ASSESSING PRESERVICE SOCIAL STUDIES TEACHERS' EXPERIENCES IN DESIGNING DIGITAL MATERIALS DURING THE DISTANCE EDUCATION PROCESS

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ABSTRACT

The aim of this study is to assess the experiences of pre-service social studies teachers in designing digital materials during the distance education process, based on various variables. This study employed an embedded mixed-methods design. The study group consisted of thirty pre-service social studies teachers enrolled in a third-year "Material Design in Social Studies Teaching" course at a university in the Southeastern Anatolia region of Turkiye. Data collection instruments included the Technological Pedagogical Content Knowledge Self-Assessment Scale (TPACK-SAS), Individual Innovativeness Scale (IS), Technology Integration Strategies Scale (TIS), a semi-structured interview form, and participant diaries. The quantitative data were analysed using parametric and non-parametric tests, while qualitative data underwent thematic analysis. Mixed-method integration was achieved through joint displays to combine quantitative and qualitative findings. Following the completion of the digital material development process, an increase was observed in pre-service teachers' self-assessment of their technological pedagogical content knowledge, their perceptions of individual innovation, and their perceptions of technology integration strategies. The qualitative findings (interviews and diaries) support the quantitative results, which demonstrated statistically significant medium-to-large effect sizes. To ensure the integration of technology by pre-service teachers, it is recommended that they be provided with opportunities to develop digital materials.

Keywords: Distance education, digital teaching materials, technological pedagogical content knowledge, individual innovativeness, social studies.

INTRODUCTION

The rapid acquisition of new competencies and the adoption of innovative learning methodologies by societies necessitate an information-driven development process (Woolf, 2010). Within this framework, education must equip students with critical reasoning, disciplined thinking, and collaborative skills essential for success in the 21st century (Woolf, 2010). Achieving these objectives is contingent upon the establishment of a robust technological infrastructure and the widespread integration of technology into educational practices (Vockley, 2007). In the 21st-century educational paradigm, students are expected to address complex problems through creative solutions, engage in interdisciplinary collaboration, and employ logical reasoning (Woolf, 2010). Schools that fail to effectively leverage technological tools risk inadequately preparing students for the demands of the global economy (Vockley, 2007). Consequently, it is imperative to cultivate individuals who are not only proficient in utilizing technology but also capable of innovating and producing

technological advancements, thereby shaping future global citizens. In light of these developments, the pivotal role of technology in education has become increasingly evident.

In alignment with this trend, advancements in information and communication technologies (ICT) have driven significant transformations in the field of education over the past two decades (Escueta et al., 2017). Notably, the Internet has established a new digital landscape for teaching and learning processes (Kalaian, 2017). Innovations such as mobile technologies, virtual reality, augmented reality, and social networks have profoundly shaped the evolution of educational technology (Huang et al., 2019). The integration of technology into education has the potential to revolutionize both pedagogical methods and curricular content (Culp et al., 2005). It serves as a powerful tool for transitioning from teacher-centred classrooms to student-centred, interactive learning environments (Tezci, 2010) and plays a pivotal role in educational reform by enhancing quality through its incorporation into curricula and its application in improving teaching and learning outcomes (Yu & Franz, 2017). As a result, governments, educational institutions, and families increasingly recognize technology as an indispensable component of education and are investing substantially in its development and implementation (Escueta et al., 2017).

Similar to global efforts, Turkiye has made significant strides in integrating technology into its educational system. One prominent initiative is the FATIH Project, launched in 2010 with pilot implementations commencing in 2012. However, the project fell short of achieving its intended success due to various limitations, including insufficient content and the ineffective utilization of technological resources (Dincer et al., 2013). Teachers encountered challenges in developing digital content, and the available materials were inadequate to meet their instructional needs (Keles & Turan, 2015; Kurt et al., 2013). Additional contributing factors, such as overcrowded classrooms and gaps in teachers' knowledge and skills, further hindered the project's effectiveness (Kaya & Yilayaz, 2013). To address these shortcomings, the Educational Information Network (EBA) platform was introduced; however, teachers reported that the platform's content remained insufficient to fully support educational objectives (Kurtdede Fidan et al., 2016). Social studies teachers, in particular, emphasized the need to enrich EBA's content to better align with curricular requirements (Cakmak & Taskiran, 2017). These findings indicate that teachers face significant challenges in both producing and utilizing e-content, which may be attributed to their limited technological proficiency. Indeed, the literature underscores that many teachers lack the necessary competence in using technology, further complicating their ability to effectively integrate digital tools and resources into their teaching practices (Demir et al., 2011; Kayaduman et al., 2011; Yurekturk & Coskun, 2020)

For educators to effectively utilize technology, they must possess the necessary skills to both create and utilize digital content. This competency is closely tied to the training they receive during their undergraduate education. Polat (2014) emphasized that prospective teachers often experience anxiety regarding the creation of digital educational materials. To address this issue, it has been suggested that preservice teachers receive targeted training in this area to alleviate such concerns. Moreover, it is critical that preservice teachers are provided with comprehensive instruction on the integration of information and communication technologies (ICT), as this will equip them with the skills required to effectively merge technology with pedagogical practices (Lim et al., 2010).

Teachers need to possess the necessary digital competence to ensure that students can effectively benefit from technology-enhanced teaching processes. In this context, the TPACK framework serves as a critical model that supports educators in developing the skills required to integrate technology and pedagogy into their teaching practices. The TPACK framework enables educators to utilize technology in ways that align with their pedagogical expertise (Mishra & Koehler, 2006). Furthermore, the integration of TPACK and similar models with interdisciplinary subjects, such as social studies, fosters more effective and meaningful learning experiences for students.

The integration of technology in social studies education holds significant importance in fostering the development of informed, responsible, and participatory citizens within society (Heafner, 2004). The effective use of technology enables educators to enhance their pedagogical and digital competencies in the field of social studies education (Kaya, 2008). Consequently, it is crucial for preservice teachers to receive training in digital content creation and technology integration as part of their undergraduate education. A promising area for future research lies in examining the impact of online digital material design processes on preservice

social studies teachers' TPACK, technology integration strategies, and levels of individual innovativeness. Employing mixed-method research approaches can be particularly effective in comprehensively exploring this impact. Demonstrating this effect through quantitative, qualitative, and mixed data is essential for improving the understanding of the process. In this context, the aim of this study is to assess the experiences of preservice social studies teachers in designing digital materials during the distance education process, considering various relevant variables.

PURPOSE OF THE STUDY

This study aims to assess the experiences of preservice social studies teachers in designing digital materials during the distance education process, considering various relevant variables.

In alignment with the primary objective, the following research questions were addressed:

1. Is there a significant difference between the pre-test and post-test scores of the Technological Pedagogical Content Knowledge Self-Assessment Scale (TPACK-SAS) obtained from preservice social studies teachers during the process of developing online digital materials? (Quantitative Question)

   Is there a significant difference between the pre-test and post-test scores across the dimensions of the TPACK-SAS?
2. Is there a significant difference between the pre-test and post-test scores of the Individual Innovativeness Scale (IS) obtained from preservice social studies teachers during the process of developing online digital materials? (Quantitative Question)

   Is there a significant difference between the pre-test and post-test scores across the dimensions of the IS?
3. Is there a significant difference between the pre-test and post-test scores of the Technology Integration Strategies Scale (TIS) obtained from preservice social studies teachers during the process of developing online digital materials? (Quantitative Question)
4. What are the experiences of preservice social studies teachers regarding the process of developing online digital materials? (qualitative question)
5. How do the perspectives of preservice social studies teachers regarding their experiences in developing online digital materials contribute to understanding the data derived from the TPACK-SAS, IS, and TIS scales? (Mixed-Methods Question)

METHOD

This section presents information regarding the research model, study group, research environment, data collection tools, pilot application process, experimental process, data analysis, credibility, and the difficulties encountered in the research process.

Research Design

The study employed embedded design, a complex or advanced mixed-method design. This design centres one research design and embeds it into the other (Plano Clark & Ivankova, 2016). Primary data are typically quantitative, while secondary data are qualitative and support or supplement primary data. In experimental research, quantitative data assess the intervention's impact, whereas qualitative data explore participants' experiences. Mixed methods research allows for simultaneous or sequential data collection, and the rationale for using secondary data must be justified (Creswell, 2012). The main framework of this research is quantitative research. Qualitative research is supportive. The quantitative data were collected first, followed by the qualitative data. The capitalised letter indicates the dominant data, and the arrow shows the order of data collection (e.g. QUANTITATIVE → Qualitative). This writing style is based on Morse (1993, 2003). The research design is illustrated in Figure 1.

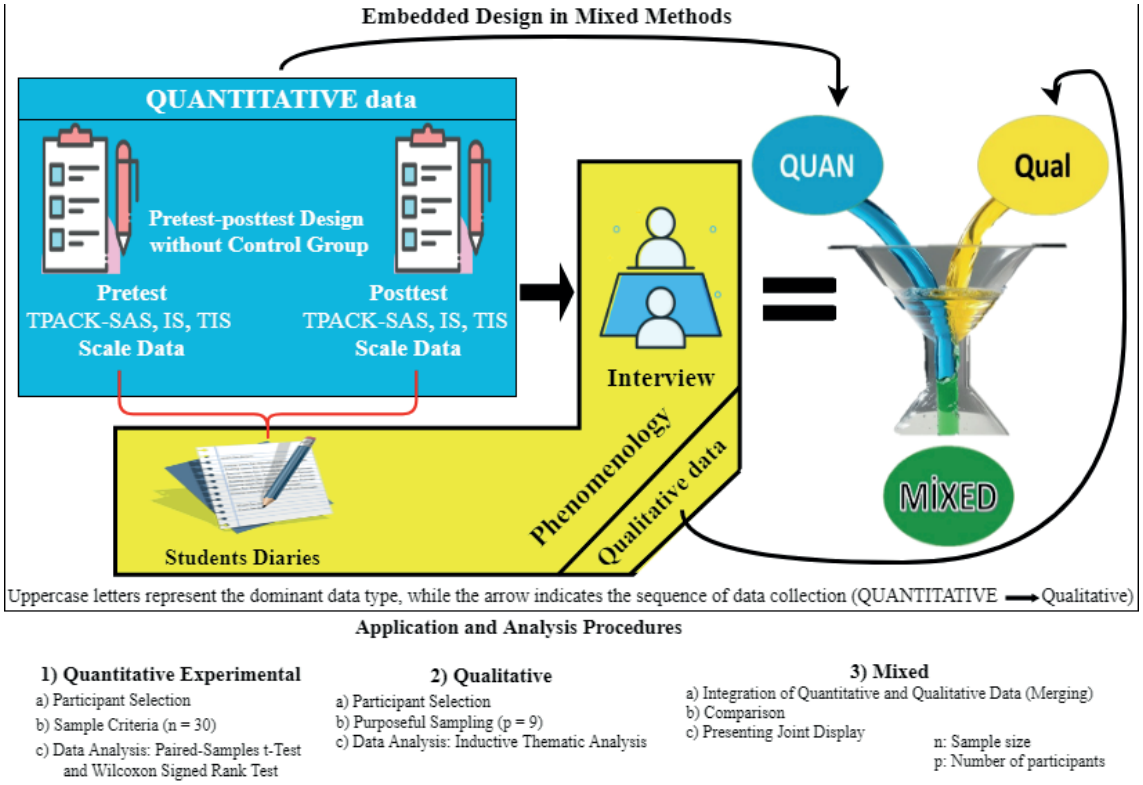


Figure 1. Diagram of the Embedded Mixed Methods Design

When conducting mixed methods research, it is essential to provide a justification for its use. The reasons for employing mixed methods research are widely discussed in the literature, with notable contributions by Greene et al. (1989) and Bryman (2006). These categorized justifications enable researchers planning mixed methods studies to substantiate their approach (Creswell & Plano Clark, 2017). The rationale for employing mixed methods in this study is based on the "complementarity" purpose, as categorized by Greene et al. (1989). Given its focus on enriching research outcomes by integrating the distinct strengths of quantitative and qualitative findings, complementarity has been chosen as the justification for this study.

The quantitative dimension of the study was conducted using a pretest-posttest design without a control group. It was not possible to select the control group for inclusion in the study for a number of reasons. These reasons are as follows:

- The sole third-grade class enrolled in the social studies education programme at the faculty of education of the university where the application was carried out represents a limitation of the study.
- The number of students enrolled in the course is insufficient to form a control group.
- The implementation was conducted remotely due to the ongoing pandemic (COVID-19).
- In light of the aforementioned reasons, a pre-test and post-test design without a control group was deemed the most appropriate approach in the quantitative dimension of the study.

The qualitative dimension of the study was conducted in accordance with the principles of phenomenological design. In a study designed according to the phenomenological design, the focus is on the common meaning of an experience concerning a concept or phenomenon as perceived by people (Creswell, 2013). The objective of this design is to ascertain the significance of an experience for individuals who have undergone the process (Moustakas, 1994). Additionally, a phenomenological study is concerned with the essence or structure of an experience (Merriam, 2002). Accordingly, the primary objective of phenomenological knowledge (Moustakas, 1994) is to comprehend the implicit, meaningful, and concrete relations inherent in the original definition of an experience within the context of a specific situation. In the qualitative research component of this study, which was conducted with preservice social studies teachers, the focus was on the meanings that preservice teachers ascribed to their online digital material design experiences.

Study Group

The quantitative dimension of the study group comprises 30 preservice social studies teachers and 9 preservice social studies teachers in the qualitative dimension.

The preservice social studies teachers who participated in the study were third-year students enrolled in the social studies teaching programme at a university situated in the Southeastern Anatolia region.

The quantitative research sample was selected using the criterion sampling method, which is one of the purposeful sampling methods. This sampling technique involves including participants who meet specific criteria in the research process (Buyukozturk et al., 2020).

The criteria for sample selection within the scope of the study were as follows:

- Having completed certain courses related to educational sciences (e.g., Introduction to Education, Educational Psychology, Philosophy of Education, Sociology of Education, Instructional Technologies, Research Methods in Education, Measurement and Evaluation in Education, Principles and Methods of Teaching, Turkish Education System, and School Administration).
- Having completed courses related to field education in social studies education.
- Participation in the course "Material design in social studies teaching," during which the intervention was conducted.
- In addition to the criteria listed above, third-year students were chosen to prepare preservice teachers for middle school teaching practice, as they are in the stage preceding their teaching practicum.

Nine of the 30 preservice social studies teachers enrolled in the course entitled "Material Design in Social Studies Teaching" participated in the interviews conducted as part of the qualitative dimension of the study. Contrary to the interviews, the number of diaries in which the pre-service teachers described their practice experiences changed after each practice. In order to protect the anonymity of the participants, code names were used. For example, the code name "Int_M3" was used for the male interviewee number 3, while "Int_F2" was used for the female interviewee number 2. Similarly, "Dia_M5" was used for the male diary writer number 5, and "Dia_F4" was used for the female diary writer number 4. Participation in the study was based on voluntary consent. The characteristics of the participants in the study group are presented in Table 1.

Table 1. Participant Characteristics in The Study Group

Type of research	Study group	Data collection tools	Gender		
			Male	Female	Total
Quantitative research	Pre-test	TPACK-SAS	9	21	30
		IS	9	21	30
		TIS	9	21	30
	Post test	TPACK-SAS	9	21	30
		IS	9	21	30
		TIS	9	21	30
Qualitative research	Participants keeping diaries	Experiences with presentation materials (diaries)	7	17	24
		Experiences with video editing materials (diaries)	10	10	20
		Experiences with interactive video materials (diaries)	4	4	8
		Experiences with animation materials (diaries)	4	4	8
		Experiences with digital story materials (diaries)	4	3	7
		Experiences with assessment materials (diaries)	4	4	8
		Experiences with distance learning materials (diaries)	4	3	7
	Interview participants	Semi-structured interview form	4	5	9

As indicated in Table 1, the quantitative dimension of the study was conducted with a total of 30 preservice social studies teachers, of whom nine were male and 21 were female. In the qualitative dimension, a total of nine preservice teachers (four male and five female) participated in the interviews.

Data Collection

In this study, the following scales were used: the Technology Integration Strategies Scale (TIS), developed by Tondeur et al. (2016) and adapted into Turkish by Tikman and Kaya (2022); the Individual Innovativeness Scale (IS), developed by Hurt et al. (1977) and adapted into Turkish by Kilicer and Odabasi (2010); and the Technological Pedagogical Content Knowledge-Self-Assessment Scale (TPACK-SAS), developed by Kartal et al. (2016). As a qualitative data collection tool, an interview form was used to explore the experiences of pre-service teachers regarding the digital material development process. Additionally, pre-service teachers were asked to maintain diaries to elaborate on the insights gained during the digital material development process.

Data Analysis

The analysis of the data in this study employed a combination of quantitative, qualitative, and mixed-method approaches. Parametric and non-parametric tests were utilised for the analysis of quantitative data, while thematic analysis was applied to qualitative data. In order to integrate the mixed-method data, the "Joint Display" strategy was implemented.

Quantitative Data Analysis

The quantitative data obtained before and after the experiment were analysed using SPSS 25. Normality tests were conducted to determine the distribution of the data. Data exhibiting a normal distribution were analysed using the Paired Samples t-Test, whereas data not meeting normal distribution assumptions were analysed with the Wilcoxon Signed-Rank Test. The analysis process also included effect size calculations, which were performed using the Comprehensive Meta-Analysis (CMA Version 3) software, employing the Hedge's g method. Hedge's g was preferred for its reliability over Cohen's d and Glass's Δ methods, particularly in small sample sizes, which are more prone to biased results (Ustun & Eryilmaz, 2014). Effect size calculations utilized the arithmetic mean, standard deviation, sample size (N), p, t, and z values. The calculated values were interpreted according to the classifications of Cohen (1992) and Thalheimer and Cook (2002). In Cohen's classification, effect sizes between 0.20 and 0.50 are considered small, 0.50 to 0.80 medium, and values greater than 0.80 large. Thalheimer and Cook (2002) provided a more detailed classification, dividing effect sizes into the following categories: "$-0.15 \leq g < 0.15$ trivial, $0.15 \leq g < 0.40$ small, $0.40 \leq g < 0.75$ medium, $0.75 \leq g < 1.10$ large, $1.10 \leq g < 1.45$ very large, and $g \geq 1.45$ huge". A "z" score can be used to calculate an effect size, such as "r," as proposed by Cohen (1988) (Fritz et al., 2012). To compute the effect size, the z-score needs to be converted into r (Field, 2009). The formula required for this transformation is $(r=Z/\sqrt{N})$ (Coolican, 2009). These r-values were interpreted based on Cohen's (1988) classification, with 0.10 considered small, 0.30 medium, and 0.50 large effects. Necessary calculations for non-parametric data were performed using online effect size calculators developed by Lenhard and Lenhard (2016).

Qualitative Data Analysis

The qualitative data collected in the study were analysed using the thematic analysis method proposed by Braun and Clarke (2006). This method allows for the identification and reporting of patterns (themes) within a dataset. An inductive thematic analysis approach was adopted, meaning the data were coded without being based on a pre-existing framework, and themes were generated from these codes (Braun & Clarke, 2006). To ensure consistency within the scope of the research, qualitative data were subjected to coding by three researchers. Two of the researchers were directly involved in the coding process, while a third was responsible for ensuring the coherence of the codes and themes. During the analysis process, audio

recordings were transcribed into digital format, and pseudonyms were assigned to each participant to ensure anonymity (see Table 1 and Table 2 in the Annexes). The data were then uploaded to the MaxQDA 2020 software. To familiarize herself with the data, the researcher thoroughly read and reviewed the transcripts before proceeding to the coding stage. After completing the coding process, the codes were grouped to form themes, which were refined through processes of addition, removal, and merging. The final themes were named in alignment with the study's objectives and supported with direct quotations from the participants. This ensured a comprehensive and transparent reporting of the findings.

Mixed Methods Data Analysis

In this study, the principle of complementarity, a key rationale for employing mixed methods research, was considered during the analysis of the mixed data. Mixed methods research allows for the synthesis of data through various approaches, often described as combining, integrating, or merging data. According to Morse and Niehaus (2009), the point at which quantitative and qualitative methodologies intersect is referred to as the "intersection point." Numerous methodologies exist for integrating quantitative and qualitative data (O'Cathain et al., 2010; Creswell & Plano Clark, 2017). Fetters et al. (2013) categorize these methodologies into three levels of integration: design level, method level, and interpretation and reporting level. For this study, integration was conducted at the interpretation and reporting level. Integration at the interpretation and reporting level can be achieved through three primary approaches: narrative integration, data transformation, and joint display (Fetters et al., 2013). Joint displays are recognized as a method for achieving and illustrating integration within mixed methods research (Guetterman et al., 2015a, 2015b). In this research, integration through joint display was employed. This approach involves presenting data visually to integrate quantitative and qualitative findings, thereby uncovering new insights. The visual representation of the data can take the form of figures, tables, matrices, or graphs (Fetters et al., 2013). In this study, qualitative data capturing the perspectives of pre-service social studies teachers regarding their experiences in designing digital materials were integrated with quantitative data derived from the TPACK-SAS, IS, and TIS scales. The integration process involved initially juxtaposing and comparing the qualitative and quantitative data, followed by presenting the results through combined joint displays.

FINDINGS

In this section, quantitative (TPACK-SAS, IS, and TIS), qualitative (semi-structured interview and diary), and mixed data analyses are presented in a way to form answers to the research questions and sub-questions. The findings obtained after the analyses were presented according to the order of the research questions.

Quantitative Findings

Findings Related to TPACK-SAS Data Obtained from Preservice Social Studies Teachers in Online Digital Material Development Processes

Parametric tests (Paired Samples t-Test) were used in the analysis of the TPAC-SAS scale, which met the normality assumption. However, some dimensions of the scale did not meet the normality assumption, and non-parametric tests were applied in these cases. The findings related to the scale are presented in Table 4.

Table 4. Test Results of the TPACK-SAS Scale: General and Dimensions

The Scale's Dimensions	Test	N	X̄	Ss	t/Z score	p	Effect Size Hedge's g/r
General	Pre-test	30	365.200	48.197	-2.660 (t)	.013	0.473 (g)
	Post test	30	393.900	33,395			
Pedagogical Knowledge	Pre-test	30	85.866	10.102	-1.778 (Z)	.075	-0.324 (r)
	Post test	30	90.066	5.930			
Content Knowledge	Pre-test	30	38.566	7.885	-.799 (t)	.431	0.142 (g)
	Post test	30	40.000	7.799			
Technological Knowledge	Pre-test	30	56.633	12.118	-2.350 (t)	.026	0.418 (g)
	Post test	30	63.933	9.598			
Technological Content Knowledge	Pre-test	30	27.63	4.390	-3.038 (t)	.005	0.540 (g)
	Post test	30	30.53	2.636			
Technological Pedagogical Knowledge	Pre-test	30	55.07	9.078	-2.802(t)	.009	0.498(g)
	Post test	30	60.37	5.308			
Pedagogical Content Knowledge	Pre-test	30	63.100	8.297	-2.017 (Z)	.044	0.368(r)
	Post test	30	67.000	5.381			
Technological Pedagogical Content Knowledge	Pre-test	30	38.333	6.098	-2.714(Z)	.007	-0.495 (r)
	Post test	30	42.000	4.152			

* In parametric tests, t-scores are indicated as (t), while in non-parametric tests, Z-scores are indicated as (Z) in parentheses

According to Table 4, a significant difference was found between the pre-test and post-test mean scores of the general TPACK-SAS scale for preservice social studies teachers after the experimental intervention ($p<.05$). The effect size (Hedge's g) was calculated as 0.473, which is considered a "small effect size" according to Cohen's (1992) classification. In the dimensional analyses, parametric tests (Paired Samples t-Test) were used for dimensions that met the normality assumption: Content Knowledge, Technological Knowledge, Technological Content Knowledge, and Technological Pedagogical Knowledge. For dimensions that did not meet the normality assumption—Pedagogical Knowledge, Pedagogical Content Knowledge, and Technological Pedagogical Content Knowledge—non-parametric tests (Wilcoxon Signed-Rank Test) were applied. The results showed significant differences in the dimensions of Technological Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, Pedagogical Content Knowledge, and Technological Pedagogical Content Knowledge ($p<.05$). Effect sizes were small for the TK and PCK dimensions and moderate for the TPK and TPCK dimensions. However, no significant differences were observed in the Pedagogical Knowledge and Content Knowledge dimensions.

Findings Related to IS Data Obtained from Preservice Social Studies Teachers during Online Digital Material Development Processes

Parametric tests (Paired Samples t-Test) were used in the analysis of the IS scale, which met the normality assumption. The findings related to the scale are presented in Table 5.

Table 5. Test Results of the IS Scale: General and Dimensions

The Scale's Dimensions	Test	N	X̄	Ss	t/Z score	p	Effect Size Hedge's g/r
General	Pre-test	30	63.63	5.282	-7.712(t)	.000	1.371
	Post test	30	76.87	7.691			
Resistance to Change	Pre-test	30	16.37	2.141	-4.724(Z)	.000	-0.862(r)
	Post test	30	28.40	5.475			
Opinion Leadership	Pre-test	30	19.30	3.175	-.451(t)	.655	0.080 (g)
	Post test	30	40.000	7.799			
Openness to Experience	Pre-test	30	20.93	2.016	-.423(t)	.676	0.070 (g)
	Post test	30	21.13	1.907			
Risk-Taking	Pre-test	30	7.03	1.608	-1.915 (t)	.065	0.341 (g)
	Post test	30	7.73	1.311			

* In parametric tests, t-scores are indicated as (t), while in non-parametric tests, Z-scores are indicated as (Z) in parentheses

Examining Table 5, the results of the Paired Samples t-Test analysis reveal a significant difference between the pre-test and post-test mean scores of the IS scale for preservice social studies teachers ($p<.05$). The effect size (Hedge's g) for the IS scale was calculated as 1.371, which corresponds to a "large effect" according to Cohen's (1992) classification. Furthermore, the dimensions of the scale (IS) were analysed. Parametric tests (Paired Samples t-Test) were used for the dimensions meeting the normality assumption: Opinion Leadership, Openness to Experience, and Risk-Taking. For the dimension that did not meet the normality assumption, Resistance to Change, non-parametric tests (Wilcoxon Signed-Rank Test) were applied. The results indicate that a significant difference was observed only in the Resistance to Change dimension pre-test and post-test mean scores ($p>.05$). The effect size (r) calculated for this dimension was -0.862, which corresponds to a "large effect" according to Cohen's (1988) classification. No significant differences were observed in the Opinion Leadership, Openness to Experience, and Risk-Taking dimensions.

Additionally, the participants in this study were categorized based on the classification proposed by Hurt, Joseph, and Cook (1977) according to the total scale scores. Participants with a total score of 80 or higher were categorized as "Innovators," those scoring between 69-80 as "Early Adopters," those scoring between 57-68 as "Inquirers," those scoring between 46-56 as "Sceptics," and those with a score below 46 as "Traditionalists." The relevant findings are presented in Table 6.

Table 6. Classification of Preservice Social Studies Teachers Based on Their Individual Innovativeness Categories

Individual Innovativeness	Pre-test		**Post test**	
Categories	N	%	N	%
Innovators	3	10	4	13.3
Early Adopters	13	43.3	17	56.7
Inquirers	13	43.3	9	30
Sceptics	1	3.3	-	-
Traditionalists	-	-	-	-
Total	30	100	30	100

According to Table 6, before the experimental intervention, 43.3% of the preservice social studies teachers were classified as "Inquirers," 43.3% as "Early Adopters," 10% as "Innovators," and 3.3% as "Sceptics." After the experimental intervention, 56.7% were classified as 'Early Adopters,' 30% as "Inquirers," and 13.3% as "Innovators."

Moreover, individuals scoring above 68 on the scale are considered highly innovative, while those scoring below 64 are classified as having low levels of innovativeness (Hurt, Joseph, & Cook, 1977). Individuals scoring between 64 and 68 are regarded as moderately innovative (Kilicer, 2011). The classification of preservice social studies teachers based on their general individual innovativeness levels is presented in Table 7.

Table 7. Classification of Preservice Social Studies Teachers Based on Their General Individual Innovativeness Levels

Individual Innovativeness Levels	Pre-test		Post test	
	N	%	N	%
Highly Innovative	16	53.3	21	70.0
Moderately Innovative	8	26.7	4	13.3
Lowly Innovative	6	20	5	16.7
Total	30	100	30	100

According to Table 7, before the experimental intervention, 53.3% of the preservice social studies teachers were highly innovative, whereas after the experimental intervention, this rate increased to 70%.

Findings Related to the TIS Scale Data Obtained from Preservice Social Studies Teachers during the Online Digital Material Development Processes

Parametric tests (Paired Samples t-Test) were used in the analysis of the TIS scale, which met the normality assumption. The findings related to the scale are presented in Table 8.

Table 8. TIS Paired Samples t-Test Results

Test	N	X̄	Ss	Sd	t	p	Effect Size (Hedge's g)
Pre-test	30	81.166	24.562	29	-4.734	.000	0.829
Post test	30	104.866	14.153				

According to the results of the Paired Samples t-Test analysis, a significant difference was found between the pre-test and post-test mean scores of the TIS scale for preservice social studies teachers ($p<.05$). The effect size (Hedge's g) calculated for the TIS scale was 0.829. This result corresponds to a "large effect" according to Cohen's (1992) effect size classification.

Qualitative Findings

Findings Regarding the Experiences of Social Studies Pre-Service Teachers in the Online Digital Material Development Processes

This section addresses the question, "What are the experiences of social studies preservice teachers regarding digital material development processes?" In this context, qualitative findings from the study conducted using the phenomenology design of qualitative research methods are presented, based on the views of preservice teachers who participated in the study. The qualitative data were collected through face-to-face interviews and the diaries of the preservice teachers. The qualitative findings were revealed using thematic inductive analysis. Following a thorough analysis of the qualitative data, eight distinct themes emerged. To present the qualitative findings (codes, sub-themes, and themes) comprehensively and concretely, a coding map was created. This coding map is presented in Figure 2.

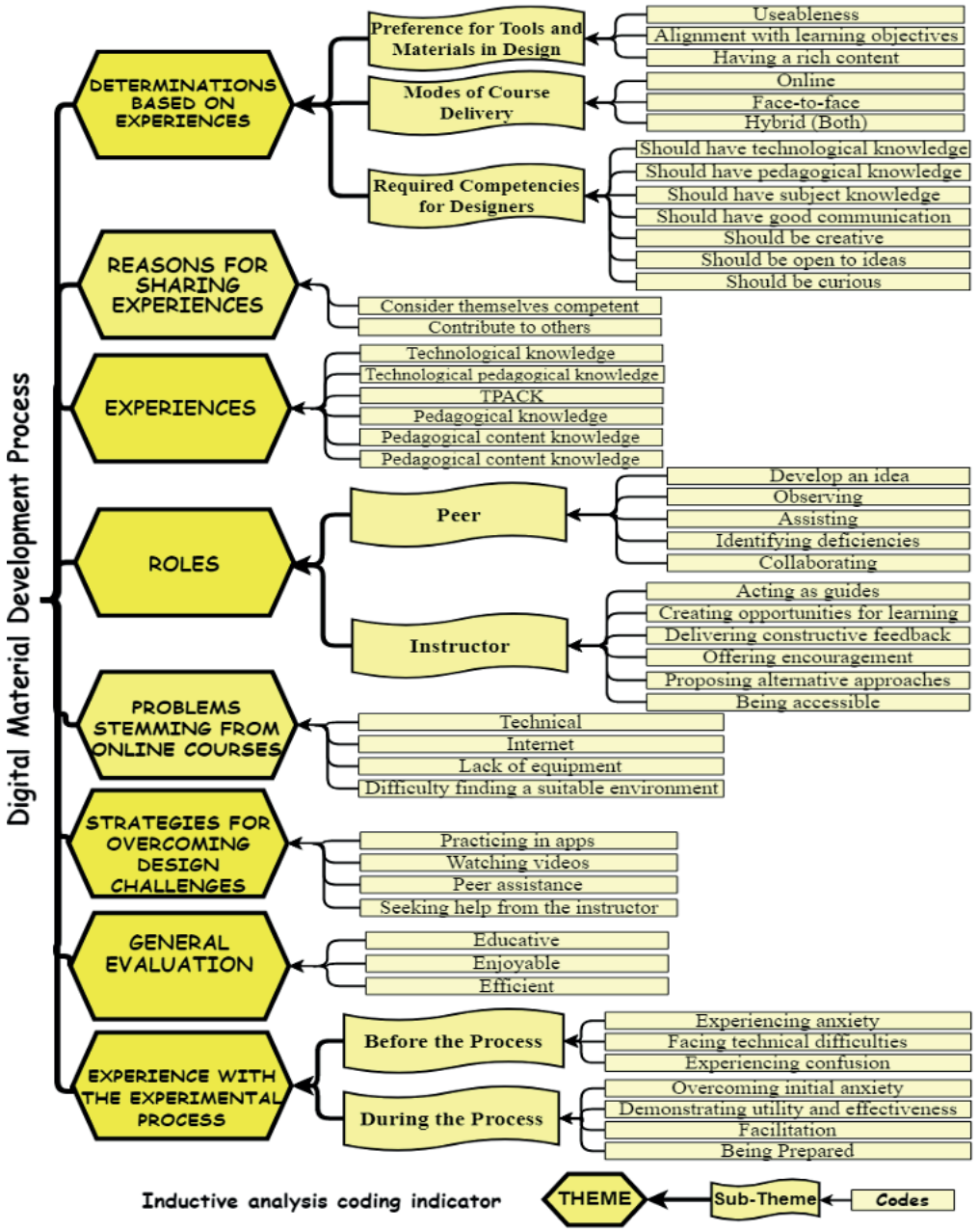


Figure 2. Coding Map of Thematic Inductive Analysis Findings

Figure 2 highlights the direction of inductive analysis. The text within the blue shapes represents the codes, the text within the green shapes represents the sub-themes, and the text within the yellow shapes represents the themes. Thin arrows indicate the flow from codes to sub-themes and themes, showing the connection between codes and sub-themes, and between sub-themes and themes. Thick arrows are used to indicate the progression from sub-themes to themes. Additionally, code expressions are written with only the first letter of the first word capitalized, while sub-theme expressions are written with the first letter of each word capitalized, and the themes are written in all uppercase letters (THEME ← Sub-theme ← Code). This representation illustrates the process of moving from parts to the whole.

Qualitative findings were revealed using thematic inductive analysis. The qualitative findings obtained at the end of the analysis were brought together under 8 themes. These are: "Determinations based on Experiences", "Reasons for Sharing Experiences", "TPACK Experiences", "Roles", "Problems Stemming from Online Course", "Strategies for Overcoming Design Challenges", "General Evaluation", "Experience with the Experimental Process". These themes provide a comprehensive representation of the participants' insights and experiences throughout the study.

The theme, entitled "Determinations Based on Experiences," reflects preservice teachers' course experiences and is categorized into three sub-themes: Preference for Tools and Materials in Design, Modes of Course Delivery, and Required Competencies for Designers.

The subtheme, entitled Preference for Tools and Materials in Design, emphasizes three key criteria (Usability, Alignment with Learning Objectives, and Rich Content) considered by preservice teachers in selecting tools and materials for the digital material development process.

- Usability: Emphasized by Int_F1, who stated, *"I pay attention to the ease of usability,"* and Int_M4, who said, *"I prefer an easy interface."*
- Alignment with Learning Objectives: The participant (Int_M1) emphasized that the selected material should be *"aligned with the learning objectives."*
- Rich Content: Int_M1 stated, *"I try to use materials that offer variety,"* and Int_M4 expressed a preference for *"alternative content."*

The subtheme of Modes of Course Delivery for the digital material development process, as determined by preservice teachers based on their experiences, is centred around three concepts: online, face-to-face, and hybrid.

- Online: Preferred for its ease of repetition and skill improvement. For example, Int_F1 stated, *"My computer skills have improved more."*
- Face-to-Face: Highlighted for facilitating better communication. Int_F3 mentioned, *"I had difficulties in terms of miscommunication because it was at a distance."*
- Hybrid: Suggested as a balanced approach. Int_F4 noted, "*The course can be taught both face-to-face and online."*

The subtheme Required Competencies for Designers highlights the essential qualifications identified by preservice teachers in the context of digital material development. Based on their experiences, the necessary competencies include:

- Technological Knowledge: Int_M2 stated, *"They should be proficient in using technology."*
- Pedagogical Knowledge: Int_F3 noted, *"The designer should be pedagogically trained."*
- Content Knowledge: Int_M1 emphasized, *"They should be well-equipped in their field."*
- Creativity: Creativity was another key attribute highlighted by participants. Int_F3 and Int_M4 stated*, "The designer must be creative."*
- Openness to Ideas: Int_M2 said, *"They should be open to different ideas."*
- Curiosity: Int_M3 noted, *"They should have a sense of curiosity,"* underscoring the importance of curiosity in design.

The theme, entitled "Reasons for Sharing Their Experiences," highlights that preservice teachers' motivations stem from their belief in their own competence and their desire to contribute to others. For example, Int_M3, who considers himself competent, expressed this by stating, *"I have shared and taught what I learned from you to both my peers and younger students. I would like to continue doing this because I see myself as competent in this area."* Similarly, Int_F5 explained, *"I share with them on topics where I am very good."*

The theme, entitled "TPACK Experiences," summarizes the experiences of pre-service teachers in the materials design course under seven codes:

- Technological Knowledge: Participants highlighted improvements in their technological skills. Int_M1 noted, *"It contributed to my technology skills; I can use the computer better now."* Int_F4 added, *"My technology knowledge was not very good, but now I use it actively."*
- Technological Content Knowledge: Teachers learned to integrate technology with content. Int_F1 shared, *"We prepared activities using Web 2.0 tools aligned with learning outcomes,"* while Int_M2 explained, *"I learned to transfer social studies content more efficiently using technology."*
- Technological Pedagogical Knowledge: Participants emphasized learning to merge technology with pedagogy. Int_F3 reflected, *"Student participation increased when I used these applications,"* and Int_M2 noted, *"This course motivated me to integrate technology into lessons."*

- Technological Pedagogical Content Knowledge: The interplay between technology, pedagogy, and content was a significant focus. Int_F5 shared, *"Bringing social studies into technology grabs students' attention and enhances learning."* Int_F3 added, *"Conducting activities aligned with learning outcomes supports my teaching career."*
- Pedagogical Content Knowledge: Participants developed strategies for effective teaching. Int_M2 highlighted, *"Using the 5E model and designing personal tasks were very beneficial*." Int_F3 noted, "*I learned how to engage students, adapt outcomes, and assess effectively."*
- Pedagogical Knowledge: Teachers gained insights into lesson planning and delivery. Int_F2 remarked, *"We used materials for reinforcement and to capture students' attention."* Int_M4 stated, *"I learned to make lessons more active and improve learning permanence."*
- Content Knowledge: Participants deepened their understanding of social studies objectives and content. Int_F2 shared, *"We had the opportunity to learn learning domains, objectives, and units in more detail,"* while Int_M1 stated, *"Designing materials helped us elaborate on objectives effectively."*

Under the theme "Roles in the Digital Materials Development Process," two sub-themes were identified: Peer Roles and Instructor Roles. The subtheme of Peer Roles focuses on five key aspects (Developing Ideas, Observing, Assisting, Identifying Deficiencies, and Collaborating) as participants emphasized the significant roles their peers played during the digital material development process.

- Developing Ideas: Participant Dia_F4 stated, *"Seeing my friends' designs allowed me to review my own design and provided ideas on how to reflect different achievements into practice."*
- Observing: Participant Dia_F2 remarked, *"After observing the material design presentations of my friends, I gained knowledge about several topics."*
- Assisting: Participant Int_F4 explained, *"I also needed help during this process; we opened our phones and consulted each other."*
- Identifying Deficiencies: Participant Dia_F9 noted, *"Listening to my friends' presentations allowed me to compare them with my own and gain insights on how to address my shortcomings."*
- Collaborating: Participant Int_F4 stated, *"We were in groups of 3-4 people, and everyone helped each other. During the breakout sessions, we supported each other."* Participant Int_F3 emphasized, *"In class, you directed us to breakout rooms, so peer collaboration was also involved... Thanks to cooperation, we learned many things from each other as a group."*

The subtheme of Instructor Roles focuses on six key aspects (acting as guides, creating opportunities for learning, delivering constructive feedback, offering encouragement, proposing alternative approaches, and ensuring accessibility) as participants emphasized the significant roles their instructor played during the digital material development process.

- Acting as Guides: Dia_M1 remarked, *"You guided us with a kind tone when we made mistakes,"* while Dia_F5 shared, *"During the course, I faced a challenge at one point, and I asked my instructor during the class. With their guidance, I resolved my issue."*
- Delivering Constructive Feedback: Dia_M2 noted, *"I received feedback from my instructor on every problem, question, or concern I had, and I never experienced any issues."*
- Offering Encouragement: Int_F3 reflected, *"First, you applied the principle of progressing from simple to complex. You showed us the easy ones first, then made it more challenging, and then encouraged us to use them."*
- Proposing Alternative Approaches: Dia_F5 shared, *"Additionally, you didn't limit us to just one application; you told us we could try it through different applications as well. Thanks to that, we got to see different applications."*
- Ensuring Accessibility: Int_F4 stated, *"The greatest advantage was being able to reach the instructor. He provided us with great support."*

The theme, entitled "Problems Stemming from Online Courses" in the material design course for pre-service teachers, has been summarized using different codes, including technical problems, internet issues, lack of equipment, and difficulty finding a suitable environment.

- Technical Problems: Some participants reported technical issues during the online course. For instance, Dia_F10 stated, *"The problem is that when I project the screen, it looks blurred to everyone else..."*
- Internet Issues: Participants highlighted challenges with weak internet connections. Dia_F15 noted, *"I had difficulty in doing the application because of the weak internet,"* while Dia_F4 shared, *"I experienced an internet problem when designing in an online programme."*
- Lack of Equipment: Hardware deficiencies, particularly the lack of computers, were a significant challenge. Int_M2 explained, *"I did the applications that could be done on the phone from the phone. I had some difficulty in this process because I did not have a computer."*
- Difficulty Finding a Suitable Environment: Some participants struggled to find a private and quiet space for the course. Int_F5 shared, *"I had a lot of siblings and nephews in the house, and I had difficulty getting them out of the room and keeping the lesson alive."* Similarly, Int_F2 noted, *"...since we were at home, the classroom environment was never like the educational environment. Sometimes I was sabotaged by my family and siblings."*

The theme, entitled "Strategies for Overcoming Design Challenges," highlights how participants coped with difficulties during the design process. They reported using strategies such as practicing in apps before, during, or after lessons, watching instructional videos, and seeking help from peers and the instructor.

- Practicing in Apps: Dia_E6 stated, "... After class, I practiced on the application to reinforce what I had learned."
- Watching Videos: Dia_E2 shared, "I watched the class videos and my friends' videos, and I solved the problem."
- Peer Assistance: Dia_K3 noted, "In the parts where I struggled, I mostly got help from my friends. I can say that I gained experience by observing them."
- Seeking Help from the Instructor: Dia_K7 expressed, "First, I sought help from my instructor... By taking their ideas and assistance, I was able to overcome the challenges I faced."

The participants' statements under the "General Evaluation" theme indicate that the digital material process was perceived as an efficient, enjoyable, and educative experience in general.

- Educative: Participants acknowledged significant growth in their technical and digital skills. Int_F3 said, *"Before the class, I didn't know how to use a computer. After the class, it contributed a lot to me."* Int_F4 added, *"I can now find programs and make applications by myself. We improved a lot thanks to this course."*
- Enjoyable: Many participants described the process as engaging and enjoyable. Int_F5 remarked, *"It was the lesson I had the most fun with during the epidemic (COVID-19)."* Int_M3 noted, *"It was a course I attended with enthusiasm during distance education."*
- Efficient: The process was perceived as efficient and effective in achieving its objectives. Int_M1 shared, *"With this course, I started to use the applications efficiently."* Int_M2 emphasized, *"It was a highly effective course in terms of both the teacher and friends."*

Under the theme of "Experience with the Experimental Process," two sub-themes were identified: Before the Process and During the Process. At the outset of the implementation week, pre-service teachers experienced anxiety, faced technical challenges, and exhibited confusion. However, as the week progressed, their anxiety and technical difficulties decreased, and their confusion was resolved. At the beginning of the process, participant Int_M3 expressed anxiety, stating, *"It seemed strange to me in the distance education process. Since I was little, the teacher was in front of us, and we were in an educational process in front of him/her."* However, he overcame this anxiety, saying, *"But I got rid of this anxiety due to the ease of use of these."* Similarly, Int_F4 initially felt anxious, stating, *"I panicked at first because it was an online environment,"* but later reported, *"We overcame this as we continued. It was very useful for us, and I was very satisfied."* These concerns, therefore, seemed to stem from the distance education setting. Additionally, Int_M4 found the process complicated at first, saying, *"I didn't know what to do... but then it started to get easier,"* and Int_F1, who lacked computer knowledge, noted, *"I had difficulty at the beginning, but after a few lessons I started to master the process."* Similarly, Dai_F1 shared, *"I thought how difficult Web 2.0 materials were, but after I learned it, I liked it."*

Mixed Findings

Findings Obtained from the Comparison of Qualitative and Quantitative Data on Preservice Social Studies Teachers' Experiences in Developing Online Digital Materials

The research question addressed in the study is, what are the results obtained from the comparison of qualitative data and quantitative data regarding preservice social studies teachers' digital material design experiences?

In this section, the findings obtained from the analysis of quantitative data (TPACK-SAS, IS, and TIS) and qualitative data (semi-structured interviews and diaries) were first juxtaposed, then compared, integrated, and visually presented. The quantitative and qualitative data were combined as shown in Figure 3.

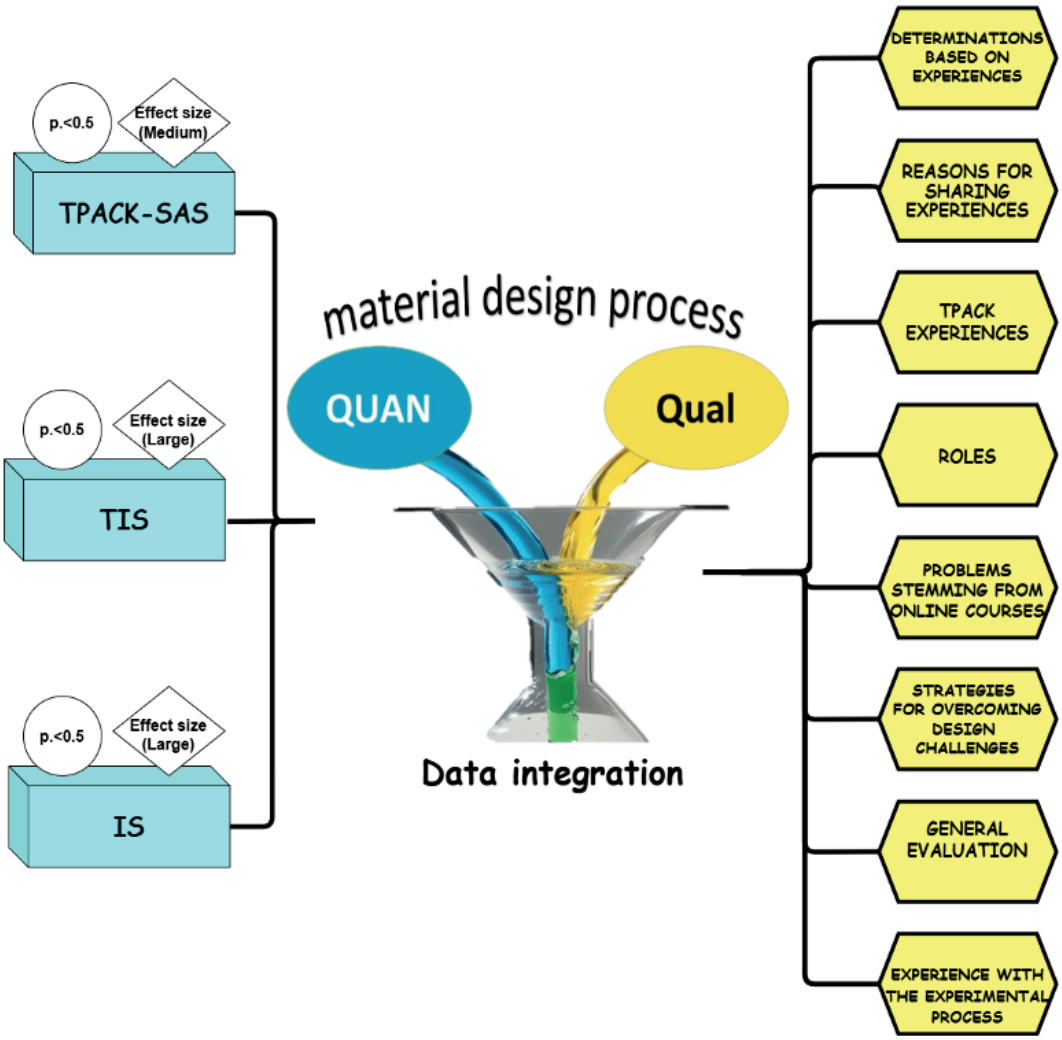


Figure 3. Juxtaposing Quantitative and Qualitative Data

In Figure 3, quantitative and qualitative data are brought together prior to comparison. To depict the entirety and the process, all data (without deriving mixed findings from the quantitative and qualitative data) are presented in a single visual representation. The primary purpose is to display all data collectively before conducting the comparison. The comparison of quantitative and qualitative data is illustrated in Figure 4.

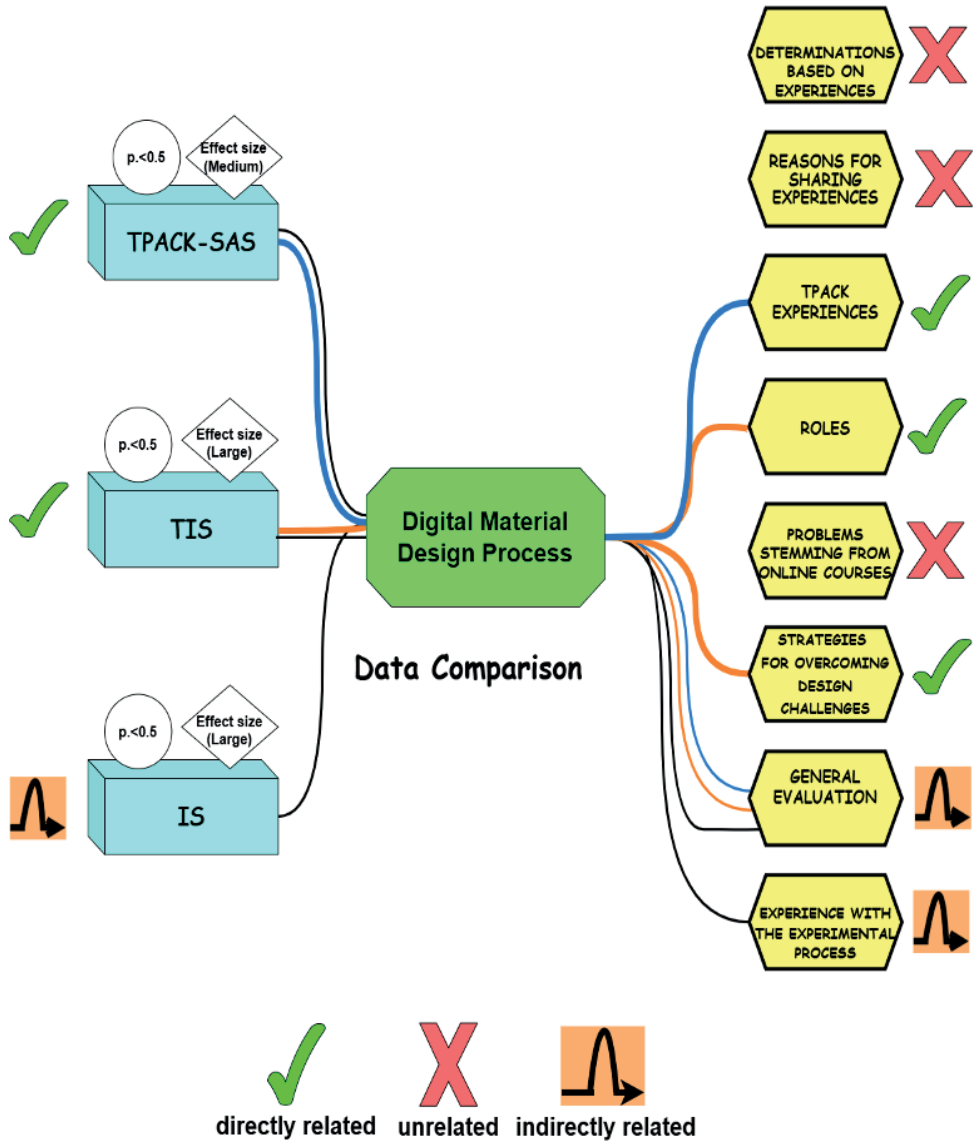


Figure 4. Comparison of Quantitative and Qualitative Data

According to Figure 4, the data from TPACK-SAS (quantitative) are directly related to the theme of digital material development process experiences (qualitative).

The data from TIS (quantitative) are directly related to the themes of roles in the digital material development process and strategies for dealing with design challenges in the digital material development process (qualitative). No qualitative data were found to be directly related to IS. Additionally, there is an indirect relationship between the themes of general evaluation and the experience with the experimental process and the TPACK-SAS, TIS, and IS data. The relationships mentioned above are shown in the following figure and tables, respectively.

Mixed Data Findings Regarding the Evaluation of Preservice Social Studies Teachers' Experiences in the Digital Material Development Process in Terms of Various Variables

A general joint display of the evaluation of preservice social studies teachers' digital material design experiences across various variables is presented in Figure 5.

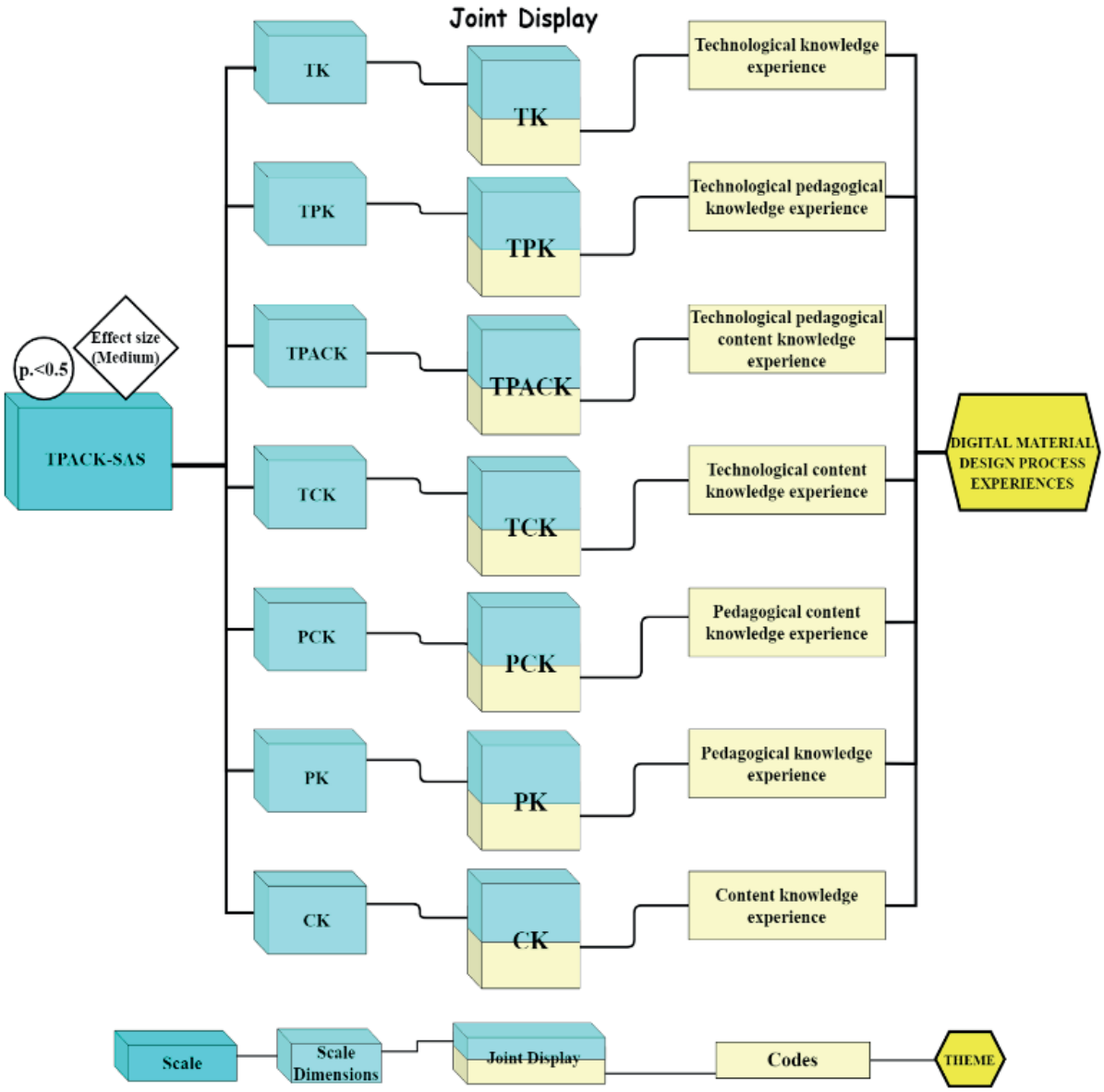


Figure 5. General Joint Display of Preservice Social Studies Teachers' Experiences in the Digital Material Development Process Evaluated Across Various Variables

According to Figure 5, the qualitative data under the theme of digital material development experiences support the significance and moderate effect size obtained from the analysis of the TPACK-SAS quantitative scale data (See Table 3 and Table 4 in the annexes for a detailed joint display).

Mixed Data Findings on the Evaluation of the Control Over Digital Material Design Processes by Preservice Social Studies Teachers

A general joint display of the evaluation of the control over the digital material development processes of preservice social studies teachers is presented in Figure 6.

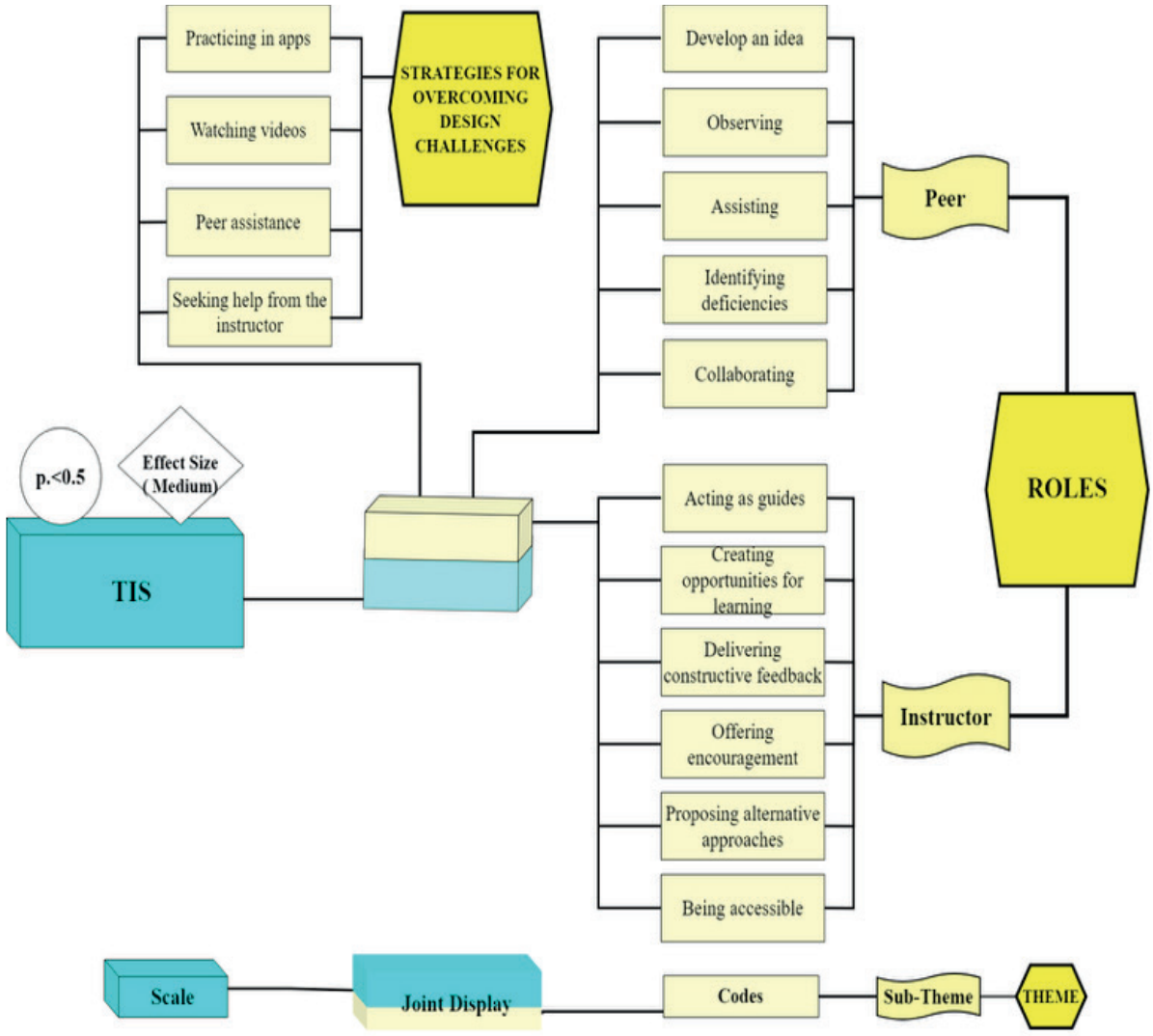


Figure 6. General Joint Display of the Evaluation of Control Over the Digital Material Development Processes of Preservice Social Studies Teachers

According to Figure 6, the qualitative data under the themes "roles" and "strategies for overcoming design challenges" support the significance and medium effect size obtained from the TIS quantitative scale data analysis (See Table 3 and Table 4 in the annexes for a detailed joint display).

DISCUSSIONS AND CONCLUSION

In this study, which employs an embedded mixed-methods approach, the aim of this study is to assess the experiences of preservice social studies teachers in designing digital materials during the distance education process, considering various relevant variables. The findings revealed that the digital material development process led to an increase in technological pedagogical content knowledge (TPACK) self-assessment. Additionally, significant differences were observed in various subdimensions of technological knowledge, content knowledge, and pedagogical knowledge. However, no significant differences were found in the dimensions of pedagogical knowledge and content knowledge. These findings are consistent with the existing body of literature (Acikgul, 2017; Tatli et al., 2016; Chai et al., 2010; Koehler & Mishra, 2005; Maor, 2017; Onal & Alemdag, 2018). During the implementation process of this study, participants utilized ICT tools in the design phase. As Kabakci Yurdakul (2011) stated, increased use of ICT is associated with an improvement in Technological Pedagogical Education competencies. Similarly, a study by Albayrak Sari

et al. (2016) indicate a positive correlation between ICT attitudes and TPACK competencies. The increase observed in TPACK-SAS levels in this study can be attributed to the participants' exposure to ICT during the experimental implementation phase.

Cevra et al. (2022) stated that individual innovativeness influences attitudes towards adopting and using new technologies. In their study, Cuhadar et al. (2013) found a moderate positive correlation between individual innovativeness levels and technological pedagogical education competencies. Similarly, Loogma et al. (2012) emphasized that the development of e-learning competencies (ICT competencies, e-learning competencies, pedagogical competencies) is closely linked to innovativeness. In the current study, pre-test and post-test data of preservice teachers' individual innovativeness levels showed significant results. The significant finding in individual innovativeness levels may have also influenced the significant results in TPACK levels. The study by Yavuz Konokman et al. (2016), conducted with classroom preservice teachers, also found a significant difference in innovation levels after material design activities, which aligns with the current study's results. In this context, the increase in technological pedagogical content knowledge (TPACK) self-assessment levels is believed to stem from the experiences gained during the course. Indeed, interview and diary data obtained from participants strongly emphasized this experiential process. TK, PK, CK, TPK, TCK, PCK, and TPACK are some of the recurring codes in the interview and diary data, and these related experiences expressed in the qualitative data can be considered as indicators that contributed to the meaningfulness and moderate effect size found in the quantitative data.

The study found that the digital material development activities increased the preservice social studies teachers' Technology Integration Strategies (TIS) levels, with this increase having a moderate effect size. The significant findings in the TIS results were influenced by the attention given to strategies during the application phase. Baran et al. (2019) identified a positive relationship between the TIS model and TPACK, while Sarri (2021) emphasized that technology integration enhances the five domains of TPACK. Tondeur et al. (2018, 2017) stated that the perception of TIS strategies strengthens ICT competencies and teaching practices. In this study, the increase in TIS results was attributed to factors such as the guidance and modelling provided by the instructor, peer collaboration, and the strategies used by preservice teachers to overcome design challenges. Qualitative data revealed that the dimensions of the TIS model (role-model educator, collaboration, realistic experience, continuous feedback) were reflected in the course process and were key elements explaining the development in TIS levels.

In the study, prior to the experimental process, preservice social studies teachers exhibited varying levels of individual innovativeness, with most falling into the inquisitive and pioneering categories, and a small proportion classified as innovative or sceptical. After the experimental process, there was a notable shift, with an increase in pioneering and innovative individuals and the elimination of the sceptical category. Furthermore, the proportion of highly innovative candidates showed a significant rise. These findings indicate that digital material design enhances innovation levels. The high innovation levels of the candidates suggest that they are inclined to use technology in their classrooms and have a positive potential for educational practices. Furthermore, studies in the literature (Cuhadar et al., 2013; Solmaz, 2019) have shown a positive and moderate relationship between individual innovativeness and technological pedagogical competence. Similarly, positive correlations were found between digital nativity and individual innovativeness (Gunduz, 2020), technology attitude scores and innovation scores (Ozgur et al., 2015), and ICT acceptance levels and individual innovativeness levels (Sahin, 2016). In this study, the significant findings in preservice teachers' technological pedagogical competence levels suggest that these may contribute to the increase in individual innovativeness. These results demonstrate that individual innovativeness and technological pedagogical competence increase in parallel, supporting each other.

As indicated by the participants in this study, the instructor assumed a variety of roles, including that of guide, facilitator, feedback provider, motivator, technological role model, and one who offers alternatives. They were also perceived to be accessible. These findings are in accordance with those of other studies in the existing literature. To illustrate, Sancar Tokmak (2015) observed that preservice teachers addressed their knowledge gaps through individual effort, peer support, or online resources. Admiraal et al. (2017) emphasized the positive impact of teacher educators who act as role models while teaching technology courses. Goodyear et al. (2001) delineated the various roles of the teacher in online education, including researcher, guide, facilitator, designer, manager, and technology expert. Similarly, Bawane and Spector

(2009) posited that instructors in online education assume a variety of roles, including pedagogical, social, evaluative, managerial, and advisory. The study findings are also in accordance with those of Foulger et al. (2017), who emphasised the pivotal roles of educators in preparing and motivating for innovative practices in teacher training. This further illustrates that prospective teachers are subjected to rigorous exposure to the roles of peers and instructor throughout the course of their training.

The study revealed that preservice social studies teachers were able to surmount the design challenges they encountered during the digital material development process through a combination of experimentation, video observation, and assistance from classmates and instructor. Sancar Tokmak (2015) observed that preservice teachers addressed their knowledge gaps through personal effort, support from peers, and guidance from instructors. Similarly, Sancar Tokmak et al. (2013) emphasised the importance of learning from group members in material design.

The preservice teachers emphasized that the materials to be designed should be functional, aligned with the learning objectives, and rich in content based on their experiences. Goksun et al. (2018) stated that user-friendly and simple interfaces are preferred, while Avci Yucel (2017) highlighted that usability and cost-effectiveness are important criteria for Web 2.0 materials. These findings are consistent with the results in the literature.

The majority of preservice teachers indicated that online courses are effective for several reasons, including the ability to rewatch lessons, improve computer skills, and practice. Furthermore, the respondents indicated that the courses should be conducted online. Similarly, Dilmac (2020) emphasized the advantages of distance education, such as providing equality, enabling the use of new technologies, and reducing costs. Gokbulut (2020) asserted that distance education provides opportunities for working students and that technical difficulties are uncommon in this modality. Some preservice teachers, however, found face-to-face education more effective due to communication issues and low efficiency. Similar findings can be found in the literature. Kemp and Grieve (2014) found that, despite no difference in test performance, students preferred face-to-face education. Burma (2007) found that the perception of quality in distance education is low. Friesen (2021) and Tanta (2021) stated that during the pandemic, distance education was perceived as inadequate and preferred face-to-face education. Aksel (2021) and Yenerer (2021) also found that online education was negatively evaluated compared to face-to-face education in terms of scores and opinions. Some preservice teachers mentioned that, under appropriate conditions, courses could be conducted both online and face-to-face. Crews and Butterfield (2014) determined that face-to-face education supports interaction and active learning, while online education supports flexibility and organization. Cruz Colon (2021) found that the perception of distance education depends on individual differences.

The preservice teachers indicated that the individuals responsible for designing digital materials should possess creativity, receptivity to ideas, effective communication skills, and a comprehensive understanding of technology, pedagogy, and content. This conclusion is corroborated by existing literature. Sancar Tokmak (2015) underscored the significance of possessing expertise in creativity and all TPACK domains, in addition to design expertise, for the development of digital educational materials.

The participants encountered some issues in the online courses they were taking due to a variety of factors, including internet problems, technical limitations, a lack of the necessary equipment, and difficulty in finding an appropriate environment in which to study. Similarly, Ozudogru (2021) identified technical and communication issues, Cahapay (2021) highlighted browser incompatibility, internet connection problems, and distractions, Friesen (2021) emphasised issues with access to resources and isolation, and Aytac (2021) emphasised internet and equipment problems. Fichten et al. (2009) observed that students encountered difficulties in accessing learning management systems and a lack of available materials and information.

The study revealed that preservice teachers perceived the digital material development process as an educational, enjoyable, and efficient experience. Koehler and Mishra (2005) emphasised that learning through a design approach is beneficial, enjoyable, and challenging, while Bervell et al. (2020) observed that online satisfaction increases in situations with intense student-student, student-teacher, and student-material interactions. These positive interactions may have contributed to the results of the current study.

In the material design process, preservice teachers developed the selected learning outcomes using appropriate digital tools. Owusu-Agyeman and Larbi-Siaw (2018) stated that the correct content and technology can

enhance students' knowledge and skills. The implementation of similar processes may have led to meaningful improvements in this study.

It is hypothesised that the observed increase in levels of TPACK self-assessment and Technology Integration Strategy can be attributed to the experiences gained during the digital material development process. This is corroborated by the fact that the data obtained from the participants through the interview and diary method placed particular emphasis on this experiential process. Nevertheless, no qualitative data could be identified that directly explained the observed increase in individual innovativeness. Additionally, some of the participants' experiences, such as enjoyment of the lesson, learning, and a productive lesson, may have indirectly contributed to the increase in TPACK-SAS, IS, and TIS levels. Moreover, some preservice teachers voiced concerns, encountered technical challenges, and experienced confusion at the outset of the application week. As the week progressed, the participants' anxieties and technical challenges diminished, and the confusion was resolved. This resolution may be taken to indicate that the participants adapted to the experimental application process. It can therefore be posited that these experiences may have indirectly contributed to the increase in TPACK-SAS, IS, and TIS levels.

Upon evaluation of the results of the study, it can be stated that, in general, the preservice teachers' experiences in the digital material development process led to an increase in their TPACK-SAS, TIS, and IS levels. Moreover, an analysis of the combined data set, comprising both quantitative (TPACK-SAS, TIS) and qualitative data, indicates that the experiences expressed in the qualitative data contributed to the attainment of statistically significant, medium, and large effect sizes in the quantitative data. In the integration of mixed data, it was concluded that the qualitative data provided a complementary dimension to the quantitative data.

The integration of digital material design into educational practices offers significant opportunities to enhance technology integration, individual innovativeness, and technopedagogical competencies, particularly among preservice Social Studies teachers. To maximize the potential benefits, both practical applications and future research directions should be carefully considered.

Digital material design can serve as an effective tool to improve preservice Social Studies teachers' skills in technology integration, individual innovativeness, and technopedagogical competencies. It is essential to address technical challenges, such as internet connectivity issues, hardware deficiencies, and inadequate learning environments, to facilitate smoother online learning experiences. Preservice teachers should be supported throughout the design process with resources like trial runs, instructional videos, and assistance from peers and instructor. Collaborative and communicative approaches should be encouraged, fostering teamwork among preservice teachers. Instructor play a vital role in guiding, motivating, and acting as technological role models. Material selection should focus on user-friendliness, alignment with learning objectives, and rich content. Individuals engaged in digital material design should possess strong technopedagogical domain knowledge, creativity, and communication skills. Finally, considering the educational, enjoyable, and motivational potential of digital material design processes, these aspects can be leveraged to enhance overall motivation in education.

Future studies should explore the impact of digital material design experiences across diverse grade levels, teaching programs, regions, and variables. Controlled experimental research designs could provide more detailed insights into these processes. Additionally, studies on digital material design in face-to-face environments, rather than solely online settings, could offer valuable perspectives. Similar research can also be extended to Social Studies teachers, in addition to preservice teachers, to gain a broader understanding of its impact in professional teaching contexts. Furthermore, studies employing different mixed method designs on this topic can be conducted.

Suggestions

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Authors' Note: This study was reproduced from the Ph.D. thesis titled "Assessment of Digital Material Design Experiences of Preservice Social Studies Teachers in Terms of Various Variables: A Mixed Design Research" prepared by the first author, supervised by the second author.

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