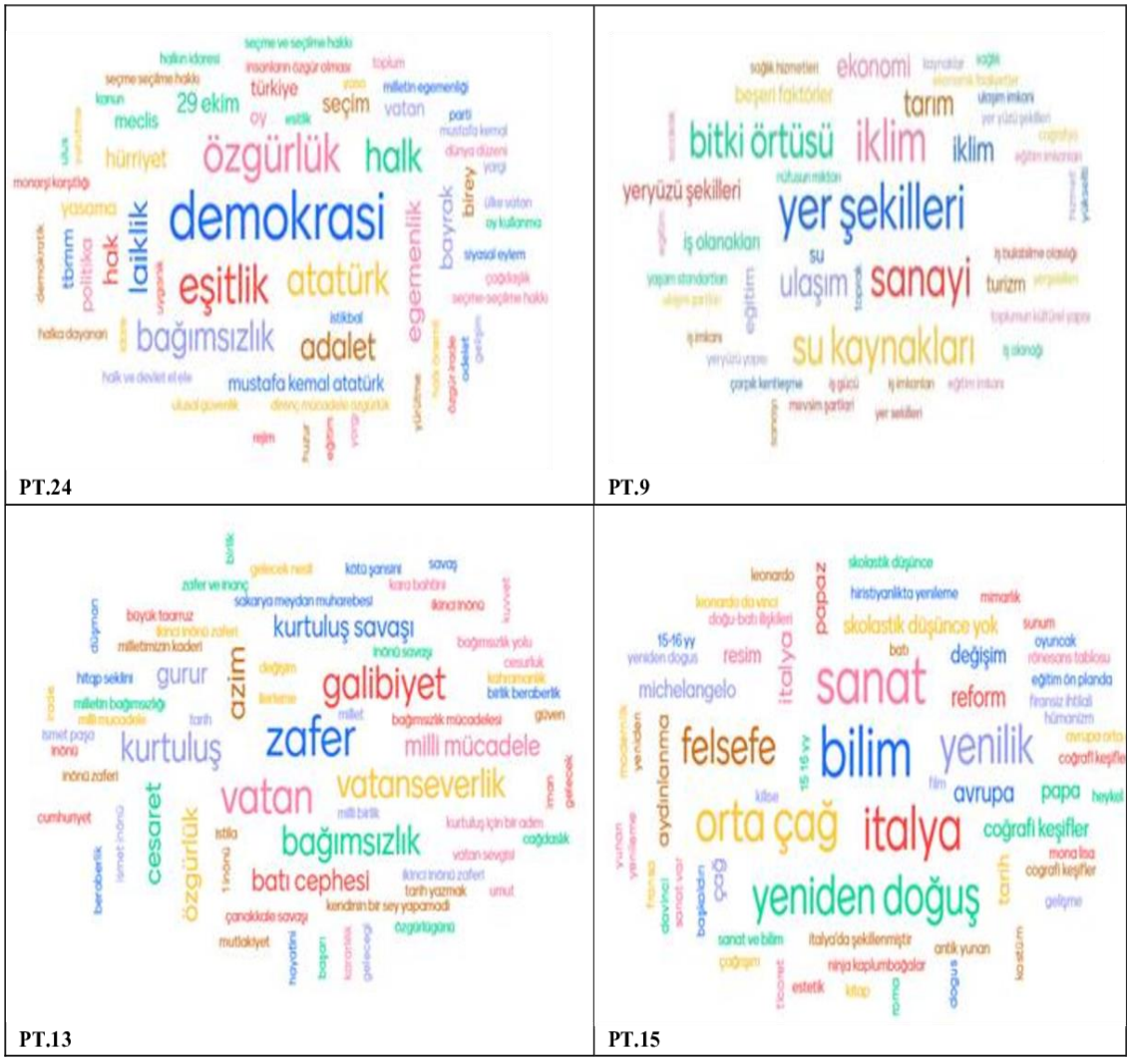


Figure 3 exhibits sample Infographics prepared by pre-service teachers via Canva (https://www.canva.com/) in the explore phase of the course in order to enable students to make inferences about the subject to be taught.

Figure 3

Sample Infographics

By using Powtoon (https://www.powtoon.com/edu-home/); pre-service teachers prepared digital stories to teach a new topic in the "Explain" phase of the course and to enable students to reinforce the topic they learned in the "Elaborate" phase. An example digital story is exhibited in Figure 4.

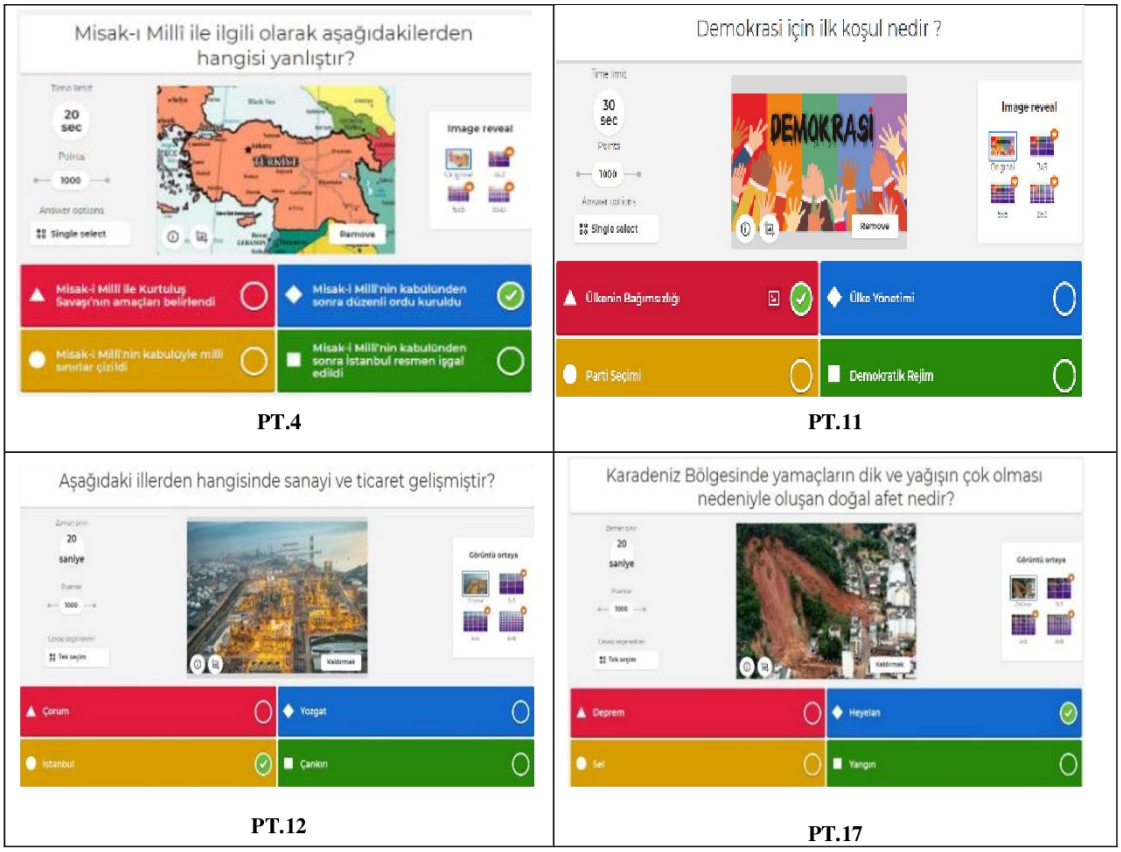
Figure 4

Sample Digital Story

Sample multiple-choice assessment tests, prepared by Kahoot (https://kahoot.com/) in the "Evaluate" phase in order to determine at what level the students learned the relevant subject is exhibited in Figure 5.

Figure 5

Sample Kahoot Applications



For the purpose of the digital materials prepared, pre-service teachers jointly used the three basics of TPACK. Prospective teachers developed the technological sub-dimension through Web 2.0 tools, while the 5E learning model provided a framework for combining technology and pedagogy. They improved their content knowledge through the social studies course curriculum that they will be required to teach in the future. Consequently, they had the opportunity to practice all the components necessary for TPACK.

Data Analysis

Analysis of the Data Collected Through Technological Pedagogical Content Knowledge Self-Confidence Scale (TPACK-SCS)

Following the necessary arrangements, the normality of the quantitative data collected in the research was checked to decide which parametric or non-parametric tests to use for data analysis. As the data showed a normal distribution, they were analyzed using a Paired Samples t test to calculate the effect sizes. The effect size of .8 is usually considered as large, .5 is considered as medium, whereas .2 is considered as small (Can, 2017; Green & Salkind, 2005; Pallant, 2005).

Analysis of Semi-Structured Interviews

Content analysis was used to analyze the interviews conducted to collect qualitative data as a result of the study. During the data analysis, the process steps recommended by Miles and Huberman (2016, pp. 58-65) were taken into consideration,

namely, "code generation, code review, code definitions, code naming, control coding, and coding time". In this connection, each researcher first coded the available data. Later, the researchers reviewed the codes they generated several times and then defined the finalized codes. At the stage of defining the codes, they examined how the concept identified for the code was expressed in the relevant literature (For example, self-confidence is the belief that individual can successfully perform a certain activity (Feltz, 1988). In this context, PT.7 said, "*I had no knowledge of producing digital material before. Now I can easily make digital materials."* PT.6 likewise said, *"As I used Web 0.2 tools, my self-confidence increased. Now I can easily use tools like Mentimeter, Canva, Kahoot and Powtoon").* In naming the codes, the name closest to the concept was given to each code and no numbers were used. A consensus was reached among the researchers for the control coding of the data. In this context, reliability was calculated by using the following formula: [(Reliability = number of agreements / (total number of agreements + number of disagreements)]. The reliability coefficient is generally desired to be 90% (Miles & Huberman, 2016). In this study, the reliability was estimated as 96%. The analysis of the data was analyzed immediately without waiting for the next data, paying attention to the coding time of the data in an attempt to form a perspective for the next coding. Direct quotations from the responses of the prospective teachers were included and the findings interpreted. During the implementation process, the personal data regarding the prospective teachers was kept confidential, and those with whom the interviews were conducted were coded as PT.1, PT.2, PT.3...and PT.9, etc.

Ethical Procedures

Before proceeding to the implementation phase, participants were notified about the purpose of the study. Principle of volunteerism is observed when determining the study participants. Pre-service teachers were duly notified that they would be able to leave the research unconditionally in any phase. In none of the phases, the real identity information of the pre-service teachers was disclosed. The fact that the research does not pose an ethical problem has been confirmed by the ethics committee report issued 927 and dated 27.11.2020 received from Human Research Ethics Committee of Zonguldak Bülent Ecevit University.

Results

Firstly, the findings related to the "Technological Pedagogical Content Knowledge Self-Confidence" of pre-service teachers were explained. Then, opinions of pre-service teachers with regard to the digital materials generated throughout the process and the effect of these materials on their "Technological Pedagogical Content Knowledge Self-Confidence" were explained.

Findings related to the Technological Pedagogical Content Knowledge Self-Confidence of Pre-service Teachers

Paired Samples t-Test was used to determine whether there is a significant difference between TPACK pre-test and post-test results of pre-service teachers. Test results are exhibited in Table 2.

Table 2

Paired Samples t-Test Results with regard to TPACK Self-Confidence Pre-Test and Post Tests

	Implementation	*N*	$\bar{X}$	*Ss*	*Sd*	*t*	*p*
TPACK	Pre-test	23	29.39	4.22	5.22	-3.51	.00*
	Post test	23	33.21	4.03			
TPK	Pre-test	23	27.47	4.54	5.55	-3.45	.00*
	Post test	23	31.47	4.11			
TCK	Pre-test	23	14.26	5.69	8.46	-1.15	.25
	Post test	23	16.30	6.73			
TK	Pre-test	23	38.17	6.73	11.26	-2.94	.00*
	Post test	23	45.08	7.87			

*p<.01

Table 2 reveals a significant difference (p<.05) between the pre-test and post-test mean scores of TPACK [*pre-test* $\bar{X}$=29.39, *post-test* $\bar{X}$=33.21], TPK [*pre-test* $\bar{X}$=27.47, *post-test* $\bar{X}$=31.47] and TK [*pre-test* $\bar{X}$=38.17, *post-test* $\bar{X}$=45.08] sub-dimensions. However, no statistically significant difference was found between the pre-test ($\bar{X}$=14.26) and post-test ($\bar{X}$=16.30) mean scores of TCK sub-dimension (p>.05). The effect sizes for the TPACK, TPK and TK sub-dimensions were calculated in the analysis as d= .92, d= .92 and d= .94, respectively, and these values were concluded to indicate a large effect. In other words, the findings have revealed that digital material preparation training provided through instructional technologies had a statistically significant effect on the TPACK self-confidence levels of pre-service teachers.

Opinions of Pre-service Social Studies Teachers on the Process of Preparing Digital Materials

Pre-service social studies teachers provided training on preparing digital materials specific to the social studies were asked to reply to the question, “How can you define the modifications that the digital material preparation training you participated in brought to you?” Findings derived through the opinions of pre-service social studies teachers with regard to the effects of digital material preparation training are exhibited in The Max Map Code Generation Model in Figure 6.

Figure 6

The Max Map Code Generation Model with regard to the Digital Course Material Preparation Training

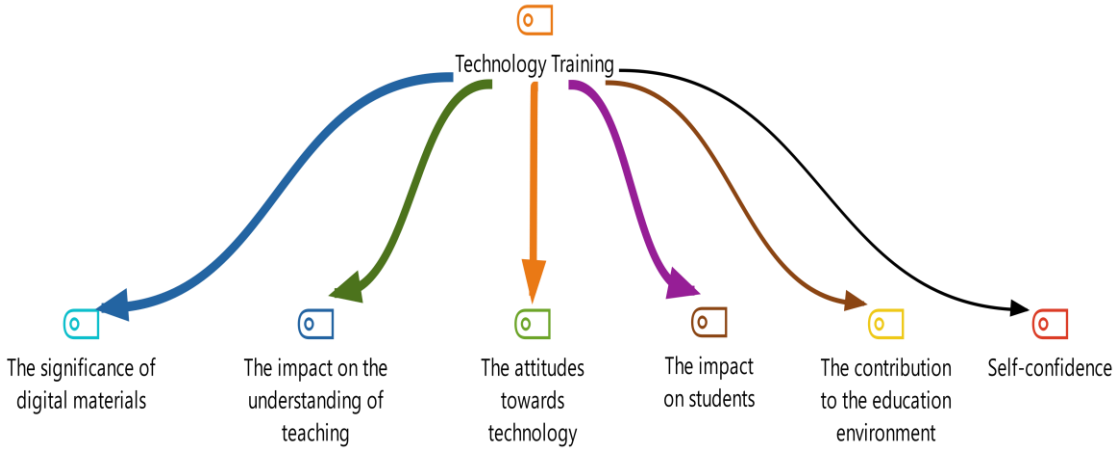


Figure 6 reveals that the data collected from pre-service teachers as a result of the analysis were categorized under the following codes with regard to digital material preparation training: *the significance of digital materials, the impact on the understanding of teaching, the attitudes towards technology, the impact on students, the contribution to the education environment* and *self-confidence*. The evaluation of these codes through the statements of pre-service teachers featured the student-focused structure of digital materials. Based on the features of the Web 2.0 tools used in the instruction process, one of the pre-service teachers expressing an opinion in this regard was PT.4 (pre-service teacher) who said: "*Using the digital material development tools that we have learned, we can prepare the materials that match the learning styles of today's students*." PT.5 stated that generated digital materials "*enabled the students to focus on the lesson*" while PT.9 stated that generated digital materials "*enabled students to develop creative thinking and critical perspective*". Similarly, PT.9, who evaluated the process, emphasized that digital materials ensure permanent learning by appealing to multiple senses by saying that "we have generated beautiful materials that will contribute to permanent learning by combining audio, video and visual elements in the digital story application". PT.2 reflected the importance of digital materials through his own life by saying "*At the end of these trainings, I realized the importance and necessity of using digital materials*" while PT.7 pointed out that digital materials may provide teachers with important opportunities regarding instruction processes by saying, "*These digital materials will make a great contribution to the teaching profession*".

Positive changes have been observed with regard to the understanding of teaching of pre-service teachers receiving training on digital material preparation. Such a change was reflected in the opinions of PT.2 with the words, "*At the end of the trainings we received, I learned that the teaching profession is not limited to the content knowledge, I also need to get to know other fields*". On the other hand, PT.9 verbalized the change brought about by the digital material preparation training with the words "*I realized that we need to use digital materials to teach lessons more effectively and with fun*." PT.6, who has experienced the positive effects of digital materials, emphasized the significance of using digital materials in his future teaching plans by saying "*While*

teaching, I will support my lesson with technology using Web 2.0 tools in the classroom instead of being limited to a lecture". PT.1, who has experienced the importance of digital materials just like PT.6, emphasized that student-centered digital materials may be an alternative to traditional teaching methods by saying, "*Students of today think that the lessons taught by being limited to traditional teaching methods are boring. That's why I realized that I needed to find new ways to ensure the student like the lessons*".

Pre-service teachers who were provided training on preparing digital materials stated that they are no longer afraid of using technology and that they have become aware of using technology effectively in all areas of life, not just in educational settings. Evaluating this situation, PT.3 revealed the change in his views with regard to technology by saying: "*I had little knowledge about technology and I was even afraid of using technology. Owing to these trainings, I started to like technology and use it effectively in teaching instead of being afraid of it*". PT.7 interpreted the process of preparing digital materials based on his own experience with his words as follows: "*At the beginning, I had a little difficulty. But then it became more entertaining*." PT.8, who evaluated another aspect of digital materials, pointed out that developing technology has significantly transformed the traditional classroom environment with his explanation: "*I realized that the technology may be used regardless of time and space and it really saves time*."

Pre-service teachers participating in digital material preparation training stated that they will be able to develop high-quality digital materials that will contribute to learning processes using the Web 2.0 tools that they have learned herein. Drawing attention to the general structure of social studies classes, PT.1 presented a rationale for why digital materials should be used in social studies courses in his statements: "*Social studies course is usually taught via a lecture accompanied with course slides, which causes the lessons to be boring*." Based on this reason, PT.9, PT.4, PT.3 and PT.7 respectively expressed their views on the contributions of the Web 2.0 tools taught as: "*make the boring content of the social studies course more fun*", "*make it more enjoyable*", "*allow learning without getting bored*" and "*allow learning to be permanent*". Addressing the opinions expressed by different pre-service teachers about the contributions of Web 2.0 tools on students' learning processes, PT.6 clarified the multifaceted contributions of Web 2.0 tools with the words: "*for instance, when I incorporate Kahoot application at the end of the unit, I will not only ensure the participation of my students and give them the opportunity to have fun but also, I will be able to give them feedback. Thus, I will have the opportunity to prevent and correct incorrect learning*."

Pre-service teachers participating in digital material preparation training have stated that Web 2.0 tools they have learned will make numerous contributions to educational environments. Evaluating these effects, PT.4 said that "*owing to these tools, educational environments may be transformed into much more fun places*" while PT.7 emphasized that *these tools may contribute to permanent learning by attracting the attention of students*. Furthermore, by saying that "*these tools give us the opportunity to address multiple sense organs*", PT.9 revealed the ability of Web 2.0 tools to address different sensory organs of students. In addition, PT.5, PT.2 and PT.6 respectively pointed out the benefits of Web 2.0 tools as "*they save time*", "*allow the topics to be*

taught more efficiently" and "*thanks to these tools, abstract concepts may be transformed into rather concrete ones*".

Pre-service teachers participating in a nine-week digital material preparation training stated that the training improved their self-confidence with regard to developing digital materials. Evaluating the available expressions: PT.7 explained his experiences as follows: "*I had no previous experience in producing digital material. Now, I can easily develop my own digital materials*". Similarly; PT.6, who interpreted the digital material preparation training that s/he participated in through her/his own experiences, said that: "*I have improved my self-confidence gradually using Web 2.0 tools. Now, I can easily use tools such as Mentimeter, Canva, Kahoot and Powtoon*". On the other hand, PT.2 expressed his views as follows: "*My self-confidence has improved as I have proceeded to use these tools*".

Discussion and Conclusion

This study aimed to examine the extent to which a digital course material preparation training benefited the pre-service social studies teachers in improving their TPACK self-confidence. In other words, the research reviewed the improvement in TPACK self-confidence levels of pre-service social studies teachers who had been provided with the opportunity to jointly make use of technology, pedagogy, and content knowledge. Both quantitative and qualitative data revealed a significant improvement with regard to the TPACK levels and TPACK self-confidence levels of pre-service social studies teachers. The results are in parallel with those of various studies in the relevant literature (Acarli, 2020; Bayrak & Bayrak, 2021; Lachner et al., 2021; Sancar-Tokmak & Yanpar-Yelken, 2015; Tatlı et al., 2016; Torun, 2020). The possible reasons for such improvement as regards the pre-service teachers' TPACK self-confidence levels may be summarized as follows: a) *pre-service teachers who have experienced integrating digital applications (Web 2.0) for a sufficient period of time will quite easily become accustomed to integrating content knowledge that they will use throughout their professional lives into instructional technologies* b) *the opportunity to directly incorporate technology to the educational process on the basis of a pedagogical approach (5E teaching model)* c) *exhibiting the digital materials that they have prepared in a classroom environment* d) *the effect of peers and faculty members in the evaluation phase* e) *the feedback provided to the designed digital material and the pre-service teachers' consideration of these feedback* f) *the reliance of both teachers and students in that gained technological experience will enrich the teaching activity*. In an effort to improve the TPACK self-confidence levels of teachers through Web 2.0 tools- an aim similar to that of this study- Bayrak and Bayrak (2021) noted that the in-service training provided to teachers caused a significant improvement in their TPACK self-confidence levels. Bayrak and Bayrak (2021) further listed the reasons underlying such improvement as the willingness of teachers to attend the training, appropriateness of the Web 2.0 tools taught in the training for the needs of the teachers and having the opportunity to practice the Web 2.0 tools taught in the training. Active participation in the implementation phase is also found to be among the reasons that stand out in this study. Uçar et al. (2014), who drew attention to the importance of having the opportunity to experience these technological tools directly in the implementation phase, found that devoting more time to the implementation phase or using a computer

will improve TPACK self-confidence. Because, as teachers' experience in using the computers and the Internet increase, their TPACK self-confidence improve accordingly (Güder & Demir, 2018). Acarli (2020), who confirmed this finding with his own study, concluded that prospective teachers who have learned computer technologies during their education have had significantly higher TPACK self-confidence scores. Drawing attention to the same reason, İnce-Aka et al. (2018) found that the presentations prepared and used by pre-service teachers, supported by multiple learning elements, positively influenced the improvement of pre-service teachers with regard to TPACK self-confidence. Henceforth, they concluded that teachers who have correctly configured their technological expertise would be more confident and would faster integrate this knowledge into other content structures. Referring to a different dimension of the implementation phase, Kapici and Akcay (2020) emphasized that pre-service teachers who were given the opportunities to learn and practice with technology improved their TPACK self-confidence. Pre-service teachers' attaining an application-based experience by combining technological, pedagogic and content knowledge before starting their profession attracts attention as a joint result derived in different studies. This result substantiates the following views of Koehler et al. (2013), *Since many teachers of today had completed their academic education at a time when instructional technology was not as developed as it is today, it is not surprising that they do not consider themselves sufficiently prepared to make use of technology to be able to integrate it in a classroom environment, and that they do not appreciate or value the relationship between technology, teaching and learning.* As the experience of using technology increases, the resistance to incorporating technology into teaching processes decreases. As this resistance decreases, professional educators' (pre-service teachers, teachers, academicians, etc.) positive attitudes, levels of anxiety, self-efficacy, motivation and self-confidence towards TPACK also increase. Drawing attention to the improvement in practice, Onbaşılı (2020) pointed out that Web 2.0 tools positively influence the learning process, develop advanced thinking skills, creativity, and imagination, and be innovative and effective in reducing anxiety levels pre-service teachers. Similarly, Christensen and Knezek (2000) suggested integrating technology into teaching processes in addition to considering the attitudes of pre-service teachers towards using technology while teaching. Having understood the critical role of technology in the teaching process, the pre-service teachers seemed to end up developing positive attitudes towards technology. Likewise, the higher the teachers' tendency to rely on TPACK, the clearer the effect on the use of technology in the classroom. In this regard, the teachers' confidence in their ability to make use of technology is, therefore, a strong and direct indicator of how effectively they will use it (Lee & Tsai, 2010).

Different digital applications or Web 2.0 tools were included in the implementation phase of this study (See Table 1). The tools included in the implementation phase attracted the attention of pre-service teachers. The opportunity to experience these applications, which they might not have met before, has made pre-service teachers an effective party to the process and improved their technological aspect. Aktaş and Özmen (2020), who examined the effect of trainings aiming at developing TPACK on the performance of pre-service teachers with a similar approach, revealed that the training provides a positive improvement on TPACK components of

pre-service teachers. Underlying reasons were explained with the fact that pre-service teachers experienced the technological tools such as smart boards, simulations, animations for the first time. The reasons revealed in the present study are in conformity with those indicated by Aktaş and Özmen (2020). Similarly, having examined the impact of the textbook preparation process, which was supported by instructional technologies, on the pre-service social studies teachers' self-confidence levels as regards TPACK, Torun (2020) reported that such levels improved significantly at the end of the training provided. The reasons for this could be the inadequacy of initial knowledge and skills of pre-service teachers with regard to TPACK, the fear related to TPACK, and the views of pre-service teachers who used to find it useless. However, the implementation phase is stated to eliminate the fear and anxiety of pre-service teachers thereto. The views of PT.3, included within the qualitative findings of this study focusing on digital material design similar to Torun (2020), saying that "*My prior experience with technology was insufficient and I was afraid of using technology. Owing to these trainings, I started to like technology and use it effectively in teaching instead of being afraid of it*," bring two studies together under a common point. That is, as negative beliefs in technology change towards favorable views, that make it even easier to integrate technology into teaching processes and improve teachers' self-confidence. Sancar-Tokmak and Yanpar-Yelken (2015), who wanted to improve TPACK self-confidence by asking pre-service teachers to prepare digital stories, stated that the digital story preparation process improves the closeness of pre-service teachers towards using technology in teaching, their competency in technology and their levels of TPACK self-confidence. In addition, digital stories have been included in the "Explain" and "Elaborate" phases of the 5E teaching model, which dominates the pedagogical aspect of this study. The improvement achieved by Sancar-Tokmak and Yanpar-Yelken (2015) through digital stories has been confirmed in this study. Cesur-Özkara et al. (2018), who aimed to improve the TPACK efficacy of teachers through in-service trainings, indicated that the training provided improvements with regard to the TPACK self-confidence of pre-service teachers. In addition, they revealed an improvement with regard to the pre-service teachers' ability to attain an interest towards technology, being open to developments, to learn innovations and to create a desire for learning. Durusoy (2019), who examined the effects of designing teaching materials on the TPACK of pre-service teachers through a design-based learning approach, emphasized that these activities ensured pre-service teachers to become aware of new technologies and improved their skills to incorporate them in the teaching process. In addition, they indicated that throughout this process, they learned the significance of technology integration and the factors that need to be considered, that they have gained knowledge about how to meet the instructional needs of students and that these all improved their self-confidence. Therefore, it is essential to bring both pre-service teachers and teachers together with up-to-date instructional technologies because high TPACK self-confidence levels of teachers support their understanding of integrating technology into teaching processes (Ergen, 2021).

Evaluating the findings obtained from these and similar studies conducted on TPACK, collectively, through the perspective put forward by Üredi and Ulum (2020) with regard to TPACK based on the opinions of pre-service teachers; it is revealed that technological, pedagogic and content knowledge provided to pre-service teachers jointly

throughout the teaching process will improve the quality of teaching, will facilitate the teaching process and will provide an advantage in terms of gaining cognitive skills, improving the learning environment and attaining affective skills.

Limitations and Suggestions

The findings of this study are subject to a number of possible limitations. The first is that the study group was created in accordance with convenience sampling the participants of this research comprised prospective social studies teachers who were trained in designing course material. The second limitation can be attributed to the limited number of digital applications or Web 2.0 tools used in the implementation process. Accordingly, using diversified digital application/Web 2.0 tools throughout the material design process can reveal different findings. The third limitation can be attributed to pre-service teachers' exhibiting the digital materials generated in a classroom environment consisting of peers. Applying the generated digital materials in a live classroom environment addressing the targeted age group may reveal different results. Taking into account the basic structure of TPACK, the effective aspects of digital materials designed with Web 2.0 tools in addition to the findings and results of the study conducted, despite the limitations hereto, our recommendations are as follows:

- This study revealed that designing materials with Web 2.0 tools affects the TPACK self-efficacy of pre-service teachers. In order to popularize this effect, academic staff lecturing on material design in Faculties of Education may incorporate digital applications or Web 2.0 tools into their curriculum.
- The research aims whether a digital course material design training provided to prospective social studies teachers effect their TPACK self-confidence. Prior applied studies related to TPACK self-confidence are limited. Therefore, further applied studies can be conducted with similar or different study groups.
- This study examines digital applications/Web 2.0 Tools (Canva, Mentimeter, Powtoon, Kahoot). Similar research can be carried out focusing on different applications/Web 2.0.
- The focus of this study is TPACK self-confidence. Similar studies can be conducted on different variables such as the motivation that drives educators emotionally, self-efficacy, self-regulation, attitudes.
- The development of prospective teachers' digital competencies was observed in this study, which was based directly on their education. To prepare the teachers for the future, Initial Teacher Education (ITE) programs should focus more on the digital competencies of prospective teachers with a special emphasis on the practical rather than theoretical knowledge. Future studies can be conducted in different teacher training areas to guide Initial Teacher Education (ITE) programs.

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Statement of Responsibility

Fatih Kayaalp; theoretical framework, methodology, implementation phase, data collection, data analysis, processing and interpretation of data, writing, supervision and regulation. Bayram Gökbulut; theoretical framework, implementation phase, methodology, data collection, data analysis, processing and interpretation of data, writing, supervision and regulation. Elif Meral; theoretical framework, methodology, data collection, data analysis, processing and interpretation of data, writing, supervision and regulation. Zeynep Başcı Namlı; theoretical framework, methodology, data collection, data analysis, processing and interpretation of data, writing, supervision and regulation.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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