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FROM THE EDITOR

Dear Colleagues,

The *Journal of Theoretical Educational Science* is happy to publish the third issue of 2022! In the July issue of 2022, we have been publishing 10 research articles and 1 book review from 22 authors. We are glad that these articles represent the different disciplines of education. For this issue, the average time from submission to acceptance for research articles was 4.4 months (min. 2 months max. 10 months), and the average time from submission to publication was 7 months (min. 5 months max. 11 months). These statistics prove how our reviewing and publication process works equally for everyone. The maximum times were due to the one article that was revised late. In this issue, we included one book review, too. We are planning to include a few review studies. Authors are requested to send us an e-mail for the related book review.

Finally, we should also express our sincere thanks to the Editorial Board, 27 reviewers and authors for their invaluable contributions.

We look forward to receiving submissions from different parts of the world!

Kindest regards,

<div style="text-align: right">

Fatih GÜNGÖR, PhD
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</div>

Assessment of Mathematical Reasoning Competence in Accordance with PISA 2021 Mathematics Framework

Matematiksel Muhakeme Etme Yeterliğinin PISA 2021 Matematik Çerçevesine Göre Değerlendirilmesi

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ABSTRACT: The aim of this study is to develop a rubric to assess mathematical reasoning competence. Since the aim is to assess a competency, the frameworks of the PISA exams in the literature, which give an important place to competencies, have been examined. Due to its focus and in-depth analysis of mathematical reasoning, each of the actions expected from the mathematical reasoning process in the PISA 2021 Mathematics Framework was handled as a criterion and a rubric was created. Data were collected from 30 mathematics teachers with the data collection tool consisting of questions that were stated to be suitable for assessing mathematical reasoning skills in the resource presented as a broadened perspective for the PISA 2021 Mathematics field. The collected data were analyzed using the finalized rubric. In reliability analysis; The "percentage of agreement" among researchers was used to determine the criteria included in the rubric and to be followed with the data collection tool, "Cohen's kappa coefficient" and "Krippendorff's alpha coefficient" methods were used for the agreement between the raters after the analysis of the collected data. The findings show that the Reasoning Competence Rubric (RCR), which consists of 12 criteria, is valid and reliable.

Keywords: Mathematical reasoning, competence, mathematical reasoning rubric, mathematical literacy, PISA.

ÖZ: Bu çalışmanın amacı, matematiksel muhakeme etme yeterliğini değerlendirmeye yönelik bir değerlendirme tablosu geliştirmektir. Amaç bir yeterliğin değerlendirilmesi olduğu için yeterliklere önemli bir yer veren PISA sınavlarının literatürdeki çerçeveleri incelenmiştir. Matematiksel muhakeme etmeyi odağına alması ve derinlemesine incelemesi sebebiyle PISA 2021 Matematik Çerçevesi'nde yer alan matematiksel muhakeme etme sürecinden beklenen eylemlerin her biri kriter olarak ele alınıp değerlendirme tablosu oluşturulmuştur. PISA 2021 matematik alanı için genişletilmiş bir perspektif olarak sunulan kaynakta yer alan matematiksel muhakeme etme becerilerini ölçmeye uygun olduğu belirtilen sorulardan oluşturulan veri toplama aracı ile 30 ilköğretim matematik öğretmeninden veriler toplanmıştır. Toplanan veriler son hali verilen değerlendirme tablosu kullanılarak analiz edilmiştir. Güvenilirlik analizlerinde, değerlendirme tablosunda yer alan ve veri toplama aracı ile izlenecek olan kriterlerin tespiti için araştırmacılar arasındaki "uyum yüzdesi", toplanan verilerin analizi sonrasında puanlayıcılar arasındaki uyum için "Cohen'in kappa katsayısı" ve "Krippendorff'un alfa katsayısı" yöntemleri kullanılmıştır. Değerlendirme tablosunun geçerliğini sağlamak için uzman görüşlerine başvurulmuştur. Elde edilen bulgular 12 kriterden oluşan Muhakeme Etme Yeterliği Değerlendirme Tablosunun (MYDT) yeterli düzeyde geçerli ve güvenilir olduğunu göstermektedir.

Anahtar kelimeler: Matematiksel muhakeme, yeterlik, muhakeme etme değerlendirme tablosu, matematik okuryazarlığı, PISA.

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Reasoning is the process of supporting an idea, confirming that idea or justifying a decision (Toulmin et al., 1984). Leighton (2003) defined reasoning as the process of organizing evidence, beliefs, and thoughts about the accuracy of conclusions. It can be said that these two definitions are similar in that they see reasoning as a process. Considering the relationship of reasoning with mathematics, reasoning is the foundation of mathematics epistemologically. As science verifies through observation, mathematics relies on logic (Steen, 1999).

Bal-İncebacak and Ersoy (2016) stated that mathematics contains many skills that an individual needs to develop, and one of the most important of these skills is reasoning. There are many definitions in the literature on mathematical reasoning. Russell (1999) defined mathematical reasoning as a tool for understanding the abstract, symbolic expressions that create mathematics. Peresini and Webb (1999) stated that mathematical reasoning is a dynamic activity that includes various ways of thinking. Yackel and Hanna (2003) stated that mathematical reasoning is a common activity in which more than one mathematical skill interacts, and they present a view parallel to Peresini and Webb's (1999) definition.

Reasoning is one of the important aims of mathematics teaching (Yankelewitz, 2009). When national and international improvement movements are examined, it can be seen that mathematical reasoning plays an important role in learning mathematics (Erdem, 2015). For this reason, it was stated that understanding mathematics would be incomplete without reasoning (Ball & Bass, 2003). It is useful to examine the definitions of reasoning in the mathematics teaching programs of different countries since reasoning is important among the skills that mathematics should provide to the individual and is among the objectives of mathematics teaching.

In the secondary education program of the Ministry of National Education [MoNE] (2013), reasoning is defined as the process of acquiring new information. Again, some indicators that should be taken into account to gain reasoning skills in the secondary school mathematics course 2013 curriculum are;

➢ Defending the accuracy and reality of inferences

➢ Making logical inferences and generalizations

➢ Explaining and using mathematical patterns and relationships when analyzing a mathematical situation

➢ Making predictions about the outcome of operations and measurements using strategies such as rounding, grouping appropriate numbers, using first or last digits, or strategies they have developed.

➢ Making an estimation of the measurement by taking into account a certain reference point (MoNE, 2013, p. 5).

In the secondary school mathematics course 2018 curriculum, the aim of providing students with reasoning skills is "The student will be able to easily express their own thoughts and reasoning in the problem-solving process, and will be able to see the mathematical reasoning deficiencies or gaps of others (MoNE, 2018, p. 9)." is in the form. The New Jersey Mathematics Teaching Curriculum states that mathematical reasoning is the critical skill that enables a student to make use of all other math skills (New Jersey Mathematics Coalition and the New Jersey Department of Education [NJMCF], 1996, p. 44). In the Australian Mathematics Teaching Curriculum, on the

other hand, reasoning is considered as a mathematical competence that needs to be developed in students and is defined as the capacity for actions such as proving, evaluating, explaining and making inferences (Australian Curriculum and Assessment Authority [ACARA], 2017).

Mathematical Reasoning and Mathematical Literacy

The concept of mathematical literacy entered the literature with the Program for International Students Assessment [PISA] exams. PISA exams, developed in 1997 and administered for the first time in 2000, are administered by the Organization for Economic Co-operation and Development [OECD] in three-year periods to evaluate the knowledge and skills of students in the 15-year-old group. PISA exams are accepted as an important tool to evaluate the education quality of countries, and the results of PISA exams create a discussion environment where issues, such as education systems and teaching quality of countries, can be discussed (Dabic-Boricic et al., 2020). Turkey has not been able to get rid of the back ranks in the PISA exams it has participated in since 2003 (OECD, 2003, 2007, 2010, 2013). This situation has been instrumental in taking PISA results into account when deciding on education policies in Turkey, as in many participating countries (Gür et al., 2012). When considered in this context, it can be said that the PISA exams and the frameworks determined for these exams have an important place in the mathematics education literature.

The literature on mathematical literacy is quite rich (Gatabi et al., 2012; Güzel, 2017; Matteson, 2006; Özgen, 2021; Yıldız, 2019). Many definitions of mathematical literacy have been made so far (İskenderoğlu & Baki, 2011; OECD, 2013; PISA 2021a; Steen et al., 2007). Steen et al. (2007) defined mathematical literacy as the capacity to use mathematical knowledge and understanding effectively to overcome difficulties in daily life. İskenderoğlu and Baki (2011) defined mathematical literacy as a way of using mathematics in our individual lives as well as using individual capacity and making causal defenses to understand the role of mathematics in the world. The definition made by the OECD in the PISA 2021 Mathematics Framework is as follows:

> Mathematical literacy is an individual's capacity to reason mathematically and to formulate, employ, and interpret mathematics to solve problems in a variety of real-world contexts. It includes concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to know the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective 21st century citizens (PISA, 2021a, p. 7).

Mathematical reasoning takes its place among the mathematical competencies both in the OECD definition of mathematical literacy (Mathematical literacy is an individual's capacity to reason mathematically and to formulate, use and interpret mathematics to solve problems in a variety of real-world contexts) and in the mathematical literacy model specified in Figure 1.

Figure 1

PISA Mathematical Literacy Model

Challenge in real world context
Mathematical content categories: Quantity; Uncertainty and data; Change and relationships; Space and shape
Real world context categories: Personal; Societal; Occupational; Scientific

Mathematical thought and action
Mathematical concepts, knowledge and skills
Fundamental mathematical capabilities: Communication; Representation; Devising strategies; Mathematisation; Reasoning and argument; Using symbolic, formal and technical language and operations; Using mathematical tools
Processes: Formulate; Employ; Interpret/Evaluate

Problem in context → **Formulate** → Mathematical problem
Mathematical problem → **Employ** → Mathematical results
Mathematical results → **Interpret** → Results in context
Results in context → **Evaluate** → Problem in context

Note. (PISA, 2021b, p. 5)

The key to mathematical competencies is mathematical literacy (Doyle, 2007). Having mathematical competencies is closely related to mathematical literacy (Turner, 2010). Mathematical competencies are "the cognitive processes that should be activated to connect the real world in which the problem arises with mathematics and solve the problem posed" (Sáenz, 2009, p. 126). Niss (2003) defined the concept of mathematical competence, which he examined under eight different titles (thinking mathematically, posing and solving mathematical problems, modelling mathematically, reasoning mathematically, representing mathematical entities, handling mathematical symbols and formalisms, communicating in, with, and about mathematics, making use of aids and tools), as the ability to understand and use mathematics, while Niss and Højgaard (2019) defined mathematical competence as the ability to master the basic aspects and wishes of mathematics and to act effectively in this field.

Various sources (Altun, 2020; Kilpatrick et al., 2002; Niss, 2003; OECD, 2013; PISA, 2021a) in the literature show that mathematical reasoning is among the mathematical competencies. An individual with mathematical competence can solve problems encountered in school, mathematics lessons and daily life by reasoning (Demir & Vural, 2016). Herman (2018) stated that reasoning is a very important aspect of mathematical competencies in learning mathematics. These statements reveal the importance of reasoning among the mathematical competencies.

OECD (2013) states that mathematical reasoning competence includes the processes of searching for problem elements, inferring from them, checking a rationale,

searching the rationale for statements to provide solutions to problems, and logical thinking processes that link all these together. The PISA 2021 Mathematics Framework supports that reasoning is a core competence for the science of mathematics, saying that mathematics is a science about well-defined objects and concepts that can be analyzed and transformed in different ways by mathematical reasoning.

In PISA frameworks published by OECD in previous years (OECD, 2013, 2017, 2019), expected actions in the mathematical reasoning process are integrated with mathematical process skills. In the framework of PISA 2021, mathematical reasoning was handled as a fundamental aspect of mathematical literacy and focused on (Figure 2), and the expected actions in the mathematical reasoning process are listed (Figure 3) as follows:

Figure 2

Mathematical Literacy: The Relationship between Mathematical Reasoning and Mathematical Process Skills
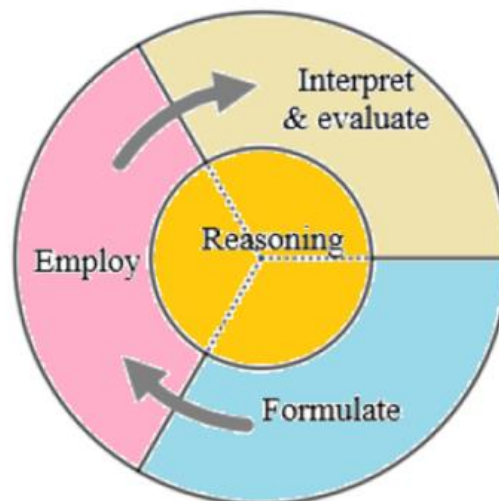
Note. (PISA, 2021a, p. 8)

Figure 3

A Part of Expected Actions for Mathematical Reasoning

** Draw a simple conclusion

** Select an appropriate justification

** Explain why a mathematical result or conclusion does, or does not, make sense given the context of a problem

Represent a problem in a different way, including organising it according to mathematical concepts and making appropriate assumptions

Utilise definitions, rules and formal systems as well as employing algorithms and computational thinking

Explain and defend a justification for the identified or devised representation of a real-world situation

Explain or defend a justification for the processes and procedures or simulations used to determine a mathematical result or solution

Identify the limits of the model used to solve a problem

Understand definitions, rules and formal systems as well as employing algorithms and computational reasoning

…

Note. (PISA, 2021a, p. 35)

Although mathematical reasoning is a competence covered in many mathematics teaching curricula around the world, teachers struggle to understand, teach and assess mathematical reasoning (Loong et al., 2018). Loong et al. (2018) developed a rubric that deals with each of the three reasoning actions (analyzing, generalizing, justifying) at five levels (not evident, beginning, developing, consolidating, extending) assessment students' reasoning and presented it to the use of teachers. Bal-İncebacak and Ersoy (2016) used the mathematical reasoning stages of TIMSS 2003 to assess the mathematical reasoning skills of secondary school 7th grade students. Çoban and Tezci (2020), on the other hand, developed a scale consisting of multiple-choice and open-ended questions aiming to reveal the level of mathematical reasoning skills of secondary school students. On the other hand, Ersanlı et al. (2018) revealed that subject-based dimensions of mathematical reasoning (e.g., proportional reasoning, reasoning about ratio-proportionality, etc.) were addressed in more than one study, but there was a gap in research on thinking styles and perspectives in the dimension of mathematical reasoning. Teachers are the most effective people in teaching reasoning skills to students. (Altıparmak & Öziş, 2005). Despite this important role of the teacher in helping students gain reasoning competence, Herbert (2019) listed the difficulties of teachers in assessing mathematical reasoning as follows; teacher's reasoning knowledge, teacher's awareness of reasoning, students' difficulties in expressing reasoning, lack of guidance/support in curriculum documents, lack of work examples, difficulty in monitoring and reporting student progress in reasoning. When these are taken into consideration, to direct future studies and reform movements, it is considered important to assess the reasoning competencies of teachers. Therefore, the study group of this study consists of mathematics teachers. In this context, the aim of this study is to create a rubric that can be used to assess teachers' mathematical reasoning competencies, and for this, the expected actions in the reasoning process specified in the PISA 2021 Mathematics Framework were used since it is an up-to-date resource and focuses on mathematical reasoning and examines it in depth.

Method

Creation of the Rubric

A rubric is a rating system in which teachers can determine at what level a student can perform a task or demonstrate knowledge of a concept (Brualdi-Timmins, 1998). Many methods have been mentioned in the literature on the development of rubrics (Brualdi-Timmins, 1998; Goodrich-Andrade, 1997; Moskal, 2000; Moskal & Leydens, 2000; Russell & Airasian, 2001). By taking into consideration these methods, the stages of creating the rubric used in this study are discussed in detail in the following.

Determining the Criteria

Since the aim is to assess the competence of mathematical reasoning, the sources of the PISA exams in the literature, which frequently bring the concept of competence to the agenda, were scanned. Thus, due to the fact that it focuses on mathematical reasoning and examines it in detail, the expected actions in the mathematical reasoning process within the framework of PISA 2021 are primarily discussed as a list. The actions expected in the mathematical reasoning process were translated into Turkish by

taking expert opinion. Expert opinions were taken in one-on-one interviews to adapt the actions to the Turkish language. The researchers consulted the opinions of two different experts about the translations they made with the expert and the points where they had dilemmas. Later, the actions were evaluated as criteria and started to be tabulated.

In PISA 2021, the first of the reasoning actions is handled in three separate actions (1a, 1b, 1c) to include students at the extreme. Since the present study was carried out on teachers, not students, unlike PISA, the third item (1c: Explain why a mathematical result or conclusion does, or does not, make sense given the context of a problem), which includes the first two, was included and the other two items (1a: Draw a simple conclusion, 1b: Select an appropriate justification) were omitted in the rubric by taking expert opinion. Only some criteria whose action was changed were combined by taking expert opinion. The combined criteria are shown in Figure 4 and included in the rubric with the codes indicated next to it.

Figure 4

Criteria Combined with Expert Opinion
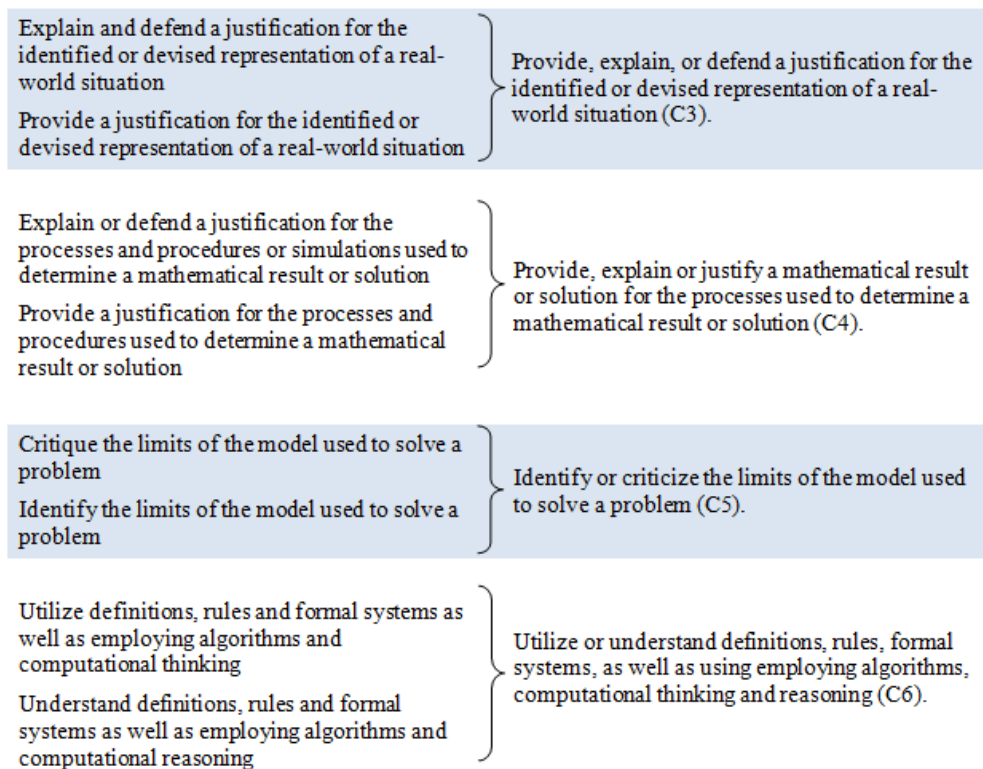
In the framework of PISA 2021, it is stated that understanding numbers, operations, representations (symbols containing numbers, etc.) and how to move between representations are the basis of mathematical reasoning. It can be said that the importance of establishing the relations between the expression "moving between representations" and the contextual language and mathematical language required for representation is emphasized. Therefore, "Explain the relationships between the context-specific language of a problem and the symbolic and formal language required to represent it mathematically." The statement "Construct or explain the relationships between the context-specific language of a problem and the symbolic and formal language required to represent it mathematically. (C9)" and included in the rubric with

the code specified next to it. Other statements (C1, C2, C7, C8, C10, C11, C12) were included in the rubric without any changes. While the verbs of the criteria are transferred to the rubric, they are conjugated with the singular third person. As a result of all these steps, a rubric with 12 criteria was obtained.

Deciding on the Type of Rubric and the Levels to be Used

According to many researchers, in the scoring made by dividing a field into sub-fields, the scoring is less affected by the subjectivity of the raters and the difference between the raters decreases (Güler, 2019). Bülbül (2019) said that the categories of the criteria in the rubrics should be determined numerically and their contents should also be defined. In other words, the scoring in the rubrics should be made according to the criteria and the way these criteria are applied and found (Bülbül & Bülbül, 2021). For this reason, the scoring strategy of the rubric was made as "analytical". Analytical rubrics contain criteria that define the dimensions of a task at multiple levels (McGatha & Darcy, 2010). Each criterion in the rubric is addressed at 0-1-2 points. According to the rubric, the individual who fully demonstrates the relevant criterion gets 2 points, while the individual who does not show any gets 0 points.

Defining the Score Levels of the Criteria

While preparing the rubrics, the highest levels of the criteria are determined first. At this stage of the study, first of all, the meaning of the highest score levels (2 points) of the criteria was determined by consulting expert opinions. After the top score levels were defined, the meaning of the other score levels (0 Points and 1 Point) was shaped in line with the expert opinions.

Creating the Draft Rubric and Determining How It will be Used

At this stage, a draft version of RCR with 12 criteria and 0-1-2 score levels for each criterion was created in detail. It is not necessary to observe each of the criteria in the rubric for any question included in a data collection tool that will use RCR in its analysis. For a question in the data collection tool, it should first be determined which of the criteria in the rubric are observable. For example, if a question allows four of the criteria to be followed, the maximum score that can be obtained from that question will be eight.

Obtaining Expert Opinion on the Rubric

An expert opinion form was used to consult the opinions of the experts regarding the RCR draft form. For an expert opinion, three academicians (one professor, two associate professors) who are experts in the field of mathematics education were asked for their opinions. Attention has been paid to the fact that the experts are experienced in the fields of mathematical competences and reasoning, have studied in related fields or taught courses in the relevant fields. Two of the experts conducted a graduate-level mathematical reasoning course, and all of the experts conducted a thesis on mathematical reasoning and mathematical literacy. They were asked to express their opinions and make suggestions in terms of the suitability of being able to be used without being tied to any mathematics subject, and the suitability of the way the criteria were handled at 0-1-2 score levels (appropriate, not suitable/suggestion). The expert opinion form was also open to expert suggestions, apart from these mentioned issues.

Performing the Validity and Reliability Analyzes of the Rubric

After expert opinions, RCR (Appendix 2) was revised, and its validity was ensured and made ready for reliability analysis. Two researchers used the rubric developed independently of each other in the analysis of the data obtained from the data collection tool. The findings of the analyzes are given in the findings section.

Data Collection Tool

As a data collection tool, a Reasoning Competence Test (RCT) consisting of two open-ended questions, in which the RCR will be used in the analysis, was used. In the resource presented as a broadened perspective for the PISA 2021 Mathematics field, there are sample questions that are stated to be suitable for measuring reasoning skills (PISA, 2021b). Among these sample questions, two questions in Appendix 1 were chosen because they have different content areas and different real-life contexts. The content categories and real-life contexts of the questions are given in Table 1.

Table 1

Content Categories and Real-Life Contexts of the Questions in RCT

Questions	Mathematical Content Categories	Real-Life Context Categories
Multiplication	Quantity	Personal
Tree Leaves	Space and Shape	Scientific

The naming of the questions belongs to the researchers. Sub-questions items were added to the questions by taking the opinion of a mathematical education expert so that the questions were aimed to gain depth, and two open-ended questions became seven questions together with their sub-items.

Data Collection

At all stages of the research, data were collected online due to the COVID-19 Pandemic period. The study group of the research consists of 30 mathematics teachers (for 11 to 14 years old pupils) working in schools under the Ministry of National Education in different cities. It was stated to the teachers that participation in the research was not compulsory, it was on a voluntary basis, and their names would be kept confidential. Demographic characteristics of the teachers participating in the study, such as gender, professional experience and education level, are given in Table 2 below.

Table 2

Demographic Characteristics of the Study Group

	Professional Experience			Education Level		
	1-5 year	6-10 year	11 year and more	Bachelor's	Master's	Doctorate
Female	20	1	2	19	4	-
Male	2	5	-	6	-	1

RCT was represented to the participating teachers online, and their feedback was received online. For this reason, uncontrollable variables such as the inability to control the environment in which the questions were solved may have had an impact on the findings, since the researcher could not actually be with them while the teachers were solving the RCR.

Analysis of Data

In the first stage of data analysis, it is necessary to decide which of the two questions in RCT allows monitoring which of the criteria in RCR. For this, the percentage of agreement between the choices made by the researchers on the basis of the criteria was examined. The percentage of agreement was calculated using the reliability formula proposed by Miles and Huberman (1994) in order to ensure the reliability of the research. This formula is as follows:

[Reliability = Agreement / (Agreement + Disagreement) x 100]

Secondly, after the criteria had been determined, the collected data were analyzed independently by the researchers using RCR. Sample analyzes are included in Appendix 3. In the literature, it is seen that many techniques such as inter-rater correlation coefficient, Cohen's kappa coefficient, Krippendorff's alpha coefficient, ANOVA based on the difference between the scorers are used to determine the reliability of agreement between raters. Cohen's kappa coefficient was developed to determine the degree of agreement between two raters, and Krippendorff's alpha coefficient was developed to determine the degree of agreement between two or more raters (Cohen, 1960; Krippendorff, 1995).

In this study, "Cohen's kappa coefficient" and "Krippendorff's alpha coefficient" were calculated to determine the reliability of agreement between raters since there were two raters. Since both analysis methods were suitable for this study, both were applied to increase reliability. SPSS for Windows 22.0 program was used to calculate Cohen's kappa coefficient. In order to calculate Krippendorff's alpha coefficient, the data obtained were uploaded to the website prepared by Freelon (2010) to calculate this coefficient and the results were tabulated. In this study, one of the methods used in the examination of the reliability of the Reasoning Competence Rubric (RCR) is Krippendorff's alpha coefficient. Having a sample size of at least 30 is a sufficient size for the Kripendorff alpha fit coefficient to accurately estimate the parameter (Kanik et al., 2010).

Ethical Approval

This study ethics committee's approval was received with the session date and number 27.07.2021/2020-05 from Bursa Uludağ University Research and Publication Ethics Committees, Social and Human Sciences Research and Publication Ethics Committee. Scientific, ethical and citation rules were followed during the writing process of this study. No falsification was made on the collected data.

Findings

The findings related to the RCR, which was developed to assess mathematical reasoning, are presented under two headings: findings related to validity and findings related to reliability.

Findings Regarding the Validity of RCR

Expert opinions were sought in order to evaluate whether the rubric developed to assess the mathematical reasoning proficiency is a valid assessment tool. In this direction, the opinions of the experts on the use of the criteria in the rubric without depending on sampling and any mathematics subject, and the appropriateness of the handling of the scoring levels in the rubric were taken. All of the experts stated that the criteria in the rubric could be used regardless of sampling and any mathematics subject. Two of the experts suggested that the handling of the scoring levels in the evaluation table was appropriate, and the third expert suggested verbal changes in some of the level 1 expression. Changes were made in one-on-one interviews with the expert. Thus, it was observed that the opinions of the experts as appropriate/not suitable were mostly similar. As the criteria were taken from the reasoning section of the PISA 2021 Mathematics Framework, it was not questioned whether they served the scope of mathematical reasoning.

Findings Regarding the Reliability of RCR

In order for RCR can be used in the data analysis of research, it is first necessary to determine which of the criteria in the RCR allow the monitoring of the questions in the data collection tool. For this reason, the reliability analyzes of the RCR, which was developed to assess the mathematical reasoning competence, started from here. The researchers independently decided which of the criteria in RCT allowed the questions in RCR to be followed. As a result, the percentage of agreement (compliance) between the choices made by the researchers on the basis of criteria was calculated as %87.5.

The criteria agreed between the researchers and allow the questions in RCT to be watched in RCR are given in Table 3.

Table 3

Criteria by which the Questions Allowed to be Tracked

Question	Option a	Option b	Option c	Option d	Throughout the question
Multiplication	C11	C2-C9	C1	-	C6
Tree Leaves	C5-C9	C5	C4-C8-C10	C3	C6

The rationale for the selection of criteria is shown in Figure 5.

Figure 5

The Rationale for Selection of Criteria

Multiplication
Option a. Expressing how the calculations available in the representations are made includes understanding and explaining the process steps followed within the framework of a certain algorithm (C11).
Option b. Suggesting a new way to do the operation requires a different representation of the problem situation (C2). Expression of representation is not a random operation. It is necessary to establish a relationship between the symbolic and formal language that creates the representation and the contextual language of the problem situation (C9).
Option c. The person should make a choice and reach a decision on the basis of instruction among all the representations put forward for the problem situation. He should satisfactorily explain the reasons for his decision (C1).
In addition to all these, the solution of the problem requires using and understanding the definitions and rules of the mathematical language (C6).

Tree Leaves
Option a. To determine the surface areas of leaves, a solution model must be expressed. The steps of the solution model to work will be the limits of the model and should be explained (C5). While explaining the solution model, the relations between the contextual language and the mathematical language should be established (C9).
Option b. The limitations of the solution model expressed in the previous question item during its implementation should be expressed. This requires criticizing the steps of the model, namely its limits (C5).
Option c. Identifying the tree leaf with the largest surface area should be based on a resolution process (C4). The meaning of the solution depends on a contextual interpretation (C8). Contextual comment should not be a random comment, but a comment consisting of explanations that support or qualify the solution (C10).
Option d. It requires a solution for the problem situation that may occur in real life. This solution can be considered as a self-designed representation. He should provide a justification for his verbal representation in which he expresses the solution (C3).
In addition to all these, the solution of the problem requires using and understanding the definitions and rules of the mathematical language (C6).

The researchers scored the data collected using RCT independently of each other according to the criteria they agreed on in Table 3. "Cohen's kappa coefficient" and "Krippendorff's alpha coefficient" were calculated to determine the reliability of agreement between raters. The values obtained as a result of the analysis are shown in Table 4 on the basis of criteria.

Table 4

Cohen's Kappa Coefficient and Krippendorff's Alpha Coefficient for the Reliability of Agreement between Raters of the RCR

Criteria	Cohen's Kappa Coefficient	Krippendorff's Alpha Coefficient
C1	.886	.888
C2	.634	.705
C3	.774	.778
C4	.774	.778
C5	.750	.758
C6	.688	.686
C7	-	-

C8	.774	.774
C9	.750	.753
C10	.750	.750
C11	.837	.839
C12	-	-

When Table 4 is examined, Cohen's kappa coefficient values calculated to determine the reliability of agreement between raters are between .634 and .886. While the lowest agreement was obtained for the criterion coded C2, the highest agreement was obtained for the criterion coded C1. When Table 4 is examined, Krippendorff's alpha coefficient values calculated to determine the reliability of agreement between raters are between .686 and .888. The lowest agreement was obtained for the criterion coded C6, while the highest agreement was obtained for the criterion coded C1.

Discussion and Suggestion

In this study, it is aimed to develop a valid and reliable rubric to assess mathematical reasoning competence. Expert opinions were taken to ensure the validity of the developed RCR. The fact that the opinions expressed by the experts were mostly the same showed that the RCR was structurally valid. The fact that the criteria in RCR were taken from the sections of PISA resources related to mathematical reasoning without any changes is seen as sufficient evidence for the validity of RCR in scope.

Considering the findings regarding its reliability, the percentage of agreement between the choices made by the researchers on the basis of criteria regarding which of the criteria in the RCR allows monitoring of the questions in RCT is 87.5%. According to Miles and Huberman (1994), the percentage of agreement must be higher than 70% in order for the inter-rater evaluation results to be considered reliable. Considering the findings of the analysis, it can be said that the selections of the researchers on the basis of the criteria are consistent.

Cohen's kappa coefficient values, which were calculated to determine the reliability of agreement between raters in the data analyzed by the researchers, ranged between .634 and .886. Kappa values between .61 and .80 were considered significant, and values between .81 and 1 were accepted as an indicator of a very high level of agreement (Landis & Koch, 1977). Calculated Krippendorff's alpha coefficient values ranged between .686 and .888. According to Krippendorff (1995), an alpha coefficient greater than .60 indicates that the assessment tool is reliable. Bıkmaz-Bilgen and Doğan (2017) revealed in the reliability analysis performed by calculating Cohen's kappa coefficient and Krippendorff's alpha coefficient that the highest reliability values were obtained when there were two raters, and the reliability gradually decreased as the number of raters increased. In this study, as a result of the analyzes carried out on two raters and the findings obtained, it was decided that the RCR is a reliable tool.

As a result, a rubric was developed for the assessment of mathematical reasoning competence in this study. When the studies on the assessment of mathematical reasoning are examined; it is thought that the rubric developed by Loong et al. (2018) is suitable for use in the data analysis part of a research, and the scale developed by Çoban and Tezci (2020) is suitable for use in the data collection part of a research. Considering

that concepts such as rubric and scale can be used with the same meanings (Goodrich-Andrade, 1997), there is no harm in comparing related studies. So, considering the use of RCR in research, which was created in line with the purpose of the current study, while it is similar to the rubric developed by Loong et al. (2018), it differs from the scale developed by Çoban and Tezci (2020). Bal-İncebacak and Ersoy (2016) used the reasoning stages introduced by TIMSS 2003 while evaluating 7th grade students' reasoning skills. The criteria in the RCR created as a result of the current study, on the other hand, include the mathematical reasoning actions set forth by the PISA 2021 framework. Therefore, it can be said that since PISA and TIMSS are international student assessment exams, the two studies show similarities in terms of analysis. The fact that RCR is a tool to assess the mathematical reasoning competence of the individual suggests that it will be useful in eliminating the difficulties in assessing the reasoning put forward by Herbert (2019).

In order for the use of RCR to become more functional in a study, it is recommended that researchers who will use RCR first determine the criteria in the RCR that they want to follow and then choose a question appropriate to those criteria. Since the questions in the RCT used in this study do not contain the criteria C7 and C12, the aforementioned criteria could not be analyzed in this research. Studies on the relevant criteria are also continuing.

Statement of Responsibility

The authors contributed equally to the related research. Therefore, each author is equally responsible.

Conflicts of Interest

The authors declare that they have no conflict of interest.

Author Bios

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After graduating from Akdeniz University, Faculty of Science, Department of Mathematics in 1996, Assoc. Prof. Çiğdem Arslan worked as a teacher at various levels in the Ministry of National Education until 2001. She completed his master's and doctorate education in Uludağ University Faculty of Education in 2007, which she started as a research assistant in 2001. She worked at Istanbul University Hasan Ali Yücel Faculty of Education between 2008-2020. She has been working as an associate professor at Bursa Uludağ University since 2020. Her main areas of study include mathematical reasoning, problem solving, teaching geometry, mathematics textbooks, teacher education and mathematical literacy.

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Appendices

Appendix 1

1. MULTIPLICATION

A group of children are learning how to multiply 2-digit numbers in different ways. In the examples below they are calculating 47 x 36.

The ways in which students represent this process in different ways are shown below.

Representation 1

X	40	7	
6	240	42	282
30	1200	210	1410
			1692

Representation 2

Th	H	T	O
		4	7
	X	3	6
		4	2
	2	4	
	2	1	
1	2		
1	6	9	2

a) Explain how the calculation is done in Representation 1 and Representation 2.
b) Suggest a different way for this group of students to do the operation. Justify your suggestion. (If you have more than one suggestion, you can specify).
c) Which computational way do you think is more instructive, including the way you propose? Base your decision on a logical reason.

2. TREE LEAVES

OAK   HORNBEAM   MAPLE

a) The drawings of the leaves of the three trees are shown above. How do you measure the surface area of leaves? Your measurement should be based on a mathematical reasoning.
b) Does this measurement method create any problems or limitations? Explain your reasoning causally.
c) As the surface area of tree leaves increases, the amount of photosynthesis increases. Which of the leaves illustrated above can be said to produce more oxygen, ignoring other biological features? Your answer should be based on a mathematical solution process.
d) These are just particular leaves from the three tree kinds of trees. The actual leaves on a tree vary somewhat in size from one to the next. Suppose you had a sample of, says, 100 leaves from each tree. How would you estimate the average surface area of leaves of each type? Your solution process should be based on a mathematical reasoning.

Appendix 2

MATHEMATICAL REASONING CRITERIA'S		0	1	2
C1	Explains why a mathematical result or conclusion does, or does not, make sense given the context of a problem.	The result/conclusion is not available or is available but the reasons are not explained.	The reasons for the result/ conclusion are not adequately explained/incomplete.	The reasons for the result/ conclusion are adequately explained.
C2	Represents a problem in a different way, including organising it according to mathematical concepts and making appropriate assumptions.	Representation is not available.	Representation is available but not organized according to mathematical concepts/appropriate assumptions are not made.	There is an accurate representation that is organized according to mathematical concepts/made appropriate assumptions.
C3	Provide, explain, or defend a justification for the identified or devised representation of a real-world situation.	No justification is provided for the devised representation or there is no devised representation.	A representation is devised but not justified.	Justification provided/explained or defended for defined or devised representation.
C4	Provide, explain or justify a mathematical result or solution for the processes used to determine a mathematical result or solution.	The mathematical solution process is not determined.	The mathematical solution process is determined, but the rationale for the process is not provided.	The mathematical solution process is determined, the rationale is provided/explained or defended for the process.
C5	Identify or criticize the limits of the model used to solve a problem.	The limits of the model used to solve a problem have not been identified/criticised.	The limits of the model used to solve the problem have been identified, but the limits are inaccurate/missing or the criticisms are not sufficient for the limits.	The limits of the model used to solve the problem have been correctly identified/criticised adequately.
C6	Utilize or understand definitions, rules, formal systems, as well as using employing algorithms, computational thinking and reasoning.	Definitions, rules, and formal systems have been ignored or misused.	Definitions, rules and formal systems have been taken into account, but incorrectly/incompletely put to work.	Definitions, rules and formal systems have been taken into account and correctly/completely put to work.
C7	Reflects on mathematical arguments, explaining and justifying the mathematical result.	The mathematical argument is not reflected.	The mathematical argument has been reflected, but the mathematical result is not explained/justified in line with the mathematical argument.	The mathematical argument has been reflected and the mathematical result is explained/justified in line with the mathematical argument.
C8	Interprets a mathematical result back into the real-world context in order to explain the meaning of the results.	No interpretation is available in a real-world context.	An interpretation is available in a real-world context but the interpretation does not depend on the mathematical result or is not correct.	An interpretation in a real-world context depends on the mathematical result and is correct.
C9	Explains the relationships between the context-specific language of a problem and the symbolic and formal language needed to represent it mathematically.	The relationship between the context-specific language and the symbolic and formal language that constitutes the representation has not been established or explained.	The relationships between the context-specific language and the symbolic and formal language that constitutes the representation are incorrectly/incompletely established or explained incorrectly/incompletely.	The relations between the context-specific language and the symbolic and formal language that constitutes the representation have been correctly established or explained correctly.
C10	Reflects on mathematical solutions and creates explanations and arguments that support, refute or qualify a mathematical solution to a contextualised problem.	A mathematical solution is not reflected for contextualised problem.	A mathematical solution has been reflected, but no explanation/argument has been created that supports, refutes or qualify a solution to a contextualised problem.	A mathematical solution is reflected, and an explanation/argument is created that supports, refutes, or qualify a solution to a contextualised problem.
C11	Explains how a simple algorithm works and to detects and corrects errors in algorithms and programs.	How the algorithm works is not explained or errors in the algorithm/program are not detected.	How the algorithm works is explained but explanations are missing, or errors in the algorithm/program have been detected but corrections is not explained.	How the algorithm works is explained correctly/fully, or errors in the algorithm/program are detected and corrections are explained.
C12	Analyses similarities and differences between a computational model and the mathematical problem that it is modelling.	The similarities/differences between a computational model and the mathematical problem that it is modelling have not been analyzed.	The similarities/differences between a computational model and the mathematical problem that it is modelling have not been adequately analyzed.	The similarities/differences between a computational model and the mathematical problem that it is modelling have been adequately analyzed.

Appendix 3

Example answers given to item b of the "multiplication" question

The answer given to item b of the "Multiplication" question must be an answer that meets the criteria coded K2 and K9.

Example of an answer 1: [6 x (40 + 7)] + [30 x (40 + 7)] Multiplication without making a table can be done by using the distributive property over the addition operation.

The teacher's answer of "[6 x (40 + 7)] + [30 x (40 + 7)]" can be considered as a representation, but this representation is an incomplete representation in terms of difference when compared to the existing representations in the question considering the operations it contains. The teacher gets 1 point from the K2 coded criterion. While obtaining the representation, the relations between the contextual language and the symbolic language were established correctly and explained as "…it can be done by using the distributive property of multiplication over addition". The teacher gets 2 points from the K9 coded criterion.

Example of an other answer:

In this method, after substituting the numbers in the table, we divide the empty squares between them as in the figure and multiply the numbers. If the resulting number is a single digit, we write 0 in the upper section. If it has two digits, we write the ones digit at the bottom with the tens digit at the top. We collect the results as I marked in red. If the addition operation is handed, we add this to the next sum. In this way, our process is finished.

The path suggested by the teacher-representation- is organized according to mathematical concepts and is different from the paths in the text of the question. The teacher gets 2 points from the K2 coded criterion. The verbal explanations he makes after the representation are the explanations in which the relations between mathematical language and contextual language are established correctly. The teacher gets 2 points from the K9 coded criterion.

Example answers given to item c of the "multiplication" question

The answer given to item c of the "Multiplication" question must be an answer that meets the criterion coded K1.

Example of an answer 1: Representation - 1, Representation - 2, and when I think about the way I propose, I find Representation - 2 more useful and more instructive. In Representation – 2, numbers are placed in the digit table according to the number of digits. In the digit table, operations are performed according to the place value of each number. With this method, students can see where the phrase "shift one step to the left", which has been said in schools for years, comes from while the subject of multiplication is being taught. In this way, instead of going to memorization by taking what is given by the way of presentation, as in teaching, and conditioning himself by saying "I must not forget to move one step"; He finds and sees where this rule comes from. Since it learns based on logical reasons, the knowledge becomes more permanent, the connection with new knowledge can be established more easily in the future, and the learning situation can be taken to a higher level.

The teacher made a decision by choosing representation 2 in the question item and explained the reasons for making this decision by saying, "The student finds and sees where this rule comes from instead of conditioning himself so that he should not forget to move one step. For logical reasons… it can take it to a higher level." explained in terms. The reasons explained by the teacher for his decision are sufficient. The teacher gets 2 points from the K1 coded criterion.

Example of an other answer 2: I think Representation 2 is more instructive. We can multiply any two-digit number.

The teacher made a decision by choosing representation 2. However, he did not adequately explain the reasons for his decision. We can also multiply any two-digit number by the representation 1. The reasons for his decision are not enough. The teacher gets 1 point from the K1 coded criterion.

Sample answers to item c of the question "tree leaves"

The answer given to item c of the "Tree Leaves" question must be an answer that meets the criteria coded K4, K8 and K10.

Example of an answer: In advanced classes, integral curves can be calculated with parabolic curves.

The teacher talked about the mathematical solution process without reaching a mathematical conclusion, but did not justify the process. It gets 1 point from the K4 coded criterion. Since there is no mathematical solution in the answer, there are no explanations supporting the solution (K10) and no contextual interpretation (K8) explaining the meaning of the result because there is no result. The teacher could not get points from the K8 and K10 coded criteria. If the teacher had made qualitative or supportive explanations for the solution he thought (K10) and then made a contextual comment as "… the leaf produces more oxygen" after the solution he put forward (K8), he could get full points from the relevant criteria.

Example of an other answer: I took the printout of the models as they were in the research pdf, drew squares of the same size in each leaf model and combined the leaf parts outside the square and placed them in another model that included all 3 leaves as a control model. When I place the square models that I placed in the models and the remaining parts into the control model and investigate, I think that the hornbeam leaf has more area and produces more oxygen.

The teacher talked about the mathematical solution process in detail. The fact that the teacher will reach the amount of oxygen production through field knowledge can be accepted as a justification for the solution process. The teacher gets 2 points from the K4 coded criterion. The teacher's comment as "Horbee produces more oxygen" is a real-world interpretation based on the mathematical result. The teacher gets 2 points from the K8 coded criterion. In addition, the teacher's statement "because the hornbeam leaf has more area ..." is an explanation for the contextual problem that characterizes its mathematical solution. The teacher gets 2 points from the K10 coded criterion.

Sample answers to item d of the question "tree leaves"

The answer given to item d of the "Tree Leaves" question must be an answer that meets the K3 coded criterion.

Example of an answer: I would choose the largest and smallest leaves and average them.

The teacher designed a verbal representation for the solution. However, he did not justify the representation he designed. The teacher gets 1 point from the K3 coded criterion. If the teacher had written an answer such as "I would choose the largest and smallest leaves to represent different leaf samples and take the average", he would have justified the solution process and received full marks from the question.

Example Answer 2: I would find the square of the leaves on the assumption that many events in nature conform to the normal distribution. Because in a normal distribution mode=median=mean, I would calculate the area of the median leaf.

The teacher designed a verbal representation for the solution of this problem that may exist in the real world. He provided a justification for the representation he designed as "many events in nature are normally distributed... since mode=median=mean in a normal distribution...". The teacher gets 2 points from the K3 coded criterion.

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
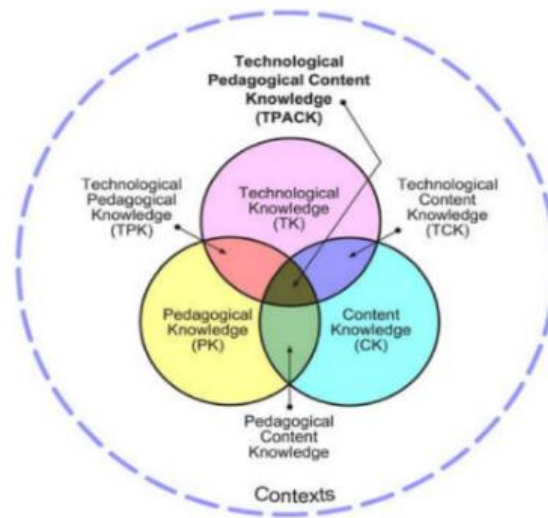
Note. (Mishra & Koehler, 2006)

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) 11.12.2020 (5. 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.
18.12.2020 (6. Week) 25.12.2020 (7. 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.
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
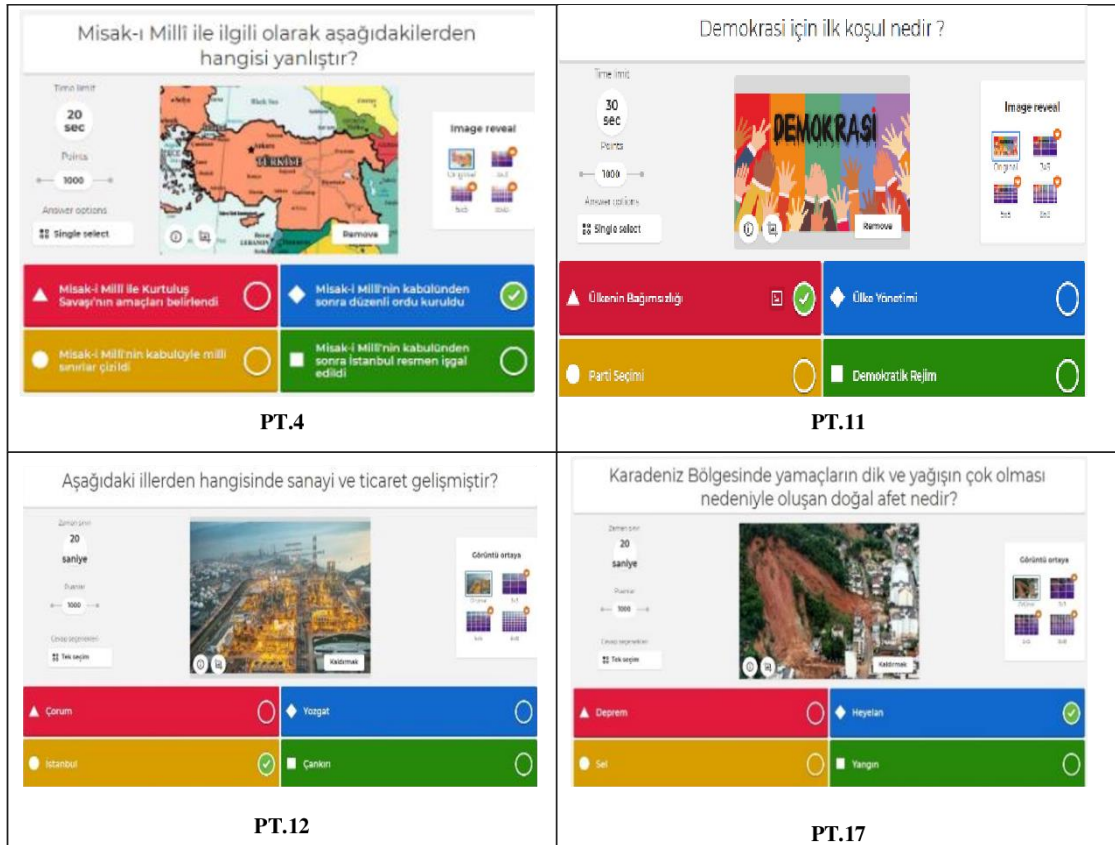
For the purpose of the digital materials prepared, pre-service teachers jointly used the three basics of TPACK. Prospective teachers developed the technological sub-dimension through Web 2.0 tools, while the 5E learning model provided a framework for combining technology and pedagogy. They improved their 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
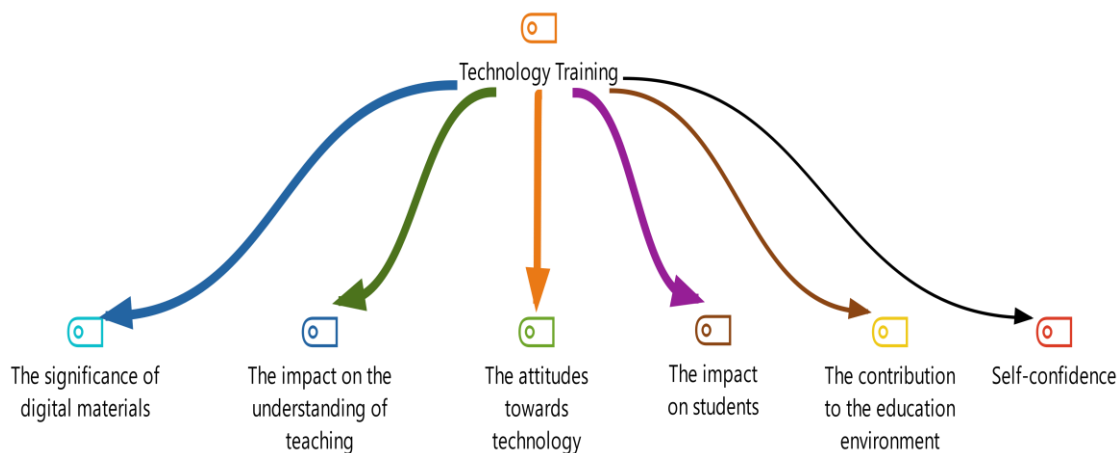
Figure 6 reveals that the data collected from pre-service teachers as a result of the analysis were categorized under the following codes with regard to digital material preparation training: *the significance of digital materials, the impact on the understanding of teaching, the attitudes towards technology, 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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Science Mapping the International Knowledge Base on the 21st Century Skills

21. Yüzyıl Becerileri Eksenli Araştırmaların Uluslararası Görünümü

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ABSTRACT: There have been considerable efforts to define, conceptualize and specify the components of 21st century skills in the field of education since the first years of the new millennium. This article presents the results of a broad bibliometric review of educational research on 21st century skills by identifying the volume, growth trajectory, and geographical dispersion of studies, as well as bringing out the intellectual structure and topical foci of the existing knowledge production in this area. Bibliometric analysis was conducted to examine a total of 4096 articles published on this topic in Web of Science (WoS) indexed journals between 2000–2021 years. VOSviewer, WoS analytical tools, and Tableau software were used to analyze the data. The results of this analysis yielded five major Schools of Thought: "New Literacies and Skills", "Teachers in the 21st Century", "Digitalization of Education", "Media and Communication", and an "Eclectic" cluster. Furthermore, the co-occurrence keyword map revealed four topical foci: "Media Literacy," "New Literacies and Digital Technologies in Education," "Digital Literacy and Competencies," and a "Multidimensional" cluster. This study adds nuanced evidence to the literature by providing a baseline for the patterns and characteristics of the knowledge base on 21st century skills.

Keywords: 21st century skills, new literacies and skills, bibliometrics, educational studies.

ÖZ: Yeni bin yılın ilk yıllarından itibaren eğitim alanında 21. yüzyıl becerilerinin bileşenlerini tanımlama, kavramsallaştırma ve belirleme konusunda önemli çabalar sarf edilmiştir. Bu araştırma, mevcut çalışmaların hacmini, büyüme yörüngesini ve coğrafi dağılımını belirleyerek ve aynı zamanda bu alandaki mevcut bilgi birikiminin entelektüel yapısını ve güncel odaklarını ortaya çıkararak 21. yüzyıl becerilerine ilişkin eğitim bilimleri bağlamında gerçekleştirilen araştırmalar üstünde yapılan geniş bir bibliyometrik incelemenin sonuçlarını sunmaktadır. Araştırma kapsamında 2000-2021 yılları arasında Web of Science (WoS) indeksli dergilerde bu konuda yayınlanmış toplam 4096 makaleyi inceleyerek bibliyometrik analiz gerçekleştirilmiştir. Verilerin analizi sürecinde VOSviewer, WoS analitik araçları ve Tableau yazılımı kullanılmıştır. Analiz sonuçları beş büyük temayı ortaya çıkarmıştır: "Yeni Okuryazarlıklar ve Beceriler", "21. Yüzyılda Öğretmenler", "Eğitimin Dijitalleşmesi", "Medya ve İletişim" ve bir "Eklektik" küme. Ayrıca, araştırmalarda birlikte kullanılan anahtar sözcükler haritası alanda dört güncel odak noktasını ortaya çıkartmıştır: "Medya Okuryazarlığı", "Eğitimde Yeni Okuryazarlıklar ve Dijital Teknolojiler", "Dijital Okuryazarlık ve Yeterlikler" ve bir "Çok Boyutlu" küme. Bu çalışmanın, 21. yüzyıl becerilerine ilişkin uluslararası literatürün yapısı ve niteliksel özellikleri için bir temel sağlayarak alanyazına katkılar sunacağı ve yeni tartışmalar açacağı beklenmektedir.

Anahtar kelimeler: 21. yüzyıl becerileri, yeni okuryazarlıklar ve beceriler, bibliyometrik analiz, eğitim araştırmaları.

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In every period of history, it has long been broadly discussed what important competencies, knowledge, skills, abilities, and attitudes people should acquire through education. Globalization, the rapid pace of change in technological and scientific advancements, transformation in production, consumption, and lifestyle habits resulted from the increase in the accumulation of knowledge, and technological advances and the necessity of updating the required human qualities led to the emergence of the need for some new skills and competencies which are crucially essential today for the field of education.

The dizzying speed of information is a powerful resource that permeates all areas of contemporary life, including media production and consumption, as well as employment. Moreover, internationalization, demographic transformation, and a lifestyle built on consumption are other key features defining this century (Jerald, 2009). These variables specific to the digital age play a decisive role in defining 21st century human qualities. Issues such as the management of scarce resources, pressures to increase profitability, gaining competitive advantage, seeking innovation (Trilling & Fadel, 2009), the replacement of human labor with automated tools (Levy & Murnane, 2013), the transition to a technology-based global knowledge economy (Bellanca & Brandt, 2010), the transformation of the industry-based economy into a service economy driven by knowledge and innovation (Unger, 2019), competition, and cooperation (Beamish & Lupton, 2016) have all played key roles in defining the required skills of employees in this era.

To succeed as 21st century workers and citizens, individuals must adapt to this new period and its transformations by effectively leveraging rapidly changing technological innovations (Griffin et al., 2012), as well as developing the skills and competencies to constantly renew themselves (Fullan & Langworthy, 2014). Based on these requirements, the meaning of education is now defined as preparing human beings to become global and conscious citizens (Kellner, 2001) who can cope with the demands of such a technology-heavy society (Berry, 2012).

Although the literature employs a variety of terms interchangeably to denote these competencies—including "survival skills," "life skills," "global skills," and "life and career skills" (e.g., Higgins, 2014; Wagner, 2008)—the most widely accepted term is "21st century skills." Though there is no clear consensus on the definition of the term (Dishon & Gidead, 2020), researchers agree that it encompasses a general framework of competency areas and skills (Joynes et al., 2019). The specific skills included within this concept may vary however, they can generally be grouped into three categories: life and career skills, digital literacies, and learning and innovation skills (e.g., Salas-Pilco, 2013; Voogt & Roblin, 2012).

Across the world, researchers and policymakers are increasingly recognizing the need to incorporate 21st century skills into national and global education systems (Care, 2018; World Economic Forum, 2015). Such skills have been taken into consideration when defining educational policies, setting learning outcomes, developing curricula, and designing teacher training and instructional modules. This increased focus has also bolstered research into 21st century skills in recent years. A limited number of studies have systematically reviewed the research on 21st century skills (e.g., Chalkiadaki, 2018; Van Laar et al., 2017, 2020); however, these studies tend to focus only on one specific skill (e.g., digital skill) or one particular context (e.g., primary education), and

none of them analyzed comprehensive databases representing the collective knowledge on this phenomenon. Moreover, none of these review studies utilized the bibliometric tools typically employed for mapping disciplines or fields of research. To fill this gap in the literature, this research seeks to provide comprehensive insight into the global knowledge base on 21st century skills through the analysis of a broad corpus of related literature.

The purpose of this study is to document, clarify, and illustrate the structural and relational characteristics of the knowledge base in order to provide a bibliometric profile of the educational studies about 21st century skills. The following research questions guided the study:

1. What is the volume, growth trajectory, and geographic distribution of research about 21st century skills?
2. What are the most influential authors, articles, and journals in the literature?
3. What is the intellectual structure of the knowledge base on 21st century skills?
4. What topical foci have attracted a great deal of attention in the literature?

Method

This section outlines the steps taken for finding and identifying sources, extracting data, and data analysis.

Conceptual Framework

Existing review studies in this field can be classified into one of three groups: a) studies showing the "big picture," which illuminate the size, geographical dispersion, etc. of the knowledge base; b) studies that seek to determine the topical foci, conceptual models, etc. of the relevant studies in the literature; and c) studies that synthesize the results of existing research in depth, which could be regarded as a kind of content analysis (Bellibaş & Gümüş, 2019).

Our conceptual framework was based on previous review studies in the field of educational research (e.g., Diem & Wolter, 2012; Hallinger, 2018). The conceptual framework was adopted according to the research questions which was asked based on the purpose of the study. Thus each dimension was added in order to find answers to the research questions. The researchers whose work we sought to emulate combined the first and the second path explained above. Our framework included four dimensions to illustrate the state of the research on 21st century skills: "size," referring to the volume of publications in the dataset; "time," tracing the developmental path or growth trajectory of the publications; "space," meaning the geographical dispersion of the publications; and "composition," referring to the topical foci and the intellectual structure (Small, 1999), which is typically defined as the research traditions, research topics, and pattern of interrelationships among the research and researchers in a specific field (Shafique, 2013).

Search Criteria and Identification of Sources

The criteria used to establish the eligibility of publications during the source identification process included the type and index of publications, time period, and topical scope. As shown in Figure 1, we utilized PRISMA flow diagram (Moher et al.,

2009), which is regarded as procedural guidelines for identifying sources for this kind of review to limit the scope of this study with articles and reviews published in the journals indexed in SSCI, SCI-Expanded, ESCI, and AHCI. The aforementioned journals were selected due to their high impact value, article acceptance rates, compliance with scientific and ethical principles, transparency of article evaluations, and double-blind peer-review processes.

We chose to use the Web of Science (WoS) as the source of data for this review because it provides reliable access to a wide variety of journals that provide an inclusive data set for the academic field under study. This review analyzed articles published between January 2000 and February 2021, and the topical scope was limited to keywords related to 21st century skills. The first step involved an initial inquiry using the WoS search engine, according to the following criteria:

Field Tags: Title (TI), Author Keyword (AK), KeywordPlus (KP);

Inclusion: (Dates) 2000 to 05 February 2021;

Inclusion: (WoS Category): Education educational research;

Inclusion: (WoS Index): SSCI, SCI-Expanded, ESCI, and AHCI;

Exclusion: (Document Type) proceedings paper, book chapter, editorial material, book review, book, and retracted publication

After that, we queried various search strings in the WoS database until we reached the most comprehensive data set for the purpose and scope of this study. This search produced a total of 4360 documents. We then utilized WoS filters to eliminate irrelevant document types, including 18 proceedings papers, 155 editorial materials, 76 book reviews, nine corrections, five letters, and one retracted publication (see Figure 1). In the end, the number of eligible articles and reviews included in the data set was reduced to 4096.

Data Extraction and Analysis

In this study, the researchers conducted both descriptive and bibliometric analysis through VOSviewer (which has been widely utilized in systematic reviews), WoS Analysis tool, and Tableau.

Descriptive analysis was employed to reflect the topographical features and the dynamics of the related literature (e.g., growth trajectory, as well as the number and percentage of the documents from authors, countries, etc.). Bibliometric analysis, which visually demonstrates the composition of the literature like a "neural network" (Hallinger, 2018), typically sheds light on the intellectual structure of the knowledge base and topical foci through citation analysis, co-citation analysis, and co-occurrence analysis.

Citation analysis is considered a measure of influence based on the hypothesis that if an article, author, or journal is cited frequently, it is relatively powerful in the related literature (Hood & Wilson, 2001; Zupic & Čater, 2015), The citation analysis in this study was limited only to authors, documents, and journals included in the WoS database, so it can be referred to as "WoS citation analysis."

Figure 1

PRISMA Flow Diagram
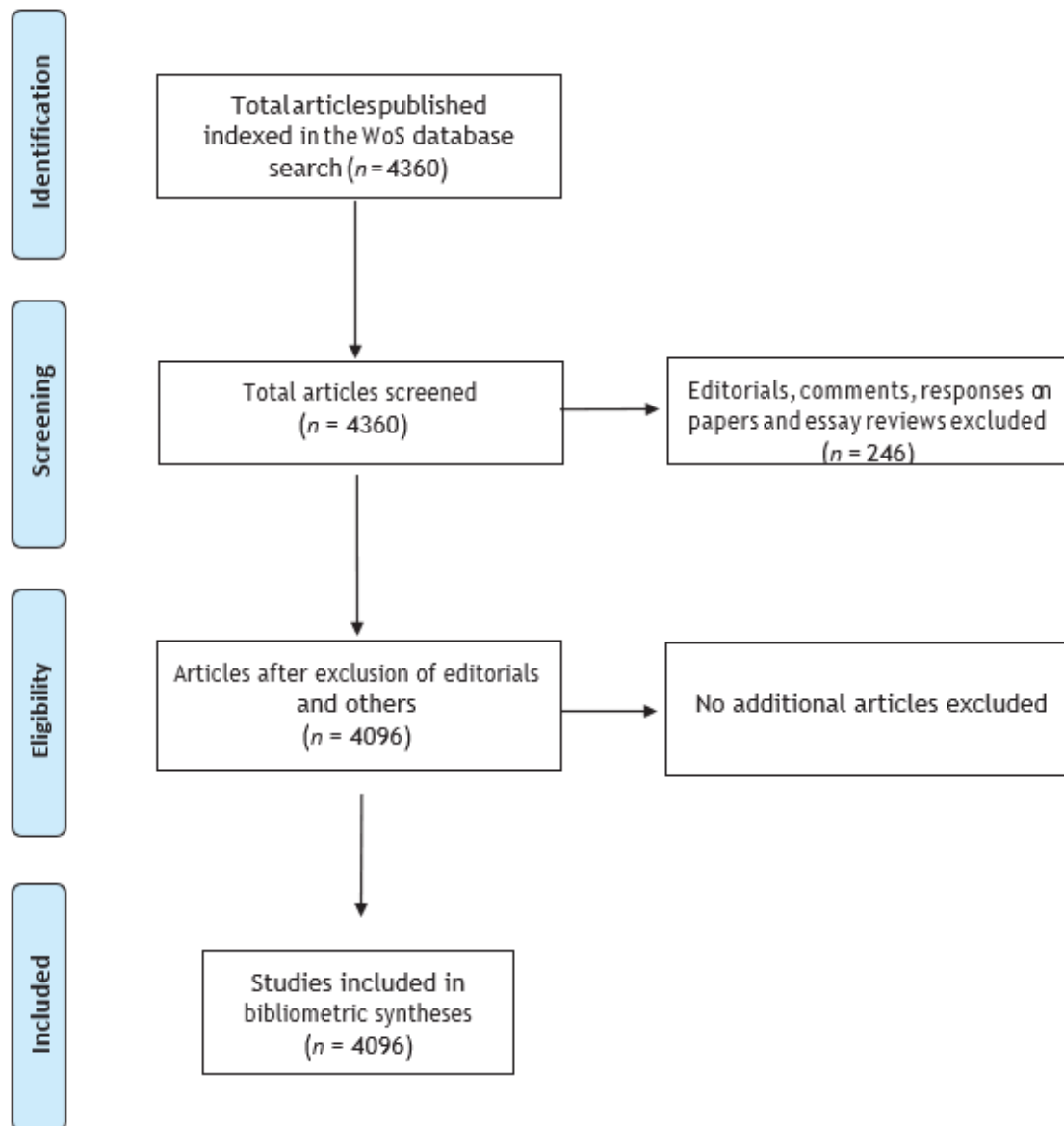
Note. (Adapted from Moher et al., 2009).

Thanks to recent advances in bibliometric software, co-citation analysis can be used on multiple levels to illuminate the relationships among authors, as well as among topics or research fronts consisting of a group of co-cited core publications (Van Eck & Waltman, 2019). As shown in Figure 2, the underlying logic of co-citation analysis is that the more frequently two authors, publications, or journals are cited together, the more likely their research field and focus are associated (McCain, 1990). In this review, author co-citation analysis was employed to identify the schools of thought within the disciplinary knowledge base of the studies.

Furthermore, co-occurrence analysis was conducted to determine the trends in the topical foci studied by scholars in the research field. Before the analysis, a thesaurus file (Van Eck & Waltman, 2017) was prepared to minimize unnecessary repetition between duplicated keywords, such as "twenty-first century skills" and "21st century skills."

Figure 2

Example for the Concept of Co-citation
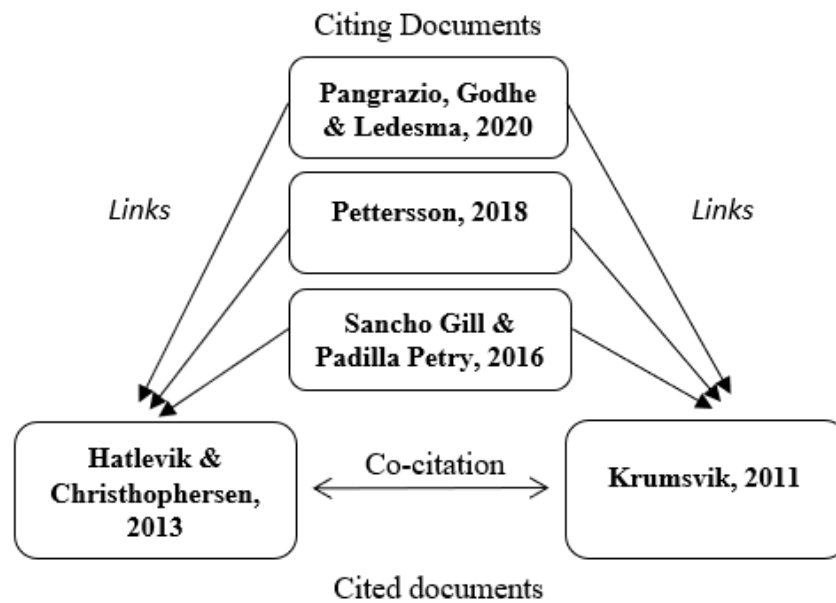
Note. (Adapted from Hallinger, 2018).

Limitations

First, though this bibliometric study enables analysis of the multidimensional structure of the related literature based on bibliographic metadata in order to see the "big picture" of the field, unlike other review methods (such as meta-analysis or content analysis), it does not provide an assessment of the quality of the articles or considerations on their findings. With this salient limitation of the methodology in mind, we believe that the findings of this study still present a valuable contribution to the field and future research, by building on the work of similar studies that have reviewed the literature of other fields and contexts (e.g., Chalkiadaki, 2018; Van Laar et al., 2017, 2020).

Second, although we attempted to include all the possible documents (n=4096) from the WoS about 21st century skills from 2000 to 2021 in our research, the scope of the database did not cover many forms of media beyond journal articles including books, theses, conference proceedings, etc. Therefore, we cannot assure the extent to which the findings of this bibliometric study are representative of the whole knowledge base.

Finally, although our database covers a broad range of studies related to 21st century skills, the WoS is still a limited repository, which could lead to critiques regarding whether this study is representative of all published knowledge on 21st century skills. This limitation was mitigated to some extent by performing a co-citation analysis, which allowed us to capture and include the relevant knowledge base that was not indexed in WoS. This enabled the identification of numerous documents in the literature beyond our dataset comprised of WoS-indexed publications.

Ethical Procedures

Ethics approval was not required for this bibliometric review.

Findings

This section presents the results regarding the patterns of knowledge production in the study sample. The findings are organized around the study's four research questions.

Volume, Growth Trajectory, and Geographic Distribution

Figure 3 presents the publication years of the 4096 articles on 21st century skills identified within WoS. It is apparent from this analysis that the number of studies has steadily increased over the past two decades. While only 90 (2.20%) articles were published between 2000 and 2006 years, this number increased to 690 (16.85%) between 2007–2013, before jumping to 3281 (about 80% of the total number of relevant publications) between 2014–2020 years. This illustrates the noteworthy growth trajectory of the studies about 21st century skills, demonstrating the sharply increasing research interest in this area over the last 20 years.

Figure 3

Distribution of the Publications according to the Years, 2000 to 2021.
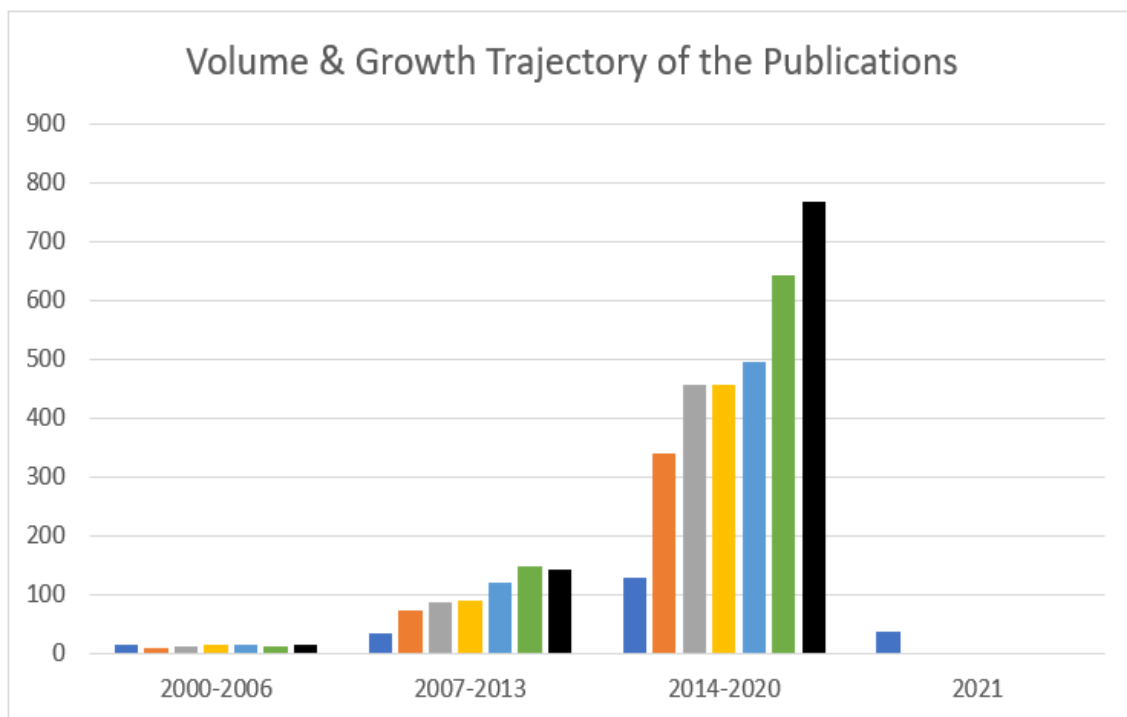
The heat map in Figure 4 shows the geographical distribution of the documents published on this topic since 2000. According to the descriptive statistics, 9262 authors from 105 countries have contributed to this knowledge base. The map shows the dominance of five countries: The United States (22.52%), Spain (13.52%), Turkey (5.75%), Australia (4.39%), and the United Kingdom (4.30%), respectively. Scholars in these countries accounted for 50.48% of the documents in the database. Other notable contributions came from Canada, Germany, China, the Netherlands, Taiwan, Ukraine, and Norway. Conversely, the heat map also displays various countries that are "lost" completely from the knowledge base. The blank spots on the heat map concretize the current limitations and deficits in scientific research in this area.

The heat map clearly demonstrates that European scholars have published the lion's share of the full corpus (45.80%). Researchers from North America accounted for 27.96% of the articles, followed by Asia (13.77%), South America (5.16%), Oceania (5.14%), and Africa (2.16%). Regional leaders in this field include Spain, Turkey, the United Kingdom, and Germany, which constitute 57.42% of the total publications in Europe; the USA, Canada, and Mexico (98.57%) in North America; China, Taiwan, and Indonesia (41.31%) in Asia; Brazil, Colombia, Chile, and Ecuador (73.06%) in South America; Australia (84.96%) in Oceania; and South Africa and Nigeria (72.82%) in Africa.

Figure 4

Geographical distribution of the Publications
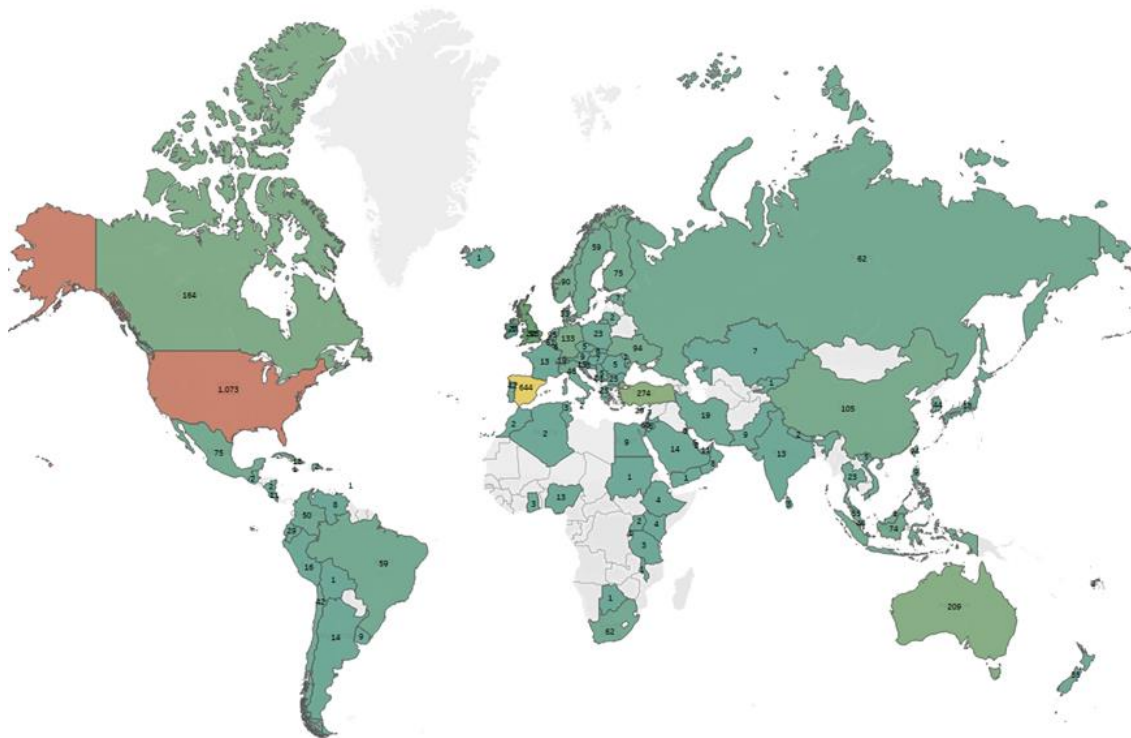
Identification of Influential Authors, Documents, and Journals

During data collection, 4096 articles written by 9240 authors were identified for the review. While 1010 of these researchers published more than one article in the study sample, 71 of them had published five or more articles represented in the corpus.

We followed a two-step analysis to reveal the most influential authors. First, we analyzed the most productive authors in order of their number of publications (not tabled). According to the results, these researchers' publications coalesced around a few central topics: teachers' professional development in the 21st century (e.g., Hatlevik, O. E., Volman, M.; Vanderlinde, R.; Diaz-Garcia, I.), information and communication technology (ICT) competencies (e.g., Aesaert, K.; Scherer, R.; Almerich, G.), new literacies (e.g., Burnett, C.; Kiili, C.), digital competencies (e.g., Siddiq, F.; Guillen-Gamez, F. D.), and media (e.g., Eickelmann, B.; Fedorov, A.; Gutierrez, A.). In addition, we found that only three of the top ten (and 8 of the top 20) most highly cited researchers were female. Regarding the geographical distribution of the publications, we

discovered that the most productive authors were from ten different countries located in Europe (17) and Asia (3).

Second, we examined the first ten most-cited authors in the corpus (Table 1). Though the authors were listed based on their total citations on WoS, other statistics such as their total number of documents or average citations per year and nation were also added in Table 1 to provide more insights into scholarly capacity, impact, and contributions. This analysis also enabled us to evaluate the patterns of growth and the geographical distribution of these articles. The most cited scholars in the table are noted for their research in the fields of teachers' professional development in the 21st century (e.g., Darling-Hammond, L.; Voogt, J. M.; Hatlevik, O. E.), educational psychology (e.g., Buettner), and digital technologies in education (e.g., Hwang, G. J). It is worth noting that only four of the scholars listed in Table 1 were also among the most productive authors. The most influential authors were from six countries in Europe, North America, and Asia. This list did not include any researchers from regional leader countries such as Turkey, the United Kingdom, Canada, China, Brazil, Australia, or South Africa.

Table 1

The Most Influential Authors Based on WoS

Author	Institution	Nation	*N*	WoS citation
Darling-Hammond, L.	Stanford University	USA	1	685
Voogt, J. M.	University of Amsterdam	Netherlands	5	432
Hatlevik, O. E.*	Oslo Metropolitan University	Norway	11	426
Volman, M.*	University of Amsterdam	Netherlands	7	345
Veenman, M. V. J.	Leiden University	Netherlands	5	298
Dignath, C.	Goethe University	Germany	1	296
Buettner, G.	Goethe University	Germany	1	296
Roblin, N. P.	University of Amsterdam	Netherlands	1	295
Kong, S. C.*	The Education University of Hong Kong	Hong Kong	9	292
Hwang, G. J.*	National Taiwan University of Science and Technology	Taiwan	6	248

Note. (*Also among the most productive scholars in the field.)

Next, we conducted a citation analysis to reveal the most highly cited documents in the database. Among the top ten most cited articles (see Table 2), the most recent was published in 2016—suggesting that the total citation metric could privilege older documents, to the disadvantage of newer research (Zupic & Čater, 2015). With this in mind, the finding that four of these top ten articles were published in the last ten years shows the powerful impact of these studies. Secondly, the most cited documents focused on similar topics to those mentioned previously (e.g., teachers' professional development in the 21st century, digital technologies in education, etc.).

Table 2

The Most Influential Documents

Authors	Year	Journal	Wos. Cit.
Darling-Hammond, L.	2006	Journal of Teacher Education	685
Voogt, J.; Roblin, N. P.	2012	Journal of Curriculum Studies	296
Dignath, C.; Buttner, G.	2008	Metacognition and Learning	295
Frymier, A. B; Houser, M. L.	2000	Communication Education	248
Baylor, A. L.; Ritchie, D.	2002	Computers & Education	204
Ferres, J.; Piscitelli, A.	2012	Comunicar	194
Greenhow, C.; Robelia, B.	2009	Learning, Media and Technology	187
Ng, W.	2012	Computers & Education	183
Saljo, R.	2010	Journal of Computer Assisted Learning	176
Manganello, J. A.	2008	Health Education Research	163

Note. (As of February 2021)

Even though the studies in this review were published by 555 different journals, Table 2 displays that the top ten most influential journals accounted for 15% of all the publications in the dataset. It should be noted that six of these top ten journals were founded before 2000, and 7 were published in European countries (the UK, Spain, and Germany), followed by the USA (3 journals). Finally, seven of the top journals are in Q1, while two are in Q2, and one is in Q3 quartile rank.

Table 3

The Most Influential Journals

Journals	WoS Cit.	Number of Articles	Impact Factor	Q	Country
Computers & Education*	3759	118	5.296	Q1	UK
Comunicar*	2182	129	3.375	Q1	Spain
Journal of Adolescent & Adult Literacy*	1000	153	1.128	Q3	USA
BMC Medical Education*	845	94	1.831	Q2	UK
Learning Media and Technology*	774	42	2.547	Q1	UK
Journal of Teacher Education	714	3	3.600	Q1	USA
Learning and Instruction	629	7	3.323	Q1	UK
Metacognition and Learning	601	9	2.690	Q1	Germany
Journal of Comp. Asst. Learning	575	26	2.126	Q2	UK
Reading Research Quarterly*	569	35	3.543	Q1	USA

Note. (*Listed also among "the most active journals")

We also analyzed the journals by volume of articles (not tabled). The results show that six of these most prolific journals were not listed among the most influential

ones, but four others (Journal of Adolescent & Adult Literacy, Comunicar, Computers & Education, BMC medical education) were also among those which devoted the most publication space to studies about 21st century skills. Taken together, the journal analyses demonstrate that while the Journal of Adolescent & Adult Literacy has been the most hospitable journal to studies related to 21st century skills, Computers & Education has demonstrated the strongest scholarly impact according to the number of citations of its articles.

Intellectual Structure of the Knowledge Base

To analyze major themes, we set a threshold of 20 citations with a display of 125 authors among the total of 78,012 researchers in the Author Co-citation Analysis (ACA) network constructed with cited scholars in the reference lists of all the publications in the corpus (*n*=4096). The cluster-enhanced co-cited author map in Figure 6 illustrates nodes, each referring to a different researcher whose size represents the frequency with which the researcher was cited in the publications in the dataset. The nodes are grouped into different colored clusters symbolizing the schools of thought that underlie the related knowledge base (Van Eck & Waltman, 2017). Additionally, the proximity of the nodes signifies co-cited researchers sharing a common perspective on the related field's traditions and disciplinary composition. These serve as crucial variables for interpreting the data represented in the co-citation map, which provides a broader picture of the state of the research in this area (White & McCain, 1998).

The ACA map in Figure 6 illustrates five consistent and distinctive "schools of thought" and visualizes the interconnectedness of the knowledge base through the density of the lines linking the different colored clusters. Gee, Cabero, Jenkins, Buckingham, Prensky, Bandura, and Livingstone feature as the biggest nodes on the co-citation map. In addition, Prensky is located in the central position on the map, which indicates a key boundary-spanning position and signifies that he integrates and interprets different ideas across the different schools of thought (White & McCain, 1998).

The purple cluster labeled "New Literacies and Skills." is composed mainly of scholars investigating new literacies and skills related to information and communication technologies (ICT). Problem solving skills (S. Brand-Gruwel), skills and literacies for multiple media (J. F. Rouet, J. A. Greene, I. Braten), new literacies emerging from ICTs (J. Coiro, D. J. Leu), and critical media literacy (L. E. Mason) are the most prominent topics within this cluster.

In the upper-right part of the map, the yellow cluster consists of researchers whose publications distinctly focus on "Teachers in the 21st Century." Scholars in this area primarily examine teachers' technological pedagogical content knowledge of teachers (M. Koehler, J. Voogt, P. Mishra, J. Tondeur, C. S. Chai), pedagogical beliefs and attitudes about technology in education (P. A. Ertmer, T. Teo), and professional development (C. Dede; L. Darling- Hammond; O. Erstad).

The blue cluster, which has a relatively central position on the map, represents a school of thought related to the "Digitalization of Education." This cluster includes scholars focusing on different subtopics, such as new digital technologies in education (J. Cabero), digital natives (M. Prensky, W. Ng, N. Selwyn), digital competence (A.

Ferrari, O.E. Hatlevik), digital literacy (J. Fraillon, D. Bawden, P. Gilster), digital skills (A. Van Deursen), and digital inequalities (E. Hargittai).

The green cluster contains various connected focal points gathered under the label "Media and Communication." This school of thought is comprised mainly of researchers in two different groups associated with densely related fields. Scholars in the larger first group—led by D. Buckingham, H. Jenkins, S. Livingstone, C. Lankshear, M. Knobel, G. Kress, R. Hobbs, and L. Matsterman—focus on media literacies. On the other hand, the second group of researchers—J. P. Gee, C. Cazden, S. B. Heath, M. Warschaurer, C. Greenhow, and W. S. E. Lam—have published articles on communication and language.

Finally, the red cluster, which is the largest and most populated one, appears at first glance to represent a group of important researchers from the field of educational psychology, including Bandura, Vygotsky, Zimmerman, Veenman, Kolb, Piaget, Dewey, Flavell, and Pintrich. However, when zooming out from the center of the cluster, additional researchers focusing on different subject areas become apparent as well. Therefore, the red cluster is more accurately represented as an "Eclectic" assemblage, comprised of nodes focusing on different areas. Apart from "Educational Psychology," this cluster represents several fields, including a group of researchers focusing on "Computational Thinking" (e.g., Wing, Kong, Papert); a second group occupying the right corner that focuses specifically on "Critical Thinking" (e.g., Facione, Halpern, Ennis); and a third group, distinctively dispersed from the others, including researchers associated with health literacy (e.g., Nutbeam, Baker).

Figure 5

Author Co-citation Map (Threshold 20 Citations, 125 Authors)

Topical Foci of the Knowledge Base

Finally, we employed co-occurrence analysis to identify the main topics explored in the literature on 21st century skills. We set a threshold of 20 co-occurring cases of "author keywords," with a display of 125 among the total of 8594 co-occurring keywords in the network. The most frequently ten co-occurring keywords in the knowledge base were media literacy (444), digital literacy (374), digital competencies (246), digital technologies (212), teacher education (209), higher education (206), communication skills (166), adolescence (153), new literacies (148), and ICT (122). The keyword co-occurrence map identifies four different clusters, which are densely linked with each other:

•*Yellow cluster:* Media Literacy

•*Red cluster:* New Literacies and Digital Technologies in Education

•*Blue cluster:* Digital Literacy and Competencies

•*Green cluster:* Multidimensional Cluster (Communication, Critical Thinking, and Problem-solving)

Figure 6

Co-occurrence Map of Keywords (N=8594 Keywords; Threshold 20 Co-occurrences, Display 125 Keywords)

The yellow cluster, which is the smallest but the most distinctive, is associated with one of the most popular subfields of this knowledge base: media literacy. This

cluster consisted of a strictly connected set of keywords about media. In addition to "media literacy," which is the biggest node both in this cluster and in the overall map, other interrelated keywords in this cluster include "media education," "media competence," "digital media," "social media," and "social networks." Regardless of their relatively small size, the existence of the "digital citizenship" and "identity" keywords reveals an important relationship among these concepts in the cluster.

The red cluster represents a dual focus on "new literacies" (e.g., content literacy, visual literacy, critical literacy) and "digital technologies in education" (e.g., internet-based educational innovations, hypertext). Moreover, some nodes in this cluster (e.g., childhood, early adolescence, adolescence, young adults, adults) highlight that these studies focused on individuals from a wide variety of age groups.

The blue cluster, located in the lower part of the map, surfaces themes related to "digital literacies and digital technologies in education." The central core of the map is occupied by "digital literacy," which includes a host of densely connected and interrelated concepts. The position of digital literacy points to its prominence as an anchoring component in the field. On the other hand, when zooming in on the keywords related to "digital technologies" and "teacher education," strong relationships emerge among concepts such as technological pedagogical content knowledge (TPACK), technological literacy, information and communication technologies, information literacy, and computer literacy.

Finally, the green cluster reflects a more multidimensional image of 21st century skills. The primary components of this cluster are "communication skills," "critical thinking skills," "problem-solving skills," and "computational thinking skills." Additionally, the inclusion of "environmental literacy" and "health literacy" within this cluster represents a less dominant set of emerging keywords associated with 21st century literacies.

Discussion and Conclusion

The results of this study illustrate that the knowledge base related to 21st century skills encompassed in WoS-indexed journals has been growing consistently over the past two decades. The capacity of this knowledge base is more remarkable when one remembers that the notion of "21st century skills" dates back only to the beginning of the new millennium. Especially significant is the growth trend and the number of studies over the past five years, which comprise 80% of the total, indicating swiftly expanding scholarly interest in this area (Charland, 2014; Voogt & Roblin, 2012). The findings regarding the volume of literature about 21st century skills take on even more importance when one notes that this review did not include other documents (e.g., conference proceedings, etc.) beyond articles and reviews. Especially in recent years, the fact that many different countries across the world have adopted 21st century skills while designing their national education policies, curricula, teacher training programs, learning outcomes, materials and instructional content to meet both the needs of societies and individuals (Ananiadou & Claro, 2009 Care, 2018; World Economic Forum, 2015) might trigger this increase in the number of studies as of late. In addition, 21st century skills are now not only included in the curriculum of pre-school, primary, secondary, high school and higher education levels, but also they are regarded as critical

skills in respect of lifelong learning (Altınpulluk & Yıldırım, 2021). This could be another the reason for this growing scholarly interest in the 21st century skills.

The earliest articles in the corpus (published between 2000–2006), which mainly provide a theoretical basis for the new skills necessitated by the 21st century, are limited in number due to the nascent nature of the field during this period. However, the increase in the number of articles between 2007–2013 and 2014–2020 can be interpreted as a product of the growing dominance of information and technology across all areas of life; during this period the initial discussions turned more urgent, leading to a significant increase in the amount of research and number of publications on this subject. This increasing scholarly interest since 2000 could be related to the emergence and rapid transformation of teaching and learning technologies (Silber-Varod et al., 2019). Moreover, the development of 21st century skill and literacy frameworks (e.g., European Parliament 2007; P21, 2017; WestEd, 2018), based on the growing concerns for the competencies needed for global civic, economic, and educational engagement, could also have triggered an increase in such studies.

Contrary to the broad trends of knowledge production represented above, the geographical distribution of the studies in this area seems relatively limited. Although more than a hundred countries were represented in the corpus, only five of them constitute half of the literature. This situation signifies that the findings are massively skewed to Europe and North America, indicating that the corpus on 21st century skills, at least that which is available in the international literature, broadly fails to account for cultural and structural differences in the field of education. The emergence of the general framework of the concept of 21st century skills, which was regarded as the main source and policy guide in the literature for a long time, took place in the United States of America (USA) through a leading organization called the Partnership for 21st Century Skills. Also, the classification studies of these skills such as EnGauge (North Central Regional Educational Laboratory [NCREL], 2003), DeSeCo (Organisation for Economic Co-operation and Development [OECD], 2005), Key Competences for Lifelong Learning (European Parliament, 2007), Common Core State Standards (National Governors Association Center [NGA Center], 2010), ATC21S (Binkley et al., 2012), etc., which are frequently referenced in the related literature, were have been carried out by the USA, European Union member countries and OECD countries. These attempts could have made the 21st century skills more visible across the countries before mentioned. Similarly, considering the ranking of the countries producing the most scientific knowledge, research, and articles in the fields of social sciences and education (SJR, 2021), these results regarding the distribution of the articles on 21st century skills are not surprising.

As illustrated in Figure 4, WoS provides little to no information about the educational policies, classroom practices, and developments related to the 21st century skills in Africa, Oceania, South America, and select Asian nations. Moreover, the representation of nations within the continent in the dataset was similarly unbalanced. Only one or two top countries are featured in each continent. Regardless of the rapid overall growth of the corpus in terms of knowledge production, especially over the last five years, there are still "missing pieces" of the puzzle on the global map. This reprises the same argument that, although the number of studies within this area is growing steadily, the knowledge base remains limited and compressed in terms of geographical

distribution (UNESCO & The Brookings Institution, 2020). The geographical distribution of the most influential and prolific authors was strictly limited to Europe, the USA, and a handful of Asian countries. Surprisingly, many regional leader countries did not have any scholars on these top author lists. Based on the findings, it can be concluded that the distribution of influential researchers is uneven and quite restricted. The main reason why the vast majority of researchers are from the countries mentioned in the previous finding is actually quite heavily related to the explanations in the former paragraph. However, in addition to the aforementioned reasons, the factors such as the low number of researchers interested in research on 21st century skills in "the missing countries on the map", the low amount of resources allocated to these studies, and the low visibility of these studies in databases due to the fact that the publications written in different languages except for English can also be considered as explanatory for this finding.

When examining the timeframes of the most cited studies on 21st century skills, it becomes apparent that the articles published between 2000–2012 had the highest number of citations due to the fact that these pioneering studies built the theoretical foundations of the subject. In addition, the twenty most cited articles centered on closely linked themes, namely teachers' professional development in the 21st century, ICT competencies, digital technologies and competencies, media, new literacies, and educational psychology. Also remarkable is the very strong overlap in research topics between the most influential authors and documents. This finding echo those of previous studies on 21st century literacies (e.g., Chalkiadaki, 2018; Voogt & Roblin, 2012)

ACA analysis revealed five interconnected schools of thought that form the intellectual structure of the knowledge base, demonstrating close linkages between the scholars and their research fronts. Co-citation analysis also showed that the scholars studying the digitization of education and those focusing on media and communication emerged as intellectual leaders in this research field. Moreover, even though educational psychology does not represent a subdimension of 21st century skills, a noteworthy number of important researchers from this field are represented in the co-citation map. This could have resulted from the close relationships between the focus points of these two research fields, because both center around learners and the factors that affect their learning process.

The findings showed that digital literacy is located at the center of the knowledge base, indicating its role in integrating and interpreting different topical foci. Furthermore, media literacy, new literacies and digital technologies in education (Lankshear & Knobel, 2011), and digital competencies constituted the most prominent themes beyond the broad umbrella of digital literacy (Jansen & Van Der Merwe, 2015). Additional emerging topics included ICT skills, critical thinking skills, problem-solving skills, computational thinking skills, and health literacy. Taken together, these findings draw a picture of the current literature, which encompasses the kinds of skills, competencies, and literacies that are hot topics in this field (e.g., Joynes et al., 2019; Van Laar et al., 2020).

The theoretical debates in the literature mention a multitude of current skills associated with the 21st century. However, it is noteworthy that literacy skills, which emerged because of advancements in information and communication technologies, are

the most common themes in the published articles. When this result is evaluated together with the significant increase in knowledge production on 21st century skills over the years, it confirms the interpretation that these theoretical discussions emerge from the shifting demands of workers and citizens necessitated by the development of information communication technologies and their proliferation in day-to-day life, thus leading to a significant increase in the number of publications on the subject (Silber-Varod et al., 2019). Finally, the emergence of numerous studies examining 21st century literacies stemming from information and communication technologies has inevitably led to the preference for technology-themed WoS journals that publish such articles. This could explain Prensky's popularity in the knowledge base of this research, as well as the prominence of other scholars such as Gee, Cabero, Jenkins, Buckingham, and Livingstone.

Implications

This bibliometric study yields several important implications for research and policy. The results of this research seem to indicate a lack of interest in 21st century skills in some countries. This situation could be caused by language barriers, insufficient financial support provided to scholars by their institutions, inadequate value or time allocated to scientific research, or lack of theoretical and/or methodological knowledge and experience. Based on the findings of the geographical distribution of the publications, language or region-specific review studies (e.g., in Africa, South America, or Arabic-speaking regions) could be conducted and published in English to highlight the state of 21st century literacies in these areas in the international literature. Such studies could also provide the opportunity to verify the findings of the present research. Conducting such reviews would not only enable comparisons between the schools of thought and topical foci of the knowledge base of these places; it would also amplify the analyses to illustrate the "big picture" of 21st century skills in greater detail, because different societies develop unique sets of characteristics based on their educational policies, practices, and needs. Future reviews focusing on different specific regions may also reveal "hidden scholars" who can provide important contributions to the related literature. Such studies will complement, expand, verify, and deepen the findings of this review and provide powerful insights to understand socio-cultural influences on the intellectual structure and the topical foci of the knowledge base, so that policymakers, researchers, and practitioners may apply new trends and approaches in the context of 21st century skills. Such studies could also be replicated to analyze one of the schools of thought revealed in this review, providing additional insights into the historical evolution of a more specific field.

Finally, future review studies should combine the articles indexed in different databases and published in different languages. While we uncovered the structural characteristics of the global literature from different perspectives based on the research questions in this review, this work was still limited to academic articles published in English. Alternative research methods could be employed to analyze the related knowledge base from different perspectives. Moreover, more nuanced findings could be generated by reviewing other forms of scholarly publications, including book chapters, conference proceedings, and theses.

Statement of Responsibility

Mustafa Polat and Bahadır Erişti contributed equally to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

Conflicts of Interest

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Self-Efficacy, School Culture, and Teaching Anxiety as Predictors of Science Teachers' Job Satisfaction

Fen Bilgisi Öğretmenlerinin İş Doyumunun Yordayıcıları Olarak Öz-Yeterlik, Okul Kültürü ve Öğretim Kaygısı

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ABSTRACT: In this research, we study the relationship of science teachers' job satisfaction with the teacher self-efficacy, the teaching self-efficacy, the anxiety toward teaching and school culture. The sample of the study consists of 185 science teachers working in public schools. We obtain the data by using "The Teacher Self Efficacy Scale", "The School Culture Scale", "Science Teaching Self-Efficacy Scale", "The Anxiety toward Science Teaching Scale" and "Job Satisfaction Scale". The results of the current research showed that science teachers' job satisfaction was directly positively correlated with their self-efficacy, science teaching self-efficacy and school culture. However, teachers' science teaching anxiety no had a direct significant relationship with their job satisfaction. In addition, the results of the structural model indicated that school culture was a strong predictor of science teachers' job satisfaction. The result of multiple regression analysis showed that these independent variables explain 40% of the variance of teachers' job satisfaction. These results shown that a positive school culture, teacher self-efficacy and teaching self-efficacy play an important role in order to provide the affective support necessary for the science teachers' job satisfaction.

Keywords: Science teachers, job satisfaction, self-efficacy, teaching anxiety, school culture.

ÖZ: Bu araştırmada, fen bilgisi öğretmenlerinin iş doyumlarının, öğretmen öz-yeterliği, öğretim öz-yeterliği, öğretime yönelik kaygı ve okul kültürü ile ilişkisi incelenmiştir. Araştırmanın örneklemini devlet okullarında görev yapan 185 fen bilgisi öğretmeni oluşturmaktadır. Veriler, "Öğretmen Öz Yeterlik Ölçeği", "Okul Kültürü Ölçeği", "Fen Öğretimi Öz Yeterlik Ölçeği", "Fen Öğretimine Yönelik Kaygı Ölçeği" ve "İş Doyumu Ölçeği" kullanılarak elde edilmiştir. Bulgular, fen bilgisi öğretmenlerinin iş doyumlarının, öz-yeterlikleri, fen öğretimi öz-yeterlikleri ve okul kültürleri ile doğrudan pozitif ilişkili olduğunu göstermiştir. Ancak öğretmenlerin fen öğretimi kaygılarının iş doyumları ile doğrudan anlamlı bir ilişkisinin olmadığı görülmüştür. Bununla birlikte yapısal modelin sonuçları, okul kültürünün fen bilgisi öğretmenlerinin iş doyumunun güçlü bir yordayıcısı olduğunu göstermiştir. Çoklu regresyon analizinin sonucu, bu bağımsız değişkenlerin öğretmenlerin iş doyumu varyansının %40'ını açıkladığını göstermiştir. Bu sonuçlar, fen bilgisi öğretmenlerinin iş doyumu için gerekli olan duyuşsal desteğin sağlanmasında olumlu bir okul kültürü, öğretmen öz-yeterliği ve öğretme öz-yeterliğinin önemli bir rol oynadığını göstermiştir.

Anahtar kelimeler: Fen bilgisi öğretmenleri, iş doyumu, öz-yeterlik, öğretim kaygısı, okul kültürü.

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There is a significant increase in the level of pressures and demands on teachers today. This situation occurs especially in relation to the development of students' academic success and skills. It is possible for the teacher, who is one of the most important factors that will bring student success, to be able to respond to these demands by being both mentally comfortable and adequate. Teachers' Job Satisfaction (JS) is an important predictor of their attachment and commitment to the profession (Dicke et al., 2020; Sahito & Vaisanen, 2020; Zhang & Yuan, 2020). In the literature, "student behavior problems", "classroom climate", "school location", "school management understanding", "teacher autonomy", "stakeholder participation", "professional experience", "teacher self-efficacy", "teacher-student relations", "cooperation between teachers" and "career development practices" were emphasized as important factors affecting teachers' JS (Katsantonis, 2020; Toropova et al., 2021; Wang et al., 2019).

Cribbin (1972) defines that job satisfaction (JS) is "a positive, relaxing and calming affection that an individual tries to get from the work environment" (p. 155). This concept refers to the reaction of individuals to the work environment and how they feel about various aspects of the profession. Gender, age, term of service, marital status, education level, personality, motives, knowledge, skills and abilities, salary, physical conditions, working conditions, promotion, hierarchical relations, the relationships with colleagues, corporate culture, and climate are the factors influencing the JS of individuals (Telman & Unsal, 2004). Researchers have revealed that increased JS has a positive effect on general life satisfaction and mental-physical behaviors at the individual level, and professional productivity and commitment at the institutional level. At the same time, they reported that the decrease in JS leads to results such as being late for work, absenteeism and quitting (Gursoy, 2013; Kurt & Demirbolat, 2019; Telef, 2011). Burke and El-Kot (2010) found that JS and turnover intention were related to job engagement. Alzyoud et al. (2015) emphasized that greater job engagement and JS predict outcomes such as lower absenteeism, willingness to leave, and better job performance. According to Ariani (2013), employees' work engagement was positively related to their individual job performance.

Considering the working conditions of all occupational groups today, teaching comes to the forefront as one of the stressful, tiring and attritional professions. However, education is seen as the basis of a country's qualified work force and economic development (Little & Green, 2009). One of the important determinants of effective education is the teacher. The effectiveness of education can be possible through the positive interaction of teachers with parents, students, colleagues, school staff and society in general (Kurt & Demirbolat, 2019; Skaalvik & Skaalvik, 2011). In all this interaction, teachers' professional commitment and professional satisfaction are affected by both teachers' own factors and social and environmental factors (Manalo et al., 2020). Skaalvik and Skaalvik (2011) examined the relationships between school context variables and teachers' sense of belonging, emotional exhaustion, JS, and intention to leave the teaching profession. According to their research results, aspects of the school context such as value congruence, supervisory support, relationships with colleagues and parents, time pressure, and discipline problems were all associated with JS and intention to leave the teaching profession. Manalo et al. (2020) revealed in their research that teachers' high levels of motivation and JS show their high levels of organizational commitment and work commitment. The results of Klassen and Chiu's

(2011) research showed that self-efficacy (SE), job stress and contextual factors affect both pre-service and service teachers' professional commitment and turnover intentions.

In literature science teachers' JS is mostly explained through many factors such as difficult working conditions, the relations with students, administrators and parents, student success, status in society, salary, the social rights, changing education policies and workload (Hean & Garrett, 2001; Mostafa & Pal, 2018). Considering the intensity and impact of science teacher attrition on education systems worldwide, Mostafa and Pal (2018) posed the question "Why do science teachers leave their jobs". Happy and satisfied teachers are more likely to continue doing their jobs, while dissatisfied teachers are more likely to quit. Therefore, they considered the satisfaction of science teachers as the key to maintaining their profession. 21st century education systems have brought an important workload for science teachers to continue their professional lives effectively. The integrated science, technology, engineering and mathematics (STEM) education, which has an important place in education reforms, has put a serious pressure on science teachers today (Du et al., 2019; Suebsing & Nuangchalerm, 2021; Thibaut et al., 2018). Science teachers have a key role in STEM education in increasing students' learning skills necessary in daily life. In general, STEM education refers to a holistic and interdisciplinary approach to solving problems encountered in daily life related to the four areas it includes. Students can learn to solve complex real-world problems with qualified science teachers who encourage the use of interdisciplinary knowledge (Wang et al., 2011; Yang et al., 2021). Hean and Garrett (2001) identified science teachers' JS as an important factor affecting the effectiveness of the science program and the quality of teaching.

While educational systems seek ways to train qualified teachers, they also strive to keep teachers in the system in the profession (Ingersoll, 2001). Mostafa and Pal (2018) reported in their comprehensive study that science teachers' JS would contribute significantly to students' motivation for success in science and their science-related career plans. From this point of view, it was interesting to determine the factors related to the JS of science teachers and to reveal the importance of these factors on JS (Russell et al., 2010; Song & Mustafa, 2015). Zakariya (2020) revealed that school climate and teacher SE have a strong direct effect on the JS of a group of teachers, including science teachers. Among the science teachers who participated in Song and Mustafa's (2015) research, those who were in the first years of their profession stated that they needed the emotional support of administrators, senior colleagues and parents in order to reduce their job dissatisfaction. Despite the aforementioned studies, Hasselquist et al. (2017) reported that studies covering affective factors associated with science teachers' JS are quite limited. We decided to carry out this research in order to provide data that will support the increase of JS of qualified science teachers in their stay in the profession. The focus of our research is to study some psychological variables related to the profession of science teachers, who have a critical impact on students' outcomes, and to pay attention to the burdens they may experience. Examining science teachers' emotions associated with their professional lives can help administrators and policymakers identify better ways to retain teachers in the field and ultimately facilitate desired student outcomes. Improving the variables associated with work engagement, such as JS, will benefit science teachers to improve their job performance. Policy

makers can use the results of the study as a basis for formulating policies and programs to help improve science teachers' well-being.

Teachers' Job Satisfaction

Zembylas and Papanastasiou (2006) defined teachers' JS as the emotional relationship that teachers establish towards their profession. Also, Adeniyi and Adeniyi (2018) expressed teachers' JS as the feeling the teachers feels towards their students, the school environment, teaching roles and all teaching and learning conditions. Caprara et al. (2003) stated that teachers' JS is a determining factor on teaching performance and defined teachers' JS as the satisfaction and pleasure they derive from fulfilling their teaching roles.

Teachers' JS is a very important factor that will influence the teaching performance and productivity of the schools (Skaalvik & Skaalvik, 2011). Teachers can teach their students more effectively when they are satisfied with their work (Nigama et al., 2018). Low JS is a major cause of teacher attrition (Nagar, 2012). According to Klusmann et al. (2008), the teachers with a high sense of JS create more learning-supportive environments for students and try to do their best to motivate the students. A great number of factors can affect the teachers' JS (Admiraal et al., 2019; Chaaban & Du, 2017; Klassen & Chiu, 2010). Dinham and Scott (1998) classify teachers' JS sources in three areas. These are: (a) the factors internally related to the "teaching profession", (b) "school-based factors" and (c) "non-school factors". In addition, Mostafa and Pal (2018) presented a model that explains the factors associated with teachers' JS based on teacher and student characteristics and school contexts. Two main components come to the fore in teacher job satisfaction: job comfort and task fulfillment. While job satisfaction refers to how satisfying the job conditions are for an individual, task fulfillment is the satisfaction one feels from achieving important aspects of one's job (Evans, 1997). Teachers' job satisfaction is expressed as an important factor affecting students' learning outcomes. Job satisfaction contributes to student satisfaction and education quality, which is the primary goal of a school (Baluyos et al., 2019). However, teacher's job satisfaction includes in-school factors such as time pressure, negative student behaviors, and school values, as well as relationships with colleagues, parents, and school management. Outside of school factors include government reforms, society's perspective on school, and the image of the teaching profession in society (Admiraal et al., 2019).

Teachers' Self-Efficacy (TSE)

Bandura's (1977) SE theory states that how one perceives one's own abilities will affect his actions. The SE reflects an individual's belief in their ability to perform their duties effectively (Bandura, 1997; Pajares, 2021). Furthermore, the SE determines how the environmental opportunities and barriers are seen according to social cognitive theory (Bandura, 2006). Therefore, efficacy affects the goals, motivation, and behavior of people. In this context, the SE is conceptualized as a multidimensional and field-specific structure (Avanzi et al., 2013; Meiring, 2019; Skaalvik & Skaalvik, 2019). Most of the research on teacher SE is based on Bandura's conceptualization of SE based on social cognitive theory (Federici & Skaalvik, 2012; Klassen & Chiu, 2011; Morris et al., 2017; Putwain & Von der Embse, 2019; Yang et al., 2021; Zakariya, 2020). Tschannen-Moran and Woolfolk Hoy (2001) defined that TSE as the teachers' beliefs in

their own abilities upon effectively teaching a subject to the students, ensuring student participation and achieving the desired results from teaching. Moreover, it is also defined as the teacher's belief in the ability to organize and implement the actions necessary to accomplish a teaching task in a given context (Gibson & Dembo, 1984; Tschannen-Moran et al., 1998). In this context, TSE is conceptualized as having three basic components: "student participation", "the competence for teaching strategies" and "classroom management" (Tschannen-Moran & Woolfolk Hoy, 2001).

The source of TSE consists of the perceptions of successful or less successful teaching experiences, including classroom management experiences, motivating students to train, collaborating with colleagues and parents (Yang & Wang, 2019). The teachers with a high sense of SE are more likely to develop challenging lessons, provide more autonomy for student learning, try new teaching strategies, and choose different teaching materials than the teachers with low SE (McKinnon & Lamberts, 2014; Sandholtz & Ringstaff, 2014). According to the studies on TSE, the student discipline problems and low motivation are associated with teacher's low SE (Gilbert et al., 2014; Klassen & Chiu, 2010; Skaalvik & Skaalvik, 2016). A number of research studies have suggested that science teacher's SE play an important role in order to determine the teaching practices (Menon & Sadler, 2018; Teig et al., 2019). It has also been reported that science teachers' negative beliefs about their experience in science teaching may affect their teaching practices (Avery & Meyer, 2012; Kazempour & Sadler, 2015). According to Enochs and Riggs (1990), "science teaching self-efficacy" (STSE) consists of two components: "personal science teaching competence", which is the belief that a person has the ability to teach science effectively, and "science teaching outcome expectation", which is the level of teacher's confidence that the student will learn the content. Kazempour (2014) implies that the teachers with low SE perception in science teaching have doubts about their ability to teach science and are indifferent to science education. On the contrary, it is emphasized that the science teachers with SE suffer less from "stress and exhaustion" and mostly "experience personal accomplishment", "commitment" and JS (Vieluf et al., 2013; Zee & Koomen, 2016).

Anxiety toward Teaching (ATT)

Nayak (2014) define that anxiety is as an emotional discomfort, fear, disappointment and worry that threaten making decisions. Moreover, anxiety is the physical, emotional and mental responses that a person experiences when faced with a stimulus from the outside or internal world (Ucak & Say, 2019). If the level of anxiety felt by the individual complicates his learning level and negatively affects his success, it is defined as negative anxiety. If the anxiety is not at a level that prevents the individual from thinking and making healthy decisions, it can sometimes cause the person to achieve success above their own inclinations, and this type of anxiety is defined as positive anxiety (Aytekin et al., 2017). Teaching is an intellectually demanding and emotionally exhausting profession. Teachers' anxiety often affects their ability to function effectively and can cause exhaustion (Desouky & Allam, 2017). The teachers should have a strong teaching qualification to encounter challenging demands. Otherwise, anxiety can disrupt the effective teaching process (Anusiem & Okoiye, 2015). Thomas (2006) defines ATT as emotions, beliefs or behaviors that interfere with a person's ability to begin continuing or finish teaching tasks. ATT can have dramatic

effects on teachers' professional effectiveness and classroom behavior. A limited number of studies have been conducted in the last thirty years to investigate the sources and solutions of anxiety toward science teaching (ATST) (Czerniak, 1989; Czerniak & Chiarelott, 1990; Czerniak & Haney, 1998; Czerniak & Lumpe, 1996; Novak & Wisdom, 2018; Yuruk, 2011). Aytekin et al. (2017) say that ATST can be affected by many reasons. If the anxiety level of the teacher responsible for teaching the lesson is high, it can be expected that the anxiety of teaching will also increase" (Aytekin et al., 2017, p. 14). Yuruk (2011) reported that science teaching proficiency and the number of science courses taken at university were important predictors of ATST. In this study, the researcher also showed that science teaching experience and past perceptions about science have indirect effects on teaching anxiety. Again, Czerniak (1989) stated that teachers' negative experiences with science teaching performance, lack of time allocated to prepare for science teaching, lack of infrastructure to teach the subject effectively, lack of administrative support, and insufficient funding for materials or equipment have significant effects on teachers' science teaching concerns. In addition, the researcher stated that the science teacher's negative experiences with the student and low SE may cause high levels of ATST. In addition, the use of technology in science teaching as a teaching tool in the classroom and the integration of lessons with technology create fear and anxiety in teachers with low proficiency in these technologies. Moreover, teachers may be concerned about managing the lesson due to a lack of familiarity with technology-assisted teaching (Chiu & Churchill, 2016; Ertmer & Ottenbreit-Leftwich, 2010).

School Culture (SC)

Each school has a unique culture that reflects common values, norms and assumptions (Gruenert & Whitaker, 2015). Johnson et al. (1996) define the SC as "shared beliefs, visions, rituals, values or norms" (p. 139). The SC is often used to define unique working conditions within institutions and to distinguish one school from another (Carpenter, 2015). Moreover, SC governs what is valuable to a school and how members should think, feel and act. In addition, the mentality and behavior of school members affect the quality of schools (Prasetyo et al., 2019). From a different point of view, SC affects teachers' sense of identity, perceptions, behaviors and even their capacity to find and apply new knowledge (Marz & Kelchtermans, 2013; Min, 2019; Seashore Louis & Lee, 2016). SC represents a structure affected by many variables such as principal-teacher, teacher-teacher and teacher-student relations (Brezicha et al., 2015; Duan et al., 2018). It is extremely important for a reliable SC for colleagues to be able to help each other, share their experiences, give ideas and work together on things (Clement & Vandenberghe, 2000; Grosemans et al., 2015). Moreover, a reliable SC fosters the professional behavior of both teachers and other staff (Prasetyo et al., 2019). Carpenter (2015) says that "a positive SC focuses on improving teaching and learning to ensure all students achieve high levels of success" (p. 684). We emphasized the importance of effective science teachers and STEM education for students to acquire 21st century skills in the introduction part of the article. As a result of literature review, we saw that there were not enough studies, except for a few studies covering SC, STEM education and especially science teachers. In one of these studies, Heba et al. (2017) found that SC plays an important role in the implementation of STEM education in schools. Researchers stated, "STEM integration required a different SC than that in non-

STEM schools" (p. 2476). STEM teachers and students participating in the research of Bruce-Davis et al. (2014) emphasized the importance of a SC where all stakeholders share similar interests for effective STEM education. Literature review showed that the relationship between science teachers' professional characteristics and SC needs more attention in terms of research.

Studies on the Factors Associated with Teachers' JS

In the literature, there are studies examining the relationship between the variables mentioned above and teachers' JS. The research results, which are the basis for the teachers' JS, TSE, STSE, ATST and SC variables to be considered in the model, are presented below.

Studies show that there is a positive and significant relationship between teachers' JS and SC, and that teachers' JS mediates the effect of SC, which is an important determinant of school effectiveness (Duan et al., 2018). While SC and teacher's stress level explain 52.3% of teachers' JS, the remaining 47.7% are affected by other variables (Febriantina et al., 2020). There is a direct and positive relationship between the dimensions of school climate, teacher-student relations and participation between stakeholders and JS (Turker & Kahraman, 2021). The meta-analysis results of Kursun and Yilmaz (2020) showed that there is a moderate and significant relationship between SC and JS. Along with the partial mediation effect of self-efficacy, school climate has a positive effect on teachers' JS (Malinen & Savolainen, 2016). Anastasiou and Papakonstantinou (2014) determined that good working conditions, motivation of the school principal, and participation in school management and decision-making processes have a positive effect on teachers' JS and reduce emotional exhaustion.

There are studies showing that there is a positive relationship between the SE (teacher SE and teaching SE) included in the model and teachers' JS. It is emphasized that the relationship revealed in these studies is also valid in different personal characteristics and contextual conditions (Burić & Kim, 2021; Gkolia et al., 2014; Zee & Koomen, 2016). Studies have found that teachers' JS is related to three dimensions of self-efficacy (classroom management self-efficacy, teaching self-efficacy, and student participation self-efficacy). It has been revealed that the effect of teaching SE on JS is higher than other SE dimensions (Edinger & Edinger, 2018; Skaalvik & Skaalvik, 2014; Zakariya, 2020). According to the current literature, the SE is one of the variables related to teachers' JS, is closely related to dedication and satisfaction to teaching (Caprara et al., 2006; Tschannen-Moran & Woolfolk Hoy, 2001). Otanga and Mwangi (2015) found that teachers' higher teaching anxiety causes them to be less satisfied with their teaching. The results of some studies have shown that teaching anxiety is not a significant predictor of teachers' job satisfaction (Demir, 2018; Ferguson et al., 2012).

In summary, teachers' JS has important effects on both their well-being and the quality of education and learning outcomes of students. For this reason, it is important to determine the variables that affect teachers' JS and their relative importance levels. Based on the literature, variables that have a significant relationship with teachers' JS were selected. Personal factors such as teachers' SE (TSE), science teaching SE (STSE), anxiety toward science teaching (ATST), and contextual factors such as school culture are among the most important of these variables. Therefore, the study was shaped around these four variables with the teachers' JS. In addition, considering that

the factors affecting the science teachers' JS are inadequately researched and theorized, there is a need for evidence that can contribute to the efforts to theorize this concept in the context of science teachers. This study tries to contribute to explain the factors affecting the science teachers' JS.

Research Model and Hypotheses

Previous studies have examined the relationships between primary and secondary school teachers' JS, SE, ATST and SC regardless of their field (Duan et al., 2018; Febriantina et al., 2020; Klassen & Chiu, 2011; Manalo et al., 2020). However, these studies dealt with sometimes two (Federici & Skaalvik, 2012; Høigaard et al., 2012; Telef, 2011; Wang et al., 2015; You et al., 2017), sometimes three of the variables of our research (Aldridge & Fraser, 2016; Malinen & Savolainen, 2016; Skaalvik & Skaalvik, 2011; Song & Mustafa, 2015). Again, studies in the literature that included science teachers examined the relationships between only some of these variables (Bozeman et al., 2013; Yuruk, 2011; Zakariya, 2020). However, we found a limited number of studies in the literature examining the relationship between science teachers' JS and ATST (Yuruk, 2011), and between JS and SC (Mostafa & Pal, 2018). On the other hand, we did not find a study that revealed the relationship between these variables and the science teachers' JS. Considering this situation, we created a theoretical model that aims to examine the relationship between TSE, ATST, STSE and SC and science teachers' JS (see Figure 1). At the same time, we tried to test this model in research. The difference of this study from previous studies is that it includes science teachers in the scope of the study by making a field distinction, and it proposes a holistic model that explains the relationship between these teachers' TSE, ATST, STSE and SC perceptions and their JS. We created this model, which tries to explain the factors associated with science teachers' JS, from a synthesis of theoretical explanations, and the model presented here has never been tried before. Thus, in this research, we aimed to examine the theoretical framework for science teachers' JS in the context of these variables and to embody the theoretical structure proposed through this research. We presented the model and hypotheses of our research in Figure 1.

Figure 1

Theoretical Model of the Research
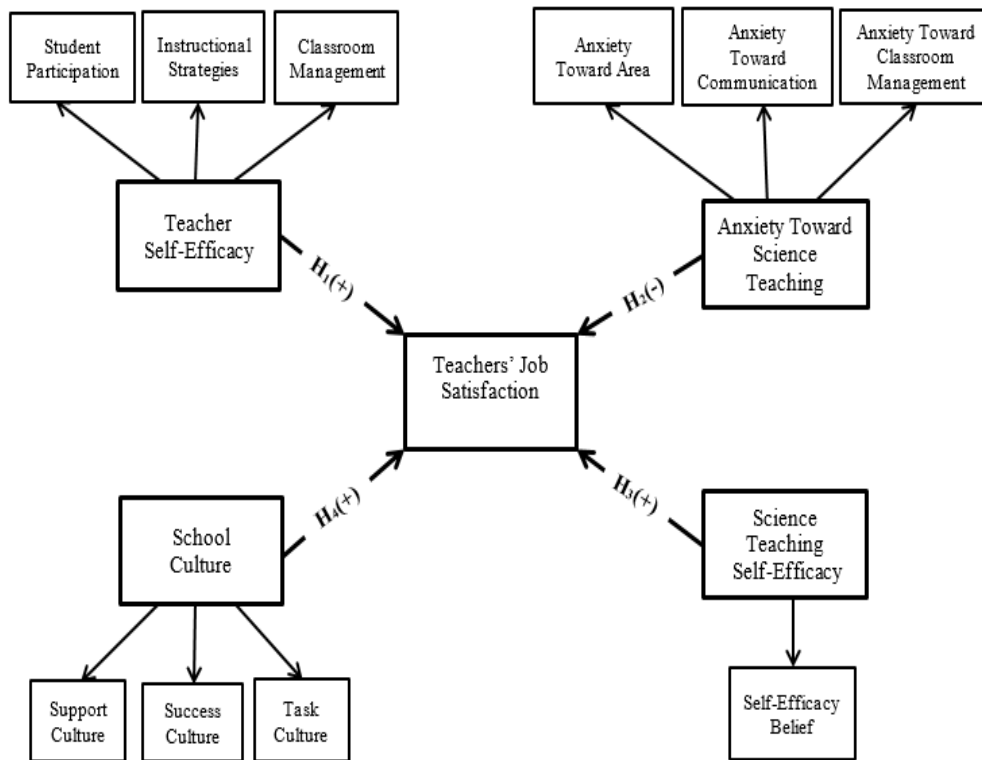
In this model, we defined science teachers' JS as the dependent variable and TSE, STSE, ATST and SC as the independent variable.

Considering the aim of the study, the following research questions were developed:

RQ: Is there a statistically significant relationship science teachers' JS with TSE, STSE, ATST and SC?

At the same time, we created the following hypotheses to test proposed model:

H1: TSE is a significant and positive predictor of science teachers' JS.

H2: ATST is a significant and positive predictor of science teachers' JS.

H3: STSE is a significant and positive predictor of science teachers' JS.

H4: SC is a significant and positive predictor of science teachers' JS.

Method

Research Design

This correlational research was carried out according to the prediction design. Correlational research is particularly useful in tackling problems in education because it allows simultaneous measurement of a number of variables and their relationships (Cohen et al., 2000, p. 199). In correlational research, "the researcher examines the relationship between one or more quantitative independent variables and one or more quantitative dependent variables" (Johnson & Christensen, 2014, p. 97). As a type of correlation research, the purpose of prediction research design is to determine the variables that will predict an outcome or criterion. In this type of research, the

researcher defines one or more predictor variables and a criterion (or outcome) variable (Creswell, 2012, p. 340). In the study, we tried to determine the predictors of science teachers' JS by using the prediction design. In this study, we defined TSE, STSE, ATST and SC as independent variables and JS as dependent variable. Using these independent variables as predictors, we tried to show their direct predictive effects on science teachers' JS. In line with the purpose of the study, a theoretical model is built based on the relevant literature and this model is tested with structural equation modeling (SEM). SEM is a multivariate statistical analysis method that allows the direct and indirect effects between observable and unobservable variables tested in a single model by defining observable and unobservable variables in a causal and relational model (Byrne, 2012).

Sampling

Secondary schools in Turkey were located in the city center, towns, villages of the city and villages of the town. This research was conducted in public schools in a city in eastern Turkey with a total population of less than 300.000. These schools were selected through convenience sampling in order for the researchers to have easy access to the schools and to deliver the questionnaires face-to-face to the teachers. The schools were in the city center with a population of about 118.000, in seven towns of this city with a population of 10.000-45.000, and in villages with a population of less than 2.000. The target group of the study included 217 science teachers in 165 secondary schools. A total of 185 (85%) science teachers from 150 (91%) secondary schools participated in this study. Stevens (2002) recommends that for social science research about 15 subject per predictor are needed for a reliable equation. Tabachnick and Fidell (2013, p. 123) give a formula for calculating sample size requirements, taking into account the number of independent variables that you wish to use: $N>50+8m$ (where m=number of independent variables). Since there are 12 independent variables in the model proposed in this study, it is sufficient to have a minimum of 180 participants. In addition, according to the Tabachnick and Fidell (2013) formula, it was evaluated that there should be 146 participants in total for 12 independent variables. According to these criteria, it can be said that the number of participants in the study is sufficient.

Each teacher voluntarily participated in this study. Table 1 included the distribution of science teachers participating in the research in terms of gender, professional career stage, duty region (location), and education degree. Of the teachers participating in this study, 119 (64.3%) were female and 66 (35.7%) were male. In this study, we chose Huberman's (1989) career stage model as a theoretical framework to represent teachers' career stages. Huberman's model characterized teacher development as five sequential stages closely related to individual teaching experience. The first was the "survival and discovery" stage, covering the first 3 years of the teaching profession. The second was the "stabilisation" phase, which took place in the 4-6 years of the profession. The third stage of the model, "experimentation/activism and stocktaking", covered the 7-18 years of the career. The fourth stage of the model spanned the 19-30 years of the career and had two possible orientations: (1) "serenity" or (2) "conservatism". The final stage of his teaching career was "withdrawal from the profession", which started with nearly 30 years of teaching experience (Richter et al., 2011). More than half of the participants (52.4%) were at the "survival and discovery"

stage. In addition, the number of participants in the "stabilisation" stage (23.2%) and the "experimentation/activism and stocktaking" (21.2%) stage was higher than those in the other career stages were. In terms of the place where they work, the participants mostly continued their teaching profession in the villages of the towns (41.6%). The vast majority of science teachers (92.4%, *n*=171) had a bachelor's degree.

Table 1

The Frequency Distribution of Participants According to Various Variables

Variable	Code	*f*	*%*
Gender	Female	119	64.3
	Male	66	35.7
Professional Career Stage	≤ 3 years (The stage of adherence to profession)	97	52.4
	4-6 years (The period of stability)	43	23.2
	7-18 years (The period of activity)	39	21.2
	19-30 years (The period of inactivity)	5	2.7
	> 30 years (The period of Withdrawal)	1	0.5
The place of duty	City Center (urban)	41	22.2
	County Town (suburban)	47	25.4
	The village affiliated the city center (rural)	20	10.8
	The village affiliated the county town (rural)	77	41.6
The level of education	Bachelor's Degree	171	92.4
	Master's Degree	14	7.6

Data Collection and Instrumentation

The data of the current research were collected in November-December 2019. Before the research, we obtained the necessary legal permissions for the application of the instrument from the National Education Directorate of the city where the research sample was located. Then, two researchers visited the schools in the sample. After meeting face-to-face with each secondary school science teacher and introducing the purpose of the research and the measurement tools, we handed over the paper version of the instrument to the teachers who declared that they would voluntarily participate in the research. We gave teachers two days to complete the six-part instrument. We visited the schools again on the days agreed in advance and received the completed instrument. In the present study, the instrument consisted of six parts. The first part was prepared to collect the demographic data of science teachers who participated in the research, including gender, professional career stage, region of duty and education degree. The other five parts aimed to collect data on the variables JS, TSE, STSE, ATST and SC. We have explained the structural features of these parts in detail in the following section.

Minnesota Job Satisfaction Scale (MJSS)

The MJSS was used to measure the science teachers' JS. The MJSS was developed by Weiss et al. (1967) and adapted into Turkish by Baycan (1985) in order to measure the JS levels of employees. The MJSS had 20 items that represent two dimensions of JS: "intrinsic satisfaction" (success, recognition or appreciation, job itself, job responsibility, promotion) and "extrinsic satisfaction" (business policy and management, type of governance, manager, relationships with employees and subordinates, working conditions, wages). The score obtained from these two subscales were the general JS score. The MJSS used a 5-point Likert-type scale, ranging from "very dissatisfied" to "very satisfied". CFA was conducted using data from the current study to examine the construct validity of the scale and it was confirmed that the scale had a two-factor model ($\chi2$=599.75 df=170, p>.05, $\chi2/df$=3.52, RMSEA=.06, IFI=.90, GFI=.91, SRMR=.06, AGFI=.82, NFI=.89 and CFI=.91). The standardized factor loads of the items ranged from .40 to .75, and the t values were between 11.52 and 5.46, and statistically significant (p<.01). Cronbach's alpha internal consistency coefficient was .85 for the whole scale.

Teachers Self Efficacy Scale (TSES)

The TSES developed by Tschannen-Moran and Woolfolk Hoy (2001) and adapted into Turkish by Capa et al. (2005) was used to measure the science teachers' SE. This scale had 24 items and three-dimensions. The scale included the dimensions of "student engagement" (8 items), "instructional strategies" (8 items) and "classroom management" (8 items). The scale had a 9-point scoring structure ranging from "Insufficient" to "Very Sufficient". In this study, CFA was performed to examine the construct validity of the scale and it was confirmed that the scale had a three dimensions structure ($\chi2$=559.39, df=249, p>.05, $\chi2/df$=2.24, RMSEA=.06, IFI=.96, GFI=.93, SRMR=.06, AGFI=.86, NFI=.93 and CFI=.96). The standardized factor loads of the items ranged from .49 to .83, and the t values were between 6.52 and 12.92 and statistically significant (p<.01). Cronbach's alpha internal consistency coefficient was .86 for the whole scale.

Science Teaching Self-Efficacy Belief Instrument (STSEBI)

The STSEBI developed by Riggs and Enochs (1990) and adapted into Turkish by Hazir-Bikmaz (2002) was used to measure the teachers' "science teaching self-efficacy". This scale had 21 items and two-dimensions. The scale included the dimensions of "science teaching self-efficacy beliefs (STSEB)" (13 items) and "classroom management (CM)" (8 items). The scale had a 5-point scoring structure ranging from "Strongly Agree" to "Strongly Disagree". Since the results of the analysis showed that the construct validity values of CM dimension of the original scale were low, this dimension was excluded from the analysis. CFA was performed to ensure the construct validity of the STSEB, and it was understood that the single-factor (STSEB) structure of the scale was compatible with the collected data set ($\chi2$=117.88 df=54, p>.05, $\chi2/df$=2.18, RMSEA=.06, IFI=.93, GFI=.90, SRMR=.07, AGFI=.81, NFI=.91 and CFI=.92). The standardized factor loads of the items ranged from .30 to .72, and the t values were between 2.61 and 10.30 and statistically significant (p<.01). Cronbach's alpha internal consistency coefficient was .86 for STSEB.

Science Teaching Anxiety Scale (STAS)

The STAS developed by Kahraman and Polat (2017) was used to determine the teachers' ATST. The STAS had 44 items that represent four dimensions of ATST: the "anxiety toward area (science and laboratory) competence" (18 items), "anxiety toward communication" (12 items), and "anxiety toward classroom management" (14 items). The scale had a 10-point scoring structure ranging from "I never feel anxiety" and "I always feel anxiety". In this study, CFA was performed to examine the construct validity of the scale and it was confirmed that the scale had a three-factor structure ($\chi2$=4197.46 df=899, p>.05, $\chi2/df$=4.66, RMSEA=.07, IFI=.96, GFI=.90, SRMR=.07, AGFI=.86, NFI=.94 and CFI=.96). The standardized factor loads of the items ranged from .47 to .85, and the t values were between 6.26 and 13.03 and statistically significant (p<.01). Cronbach's alpha internal consistency coefficient was .84 for the whole scale.

School Culture Scale (SCS)

The SCS developed by Terzi (2005) was used to determine the perceptions of science teachers about SC. The SCS had 29 items that represent four dimensions of SC: "support culture" (8 items), "achievement culture" (6 items), "task culture" (6 items), and "bureaucratic culture" (9 items). The scale used a 5-point Likert scale, ranging from "Never" to "Always". In this study, CFA was performed to examine the construct validity of the scale and the three-factor (Support, Success and Task) structure of the scale were verified ($\chi2$=779.80, df=373, p>.05, $\chi2/df$=2.09, RMSEA=.07, IFI=.92, GFI=.91, SRMR=.07, AGFI=.80, NFI=.88 and CFI=.93). The standardized factor loads of the items ranged from .47 to .72, and the t values were between 5.78 and 8.71 and statistically significant (p<.01). Cronbach's alpha internal consistency coefficient was .80 for the whole scale.

Data Analysis

The three main analysis methods performed in the current research were the multiple linear regression, CFA and SEM. The analyses were conducted using the SPSS 23.0 and LISREL 8.7 package. In this context, the measures of central tendency and dispersion (mean and standard deviation), univariate normality, the correlation between variables, the reliability of scales and multilinear regression analysis were performed with SPSS. The CFA and SEM analysis were performed with the LISREL 8.7. The main assumptions were evaluated to perform parametric tests before the analysis. Descriptive statistics were calculated, and Kolmogorov-Smirnov test was performed for the conformity of the scores of the variables and sub-dimensions of all variables to the univariate normal distribution. It was determined that the scores of the sub-dimensions of STAS and SCS did not comply with the normal distribution. Various data transformation methods are recommended according to the distribution patterns of the data to bring the skewed data closer to normal. Square root transformation was applied for moderately positively skewed scores, and logarithmic transformation was applied for those with extremely positive skewness (Pallant, 2001, p. 78; Tabachnick & Fidell, 2013, p. 86). Data conversion operations were performed using SPSS menus.

In this study, firstly the factor structures, validity and reliability studies of the measurement tools were analyzed. In this context, CFA was performed for each

measurement tool. As a result of the analysis, goodness of fit values, factor loads, and t-test significances of each scale were determined. Then, SEM analysis was performed to determine the predictors of the independent variables on the dependent variable. Chi-Square / degrees of freedom ($\chi2/df$), RMSEA, NFI, GFI, CFI, IFI, SRMR and AGFI fit indices were used both in the CFA for measurement instruments and in the evaluation of SEM fit (Kline, 2016; Tabachnick & Fidell, 2013).

Ethical Procedures

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Before the study, the implementation of the scales was approved the Provincial Directorate of National Education in which the research sample is included (8 October 2019/No: 91782061-605.01-E.19302553). Informed consent was obtained from all individual participants included in the study. Verbal informed consent was obtained prior to the data collection process. Data tools in the study were applied only to volunteer participants.

Results

This section included the results from descriptive analysis of research data, multiple linear regression, CFA and established SEM analysis of the model. The results were presented under the headings in the following sections.

CFA and Reliability Analysis Results with Central Tendency and Dispersion of Variables

Table 2 included the factor load, mean, standard deviation and reliability coefficient values for the sub-dimensions forming the JS, TSE, STSE, ATST and SC scales.

Table 2

Descriptive Statistics and factor loadings yielded from CFA

Scale	Latent variable	Item	Factor loading	*M*	*sd*	*α*
MJSS	Intrinsic Satisfaction	1,2,3,4,7,8,9,10,11,15,19,20	.40 - .72	4.05	.49	.85
	Extrinsic Satisfaction	5,6,12,13,14,16,17,18	.45 - .75	3.68	.64	
TSES	Student engagement	1,2,4,6,9,12,14,22	.49 -. 70	7.03	.83	.86
	Instructional Strategies	7,10,11,17,18,20,23,24	.58 - .73	7.44	.81	
	Class Management	3,5,8,13,15,16,19,21	.58 - .76	7.43	.83	
STSEBI	Teaching Self-Efficacy Belief	1,3,4,6,10,14,15, 16,17,18,19,20	.30 - .72	4.20	.39	.71
STAS	Anxiety toward area	1,2,3,4,5,6,7,8,9,10,11, 12,13,14,15,16,17,18	.53 - .82	2.12**	.54	.84
	Anxiety toward communication	19,20,21, 22, 23, 24, 25, 26,27,28,29,30	.47 - .75	.48*	.27	

	Anxiety toward school management	31,32,33,34,35,36,37,38 39,40 41,42 43,44	.63 - .85	.49*	.29	
SCS	Support Culture	7,10,11,16,18,24,26,27	.60 - .70	1.43**	.23	
	Achievement Culture	9,17,21,22,25,28	.47 - .72	1.46**	.22	.80
	Task Culture	1,2,3,4,5,6	.50 - .67	1.41**	.20	

* Logarithmic transformation point average,

** Square root transformation point average

The results reported in Table 2 showed that the mean of the latent variables was above the midpoint of the score range of the scales. In addition, the standard deviation values were clustered close to the mean scores of the variables. These results indicated that science teachers participating in the present study did not differ much in terms of measured characteristics. We conducted the Kolmogorov-Smirnov univariate analysis of normality for the data from the instruments. Analysis results showed that ATST scores were moderately positively skewed. We conducted a repeat analysis of normality by applying the square root transformation to the ATST scores. Table 3 represented the results of the analysis of normality.

Table 3

The Results of Descriptive Statistics and Univariate Normality for Variables

Variable	n	Mean	Std. Deviation	Skewness	Kurtosis	Kolmogorov-Smirnov
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
JS	185	3.908	.519	-.096	-.797	.063*
TSE	185	7.305	.730	.016	-.431	.038*
STSE	185	4.201	.386	-.217	-.296	.061*
ATST	185	1.974	.518	.276	-.795	.059*
SC	185	3.647	.437	-.083	-.460	.040*

* $p>.05$; Std. Error of Skewness=.179; Std. Error of Kurtosis=.355; JS: Job Satisfaction; TSE: Teachers' Self-Efficacy; STSE: Science Teaching Self-Efficacy; ATST: Anxiety toward Science Teaching; SC: School Culture

Skewness and kurtosis values were calculated for the scores of the variables. The calculated values were found in the range of 3 to -3 and were considered to provide a normal distribution (Tabachnick & Fidell, 2013, p. 79). The results indicated by Table 3 showed that the variables had univariate normality ($p>.05$). In other words, JS, TSE, STSE, ATST, and SC scores were assumed to be normally distributed for multivariate regression and SEM purposes. At the beginning of the analysis, we evaluated whether there was a linear relationship among the predictor variables and the predicted variable for the regression procedure using the scatter plot and calculated the correlation coefficients. Table 4 included correlations among variables in the model.

Table 4

Correlations among the Variables in the Model

Variables	TSE	STSE	SC	JS	ATST
TSE	1				
STSE	.422**	1			
SC	.265**	.251**	1		
JS	.374**	.333**	.575**	1	
ATST	-.162*	-.133	-.047	-.126	1

* The correlation is significant at .05 level (Two-tailed),

** The correlation is significant at .01 level (Two-tailed)

The results in Table 4 indicated a positive linear relationship between the JS variable and TSE, STSE and SC, and a weakly negative relationship with the ATST variable. In addition, the results showed that there was no multicollinearity problem among the predictor variables ($r<.70$). In addition, "collinearity diagnostic" was performed on the variables to control the multicollinearity problem. The tolerance values for independent variables are quite respectable, Tolerance>.20 and VIF<10 (Pallant, 2001, p. 143). The existing relationships among the variables showed that a predictive model could be constructed that included these variables. Outliers checked by inspecting the Mahalanobis distances that are produced by the multiple regression procedure. The maximum Mahalanobis distance value was calculated as 18.92 (Chi-square *p* value .0008). The number of independent variables was taken as degrees of freedom to determine which cases were outliers. By examining the extreme values, it was determined that there was only one case exceeding the chi-square critical value at the alpha level of .001 (Critical value=18.47, *df*=4, *α*=.001). We checked the residuals scatterplot and normal probability plot in the regression procedure for multivariate normality and linearity between the predictor variables and the predicted variable. We evaluated that the score on the scatterplot tend to cluster around zero point and this indicated that the linearity assumption was met. According to the normal probability plot of standardized residuals, the points lied in a reasonably straight diagonal line. This meant that there were no major deviations from the normality. Therefore, it was evaluated that there is no need to remove a case with an extreme value from the data set (Pallant, 2001, p. 145).

Results of the Relationships between Dependent and Independent Variables in the Model

In this section, we formulated the relationship of science teachers' JS with TSE, STSE, SC and ATST with a SEM and presented the results of the model fit analysis. After it is determined that the fit index values evaluated in SEM meet the acceptance cut-off points. The fit index values of the structural model are shown in Table 5. After determining the suitability of the fit index values for the model structure, we examined the predictive power of four variables related to the science teachers' JS.

Table 5

Fit Index Analysis Results in Model

Fit Index	Perfect fit *	Acceptable fit *	Fit Index Value of the Model	Decision
χ^2/sd	≤3	≤5	97.15/55=1.77	Perfect
RMSEA	.00 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .10	.04	Perfect
NFI	.95 ≤ NFI ≤ 1.00	.90 ≤ NFI ≤ .95	.94	Acceptable
CFI	.95 ≤ CFI ≤ 1.00	.90 ≤ CFI ≤ .95	.97	Perfect
IFI	.95 ≤ IFI ≤ 1.00	.90 ≤ IFI ≤ .95	.97	Perfect
GFI	.95 ≤ GIFI ≤ 1.00	.90 ≤ GIFI ≤ .95	.92	Acceptable
SRMR	.00 ≤ SRMR ≤ .05	.05 ≤ SRMR ≤ .08	.05	Perfect
AGFI	.90 ≤ AGFI ≤ 1.00	.80 ≤ AGFI ≤ .90	.88	Acceptable

* (Hooper et al., 2008; Joreskog & Sorbom, 1993; Klem, 2000; Kline, 2016; Tabachnick & Fidell, 2013).

According to the fit indices in Table 5, it was determined that the established model met the necessary fit criteria. In other words, it can be said that the established model is compatible with the collected data (Model fit: χ^2/df=1.77, CFI=.97, GFI=.92, NFI=.94, IFI=.97, AGFI=.88, RMSEA=.04 and SRMR=.05). We found that the five fit index values (χ^2/df, RMSEA, CFI, IFI and SRMR) that we considered for the model correspond to good model fit, and three (NFI, GFI and AGFI) correspond to an acceptable level of model fit.

In this step, we examined the structural relationships of science teachers' JS with their TSE, STSE, SC and ATST (see Figure 2).

Figure 2

SEM Analysis Related to the Model
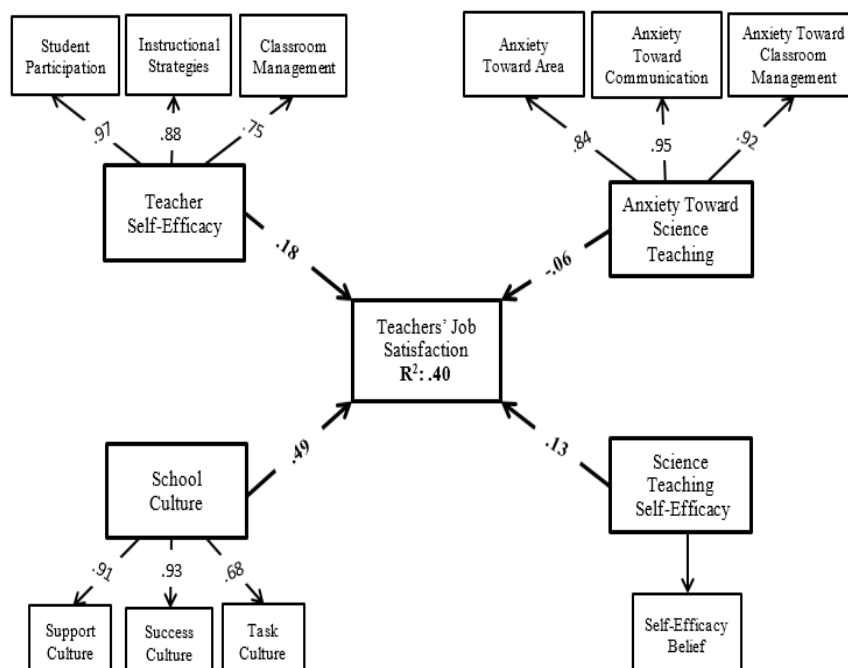
The results supported that science teachers' JS was significantly associated with several predictors tested. Science teachers' JS had the strongest association with SC (β=.49, r=.58, p<.01), followed by TSE (β=.18, r=.37, p<.01) and STSE (β=.13, r=.33, p<.01) (see Figure 3). In other words, it means that science teachers who have positive feelings in terms of SC are more likely to have higher JS when compared to SE (TSE and STSE). However, the results of the current study showed that the regression coefficient (β= -.06, r=-.13, p>.01) of the relationship between the ATST and JS was insignificant. This result showed that the amount of science teachers' ATST did not negatively affect their JS. These results confirmed H1 (t=2.77, p<.05), H3 (t=1.94, p<.05) and H4 (t=8.13, p<.01). On the other hand, they did not confirm H2 (t=0.98, p>.05). Table 6 shows the results of multiple linear regression.

Table 6

The Results of Multiple Linear Regression Analysis

Variables	B	Standard Error $_B$	β	t	Bilateral r	Partial r	Tolerance	VIF
Stable	.829	9.910		.084				
TSE	.107	.039	.181	2.772**	.374	.202	.784	1.275
STSE	.226	.116	.125	1.940*	.333	.143	.797	1.254
SC	.403	.050	.493	8.132**	.575	.518	.906	1.104
ATST	-.173	.177	-.057	-.978	-.126	-.073	.969	1.032

R=.63; R^2=.40; F=30.031**; n=185; *p<.05; **p<.01

Regression results showed that the predictive variables together explained approximately 40% of the variance in JS (R=.63, R^2=.40). Importance levels of independent variables according to standardized coefficients (β) were SC, TSE and STSE, respectively. Based on the analysis results, we represented the mathematical model for predicting science teachers' JS in Equation 1.

$$JS = 0.403SC + 0.226STSE + 0.107TSE + 0.829 \qquad (1)$$

Discussion

Current study aimed to examine the relationship between TSE, ATST, STSE and SC and science teachers' JS. For this aim, we created a theoretical model and tried to test this model through hypotheses.

The results of the current research showed that science teachers' JS was directly positively correlated with their SE and SC. In addition, the results of the structural model indicated that SC was a strong predictor of science teachers' JS. However, SE was less important in explaining science teachers' JS compared to SC. At the same time, these results met our expectation that science teachers' SC and SE beliefs were positively related to their JS. Science teachers' ATST did not have a direct negative significant relationship with their JS. This result did not meet our expectation that science teachers' ATSTs were negatively related to their JS. Capone and Petrillo (2020) found that poor TSE and JS were strongly associated with depression. This result underlines the role of work-related constructs such as SE and JS in influencing teachers'

psychological risks. You et al. (2017) showed that academic climate perception, peer support and supportive leadership, which are among the characteristics of TSE and SC, are important predictors of teachers' JS. Zakariya (2020) concluded that SC and TSE have a strong effect on JS. Katsantonis (2020) reported that SE and SC have a significant impact on teachers' satisfaction and resilience. In addition, he showed that the disciplinary climate perceived by the teachers, which is one of the school climate variables, has a negative effect on their SE, while the teacher-student relationship variable contains a positive internal meaning and therefore has a positive effect on TSE. Taxer and Frenzel (2018) found that high JS and SE levels as well as reduced anxiety support teacher happiness. According to Burić and Moe (2020), anxiety while performing a particular task can be seen by an individual as a sign of a lack of ability, which can result in low SE beliefs in a given situation. Huang et al. (2019) showed that SE was positively related to teaching performance and satisfaction, and negatively related to anxiety and depression. Contrary to the studies in the literature, the results of this study indicate that teaching anxiety is not a construct that affects science teachers' JS. However, the result that anxiety was negatively related to TSE was similar to the literature.

The results of testing the first and third hypotheses of this study revealed that science teachers' SEs (TSE and STSE) were a significant predictor of their JS. These results reiterate the positive correlation of teachers' JS with their SEs. Because the positive relationship between SE and JS has been documented in previous studies (Aldridge & Fraser, 2016; Canrinus et al., 2012; Skaalvik & Skaalvik, 2014; You et al., 2017). However, these results, which support previous studies, differed in terms of the sample studied. Previous research has mainly worked with teachers of different subjects at the secondary school level. This study, on the other hand, revealed the results of the relationships between the JSs and SEs of science teachers, which are not sufficiently covered in the literature. Contrary to our results, Wang et al. (2018) reported that science teachers' SEs were not a significant predictor of their JS. The reason for the inconsistency in the results can be explained by working with different samples. Because this study was conducted with middle school science teachers and their study was with high school science teachers. The fact that teachers are in different working conditions may be the source of this difference. Because it is stated that working conditions are related to teachers' SE beliefs and JSs (Duffy & Lent, 2009; Kahraman, 2014). As we mentioned in the previous section, knowing the positive relationship between the SEs of science teachers and their JSs, which play a key role in students' acquisition of 21st century skills and STEM education, can provide important contributions in practice. Won and Chang (2020) and Arslan (2019) reported that teachers with high SE levels have more JS than with low SE. On the other hand, Ghaffar et al. (2019) stated that low SE in science teachers triggered professional exhaustion and weakened the sense of belonging, which negatively affected student motivation and success. The result from this hypothesis may support the idea that science teachers' relatively modifiable SEs are beneficial in increasing their JS (Duffy & Lent, 2009). Thus, teachers with advanced SEs can get more satisfaction from their profession, which can foster the creation of an effective and positive teaching process.

The results of the second hypothesis of this study showed that science teachers' ATST did not have a direct significant relationship with their JS. The results of this

study that there was no significant relationship between science teachers' ATSTs and their JSs were consistent with the results of previous studies. For example, Ferguson et al. (2012) found that anxiety was not a significant predictor of teachers' JS. Similarly, Demir (2018) showed that there was no significant relationship between teachers' JS and their teaching anxiety. Although the past studies reviewed here presented results that included the relationship between ATST and JS for a mixed group of teachers without any field distinction, they did not reveal any results for this relationship for science teachers. Therefore, the result of this research points to a new result outside the relevant literature. This result indicates that ATST does not have a key role in advancing the JS of science teachers. It is understood that some of the studies in the literature evaluated the predictive power on JS by using the independent variables discussed in this study individually or using several of them together. Wang et al. (2015) determined that SE affects teachers' psychological satisfaction and their intention to withdraw from teaching through a large sample. Skaalvik and Skaalvik (2017) found that teacher anxiety and TSE were negatively related, and teacher anxiety was negatively associated with teacher JS and job engagement, and positively with burnout and teacher attrition. On the other hand, he reported that TSE was positively related to teacher JS and job engagement, and negatively related to burnout and teacher attrition. Gkolia et al. (2014) showed that teachers' JS has a positive effect on different dimensions of TSE. The results of both studies can be interpreted as teachers' JS and TSE mutually predict each other.

The results of the fourth hypothesis of this study revealed that SC predicted science teachers' JS positively. In addition, our results showed that SC was the relatively most important predictor of JS compared to TSE and STSE variables. Results revealed that the role of SC in promoting the psychological empowerment of science teachers is very clear. This study shows that both JS and SE of science teachers have a significant relationship with SC can be interpreted as indicating that teachers' professional well-being passes through a healthy school climate. However, the findings of the current study were inconsistent with the findings of Shaukat et al. (2019) that there was no significant relationship between TSE and JS. This difference between the findings of the current study and the studies of Shaukat et al. (2019) may be due to the sample and cultural differences. The results of the current research showing a direct positive relationship between teachers' SC and their JS were consistent with previous studies (Duan et al., 2018; Katsantonis, 2020; You et al., 2017; Zakariya, 2020). For example, the meta-analysis results of Kursun and Yilmaz's (2020) research on the relationships between teachers' JS and their SC showed that there is a moderate and significant relationship between SC and JS. However, the result of current study that SC is a more important variable in explaining teachers' JS compared to other predictor variables differed from previous studies. Because previous studies have shown that SE, one of the variables that we discussed in this study, is more important in explaining JS (Aldridge & Fraser, 2016; Febriantina et al., 2020; Malinen & Savolainen, 2016). However, in line with the results of our research, Turker and Kahraman (2021) revealed that SC is more important than SE in explaining teachers' JS. Therefore, results may support the idea that creating a supportive SC where teachers can work effectively and share their ideas and practices is more beneficial for them in terms of increasing JS. Capone and Petrillo (2020) emphasize that improving teachers' satisfaction can have

important effects on students' educational outcomes and their social and emotional development. Zakariya (2020) reported that understanding the relationships between teachers' SC, SE and JS plays a vital role in identifying, hiring and retaining effective teachers. Moreover, he emphasized that this is important for improving teachers' well-being, the quality of school management, and teaching and learning outcomes. Teachers' mental well-being in terms of JS is associated with their desired outcomes such as low depression, low burnout, and increased SE beliefs (Capone & Petrillo, 2020). The results of our study, when evaluated in the light of these studies, point out that the effect of individual science teachers' sense of SE and SC perceptions on their JS and practices is very important and a structure that should be considered. In other words, empirical studies in the context of these two independent variables on the way to improve the science teachers' JS can lead to better education policies. According to Ali et al. (2017), in a healthy school climate, the teacher finds his profession meaningful and takes more responsibility for his work. They emphasize that this situation has a positive effect on JS and leads to an increase in teachers' motivation and performance. However, science teachers should know that they have responsibilities in creating SC, which is one of the most important variables affecting their JS. Science teachers will feel happier when they think that they are valuable in their institution and make a meaningful contribution to their institution. When all variables are considered together, SC has the strongest effect on JS. This means that it is useful to consider factors within the SC and how they can be developed (Aldridge & Fraser, 2016). Kalman and Balkar (2018) assumes that teachers play a dominant role in the culture and effectiveness of the school, as they are one of the main actors that create and display values and beliefs in the school. Song et al. (2020) emphasize that teachers' perceptions of quality of life in schools reflect their subjective well-being, values and capacity to fulfill these values. The prominence of the SC variable as the most important predictor of science teachers' JS has been discussed in the light of some research and theoretical knowledge. In this context, when the studies are examined, it is understood that the important effects of the support culture dimension, one of the sub-dimensions of SC, on teachers' JS come to the fore more through both theoretical knowledge and research. Although limited in number, some studies in the literature confirm that the teacher-student relationship dimension of SC has a greater impact on JS than other dimensions (Veldman et al., 2013; You et al. 2017). When teachers face disturbing student behaviors, they have problems in managing it. This situation leads to a weakening of teachers' relationships with students, a perspective that does not care about students, a weakening of the culture of success and duty, and as a result, the probability of schools having teachers with low JS increases (Aldridge & Fraser, 2016). Collie et al. (2012) found that teachers' perceptions of students' motivation and behavior had the strongest influence on their teaching effectiveness and JS. They found that these variables significantly predicted teachers' sense of stress, teaching effectiveness and JS. In addition, teachers' perceptions of values in schools and value congruence (to what extent they feel that they share the norms and values that are valid at school) are significantly associated with JS and motivation to leave the teaching profession (Skaalvik & Skaalvik, 2011). In other words, it can be said that in a school that shares its values with its employees, teachers will strengthen the sense of belonging to their institution and work and can successfully manage the emotional exhaustion process related to their work. The SC is a rather

abstract concept that can be explained by many factors. However, it is shaped by shared institutional values. Especially in a good SC, the target of student success, that is, what kind of student you aim to raise and with which practices this will be done come to the fore (Aldridge & Fraser, 2016). Moreover, it can be said that in a strong SC, cooperation between teachers and other stakeholders, shared values and orientation towards common goals will increase, which will positively affect teachers' JS. Abdulahi (2020) showed that SC and TSE levels are predictors of JS in schools. In this study, it was understood that there is a significant relationship between teachers' JS and SC, especially with teachers' professional development and collaborative leadership practices. Therefore, it can be said that in order to increase teachers' JS, school leaders should strengthen and develop the professional development program and collaborative leadership practices in schools. It reveals that positive SC and climate are associated with stronger academic performance, higher graduation rates, decreased violence, increased teacher satisfaction and retention (Clifford et al., 2012). Torres (2019) stated that the support or cooperation aspects of SC are positively related to JS and student success. In a collaborative SC with a culture of shared responsibility and mutual support, teachers feel supported, realize that they have responsibilities that extend beyond the classroom to school-wide problems, and are more satisfied with their jobs and, as a result, with their school. The attitudes and behaviors of school administrators may have a significant effect on the positive relationship of school culture with both teacher job satisfaction and self-efficacy. Toropova et al. (2021) showed that there is a significant relationship between school working conditions and teacher JS. More specifically, they found that teacher perceptions of teacher workload, teacher collaboration, and student discipline at school were the factors most closely associated with teacher JS. Brezicha et al. (2020) showed that when principals provide opportunities for teachers to participate in meaningful decision-making opportunities, it leads teachers to feel a greater sense of ownership and commitment to their profession and school. Lambersky (2016) reported that principal behavior is an important factor in improving or worsening work feelings. The results of this study supported the idea that principals, who are an important stakeholder of SC, can play a role in increasing the performance of teachers by influencing their emotional states such as job satisfaction, burnout, anxiety, self-efficacy, organizational commitment and participation.

Conclusion and Recommendations

This study revealed that the professional satisfaction of science teachers is largely fed by SC and SE (TSE and STSE). Moreover, the results underline which variables need more attention in improving the science teachers' JS. The present study makes important theoretical contributions to the existing literature on the variables that shape the science teachers' JS through the proposed model. In addition, this study is one of the first studies aiming to determine the emotional and motivational variables related to the science teachers' JS in Turkey. The results of the present study shed light on the responsibilities of the stakeholders regarding these variables by revealing the factors directly related to the science teachers' JS.

The results of our research related to SE, SC, and ATST did not directly include an impact on either teachers' job performances or students' learning outcomes. That is, the results of this study did not reveal a causal effect. However, the fact that SC and SE

have strong positive associations with science teachers' JS and are important predictors of explaining JS may play a key role in retaining teachers with high satisfaction. When these results are taken into account in practice, opportunities for teachers to participate in activities promoting SE can be provided. In addition, stakeholders such as colleagues, families and administrators should try to create an effective school climate through mutually supportive relationships. Thus, it can be a basis for teachers who are trying to cope with various difficulties in their professional career process to be more satisfied and happier.

Previous studies have revealed that burnout, job stress and SE, which are significantly related to teachers' JS, are also related to anxiety (Demir, 2018; Senler, 2016). In this study, it was seen that there was a significant relationship between SE, SC and JS. However, we examined the relationship between JS and ATST without considering the mediating effect, and we saw that there was no direct significant relationship between the two variables. Future research can study whether ATST is a predictor of science teachers' JS, taking into account considering the mediating effect of the variables mentioned here. However, the theoretical model proposed by the current research can be retested in groups of teachers from different fields and in samples from different cultures. By adding different motivational and affective variables that are thought to affect the model, studies can be carried out on new models related to the professional satisfaction of science teachers, thus contributing to the development of the theoretical structure.

Limitations

The research has some limitations despite its valuable contributions. First of all, the conduct of this research in a single province in eastern Turkey is the main limitation. Therefore, a larger sample is needed to generalize the results. Since the participants of the present study were secondary school science teachers, the number of samples was limited. However, the results could be generalized to a wider range of teachers if teachers in other science fields such as physics, chemistry, and biology at the high school level were included in the study.

Statement of Responsibility

All authors contributed to the study conception and design. First author performed material preparation, data collection and analysis. Second author wrote the first draft of the manuscript and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Conflicts of Interest

The authors have no relevant financial or non-financial interests to disclose.

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Critical Thinking Skills and Dispositions of Turkish Pre-service Teachers: A Systematic Review of Research[*]

Türk Öğretmen Adaylarının Eleştirel Düşünme Becerileri ve Eğilimleri: Alandaki Araştırmaların Sistematik Analizi

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ABSTRACT: This paper aims to analyze the research literature on Turkish pre-service teachers' critical thinking skills (CTS) and critical thinking dispositions (CTD) to identify the major knowledge claims and areas of further research. This systematic review study examined both quantitative and qualitative studies conducted between years 2010-2020, in Turkey. The educational research regarding Turkish pre-service teachers' CTS and CTD was investigated in electronic national and international databases including ERIC and TR Dizin. Considering our inclusion criteria, we included 88 studies in our review. Firstly, we completed descriptive analysis of the selected studies. Then, we analyzed their content. The descriptive analysis showed that quantitative research designs dominate the field. These studies report low-level of CTS of the participants. On the other hand, we presented our thematic analysis under two main themes: traditional perspectives and critical perspectives. We conclude that a few studies adopt a critical stand in the realm of traditional approaches. We argue that such a perspective downgrades CT into a set of generic skills and neglects contextual and individual differences. It further diverges pre-service teachers from their roles as critical educators who actively participate in transformation of their society.

Keywords: Critical teachers, critical thinking, pre-service teachers, systematic review, Turkey.

ÖZ: Bu makalenin amacı, Türk öğretmen adaylarının eleştirel düşünme becerileri (EDB) ve eleştirel düşünme eğilimleri (EDE) ile ilgili araştırmaları analiz etmek ve bu araştırmaların temel bulgularını ve sonuçlarını ortaya koymaktır. Bu kapsamda, Türkiye'de 2010-2020 yılları arasında yapılan ve ERIC ve TR Dizin dâhil olmak üzere ulusal ve uluslararası veri tabanlarında yayınlanan nicel ve nitel araştırmalar incelenmiştir. Belirlenen ölçütler çerçevesinde 88 araştırma çalışmaya dâhil edilmiştir. İlk olarak, incelenen çalışmaların betimsel analizi tamamlanmış, daha sonra çalışmaların içerik analizi yapılmıştır. Betimsel analiz, nicel araştırma yaklaşımının alanda daha baskın olduğunu göstermiştir. Ayrıca bu çalışmalar, katılımcıların düşük düzeyde eleştirel düşünme (ED) becerilerine sahip olduğunu göstermiştir. Öte yandan tematik analiz iki ana başlık altında sunulmuştur: geleneksel yaklaşım ve eleştirel yaklaşım. Sonuçlar, geleneksel bakış açılarının araştırmaların çoğunda temel yaklaşım olarak yer aldığını, sadece birkaç araştırmada eleştirel yaklaşımın kavramsal çerçeveyi oluşturduğunu göstermiştir. Böyle bir anlayışın, ED'yi bir dizi genel becerilere indirgediğini ve bağlamsal ve bireysel farklılıkları göz ardı ettiğini söylemek mümkündür. Ayrıca bu anlayışın, öğretmen adaylarının toplumlarının dönüşümüne aktif olarak katılan eleştirel eğitimci rollerinin önünde bir engel olabileceği düşünülmüştür.

Anahtar kelimeler: Eleştirel düşünme, eleştirel öğretmenler, öğretmen adayları, sistematik analiz, Türkiye.

Rapid developments and changes in technology and science have brought about a new era: the information age in which the main aim of societies is to keep pace with these changes. This era demands creative and reflective citizens who think, ask questions, do research, seek the truth, and find rational solutions to the problems of the societies (Ennis, 1991; Halpern, 1999). In this regard, the pivotal role of education has been emphasized as training active citizens who are equipped with lifelong learning skills (Keser et al., 2011; Paul & Binker, 1990). Among those skills, critical thinking (CT), as a catalyzer for a democratic society, has of primary importance (Halpern, 1999).

CT is mainly defined as "purposeful, reasoned, and goal-directed. It is the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions." and includes reflecting on the thinking process (Halpern, 1998, p. 70). It is also "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as an explanation of the evidential, conceptual, methodological, criteriological, or conceptual considerations upon which that judgment is based" (Facione, 1990, p. 3). The term CT further embodies reasonable and reflective thinking (Ennis, 2011); analysis of arguments (Bowell & Kemp, 2005; Dellantonio & Pastore, 2021; Ennis, 1985; Paul, 1992, 2011), reasoning and evaluating (Ennis, 1985; Facione, 1990; Halpern, 1997), and making reasonable decisions (Ennis, 1985; Halpern, 1998; Willingham, 2008). What is more is that CT is a process initiated, analyzed, evaluated, reflected, and reconstructed by the individual (Paul & Elder, 2006) to improve the quality of his/her thinking (Scriven & Paul, 1987). Embedded in these definitions, critical thinkers are assumed to use certain skills appropriately and consciously in different contexts (Bailin & Siegel, 2003; Halpern, 1998; Paul & Elder, 2006).

Beyond its definition, CT requires the recognition of when to use critical thinking skills (CTS) and the willingness to employ those skills that refer to critical thinking dispositions (CTD) (Facione, 1990; Harrell & Wetzel, 2015). CTS and CTD are, indeed, different concepts. A critical thinker, who has the ability and is aware of when to use it, might not be willing to engage in such a process which refers to CTD (Halpern, 1998). In other words, different from CTS, CTD is "consistent internal motivations to act toward or respond to persons, events, or circumstances in habitual, yet potentially malleable ways" (Facione, 2000, p. 64). There are seven dimensions of CTD as explicated by Facione et al. (1995): open-mindedness, inquisitiveness, systematicity, analyticity, truth-seeking, self-confidence, and maturity (pp. 6-9).

Given the definitions of CT, it can be interpreted that despite some core elements, there is disagreement regarding the definition of CT due to its complexity and the origins it is rooted in. The above definitions of CT are mainly derived from the fields of philosophy and psychology (Lewis & Smith, 1993). In the field of education, on the other hand, CT traces back to Dewey's works (Ennis, 1991). To date, many scholars have contributed to the field (e.g., Ennis, 2013; Sternberg, 1987). Specifically, scholars have employed various educational interventions to improve CTS and CTD of students and teachers (e.g., Dumitru et al., 2018; Harrell & Wetzel, 2015; Heard et al., 2020; Toulmin, 2003). The prevailing finding of those studies is that when guided by teachers who had training to teach CT, educational interventions are more effective (Abrami et al., 2008). Nevertheless, Sternberg (1987) contends that teacher expectations

and perceptions stand as a barrier to the teaching of CTS. The author also argues that the reasons for the teacher fallacies are threefold. First, teachers underestimate or ignore the idea that teachers can learn from students, as well. Second, teachers mainly manage the process as an instructor rather than a facilitator. Third, they do not accept that there is not a one-size-fits-all approach to teaching CTS; on the contrary, it is a highly context-depended process. These teacher fallacies shift our attention from teachers to teacher education. Put differently, teacher education plays an important role in equipping teacher candidates with skills and knowledge to teach CT (Paul et al., 1997). Nonetheless, in the teaching of CT, higher education institutions mostly adopt an approach that detaches the subject from the context that thinking occurs while underestimating the complex and contingent nature of learning (Danvers, 2018). Therefore, including CT in teacher education programs is not sufficient. Educating future teachers as critical educators who are aware of the power of education as a transformative means (Giroux, 1988) is essential. This requires an alternative interpretation of CT grounded on the tenets of critical pedagogy (Burbules & Berk, 1999).

Status of CT in the Turkish Educational Context

Entrenched with the global developments and changes, the importance of CT is emphasized through two general statements under the purposes of the Turkish National Education:

1. as individuals … who are developed in terms of body, mind, morale, spirit, and emotions, free and with scientific thinking abilities and a wide worldview, … who are responsible toward society, who are constructive, creative and productive

2. in line with their interests and abilities, … to acquire the required knowledge, skills, behavior, and cooperative working habits… (Ministry of National Education, 1973)

In order to accomplish these goals, the formal curricula in Turkey have undergone a major change in 2004. The constructivist approach was adopted in determining the aims and objectives of the curricula at all school levels. Accordingly, teacher education programs were first revised in 2006. It was reported that teacher education programs should meet the requirements that facilitate effective implementation of the formal curricula. Specifically, it was stated that they should help student teachers to develop thinking skills. Most recently, another revision has been done in 2018, including but not limited to, adding "Critical and Analytic Thinking" as an elective course within the scope of professional teaching knowledge. Nevertheless, critical thinking is explicitly emphasized only in Foreign Language Teaching Programs and Gifted Education Teacher Program. This implies that critical thinking is still perceived as a higher-order thinking skill or part of language teaching rather than a competence that each student teacher should possess.

Succinctly, the CT literature has drawn much interest among scholars who see it as significant to the development of their society, though in different forms. A mounting body of literature in Turkey has also included CT as the inquiry unit in which student teachers participated. Nevertheless, most of them employ a quantitative approach to examine CTS and CTD of the participants and generally report low-level CTD (Cansoy

et al., 2018). Therefore, we argue that it is essential to provide a depiction of the existing research, both quantitative and qualitative, to move beyond the CT scores of the participants. In this regard, review studies that evaluate teacher education research conducted in Turkey and relate the emerging knowledge with the international literature have a pivotal role in providing breadth and depth of knowledge in the existing research while offering implications for further research and practice (Yildirim, 2013). Accordingly, this review study aims to bring the studies conducted about CTS and CTD of Turkish teacher candidates together within the last decade from a critical perspective. As the review intends to uncover common and diverging aspects across studies, it might help educators reach more solid conclusions that have implications for educational policy and practice. Also, this study differs from other review studies (e.g., Cansoy et al., 2018) in its methodology and conceptual framework. The following research questions guided our study:

1. What critical thinking areas do the studies in teacher education focus on?
2. What methodological traditions do the studies on critical thinking represent?
3. What are the knowledge claims studies on critical thinking offer for practice and further research?

Conceptual Framework

Two strands in the literature are relevant to this study: "critical thinking movement" and "critical pedagogy". Despite their commonalities, they have distinct aspirations in using the word critical. The former, rooted in the philosophical and psychological orientations, holds a more traditionalist perspective of CT. This perspective is advocated by scholars such as Ennis (1991, 2011, 2015), Halpern (1999), and Halpern and Butler (2019), who argue that CT consists of a set of skills that lead to reasonable decision-making. The word critical, as used by those scholars, refers to "to be more discerning in recognizing faulty arguments, hasty generalizations, assertions lacking evidence, truth claims based on unreliable authority, ambiguous or obscure concepts, and so forth" (Burbules & Berk, 1999, p. 46). Taking this meaning one step further, scholars in this tradition (e.g., Elder & Paul, 2021; Facione, 1990, 2020; Paul, 1981, 2018) add the dispositions aspect to CT, which refers to one's willingness to think critically. Nevertheless, it is argued that both skills-only and skills-dispositions perspectives discern CT as a higher-order cognitive skill (ten Dam & Volman, 2004).

Contrary to the prescriptive perspective in teaching of CT, the critical pedagogy tradition brings a different perspective, and questions the sovereign powers and the belief systems the term "critical" highlights" (Davies, 2015; Davies & Barnett, 2015). The proponents of this perspective argue that other forms of evidence or verification, such as experience and emotions, can also affect one's reasoning (Burbules & Berk, 1999). Furthermore, they assert that the traditional perspective is culturally biased (Sibbett, 2016) and relies on men's ways of knowing in explaining rational thinking (Severiens & ten Dam, 1998). In this context, Paulo Freire and his followers, including distinguished scholars such as Giroux and Apple, assert that Critical Pedagogy aims to create a deliberate consciousness among the public to eliminate any form of marginalization and inequality in societies by emancipating citizens from the chains of the dominant ideology and helping them to transform their societies (e.g., Freire, 2018; Giroux, 1988; Kaplan, 1991). Put differently, beyond positivist perspectives that

downgrade CT into i) a set of skills to improve thinking, ii) problem-solving without asking questions about the problem itself (etc. Whose problem is this?), iii) a process that should be exercised only by the student, iv) and an abstract mode of thinking independent of lives of students and teachers, CT requires informed and committed action (Fernandez-Balboa, 1993). CT, in this perspective, can only be achieved by emancipated teachers whose roles and functions are not defined and determined by the dominant, and are not perceived as technicians who implement, without any conceptualization, the script curricula to transmit knowledge (Giroux, 1985).

Despite the differences explained above, as a common core, both critical thinking, and critical pedagogy perspectives, as Figure 1 displays, involve action, self-reflection and reasoning that define the critical person. They emphasize that the critical person reasons and reflects on his/her reasoning, and then, take the necessary action. The action dimension, though, indicates different intentions. From a traditional perspective of CT, action refers to one's reflecting on her/his reasoning (Davies & Barnett, 2015). According to Critical Pedagogues, on the other hand, action stands for active participation in the transformation of societies toward a democratic society (Sibbett, 2016).

Figure 1

The Intersection between Critical Reason, Critical Self-Reflection, and Critical Action
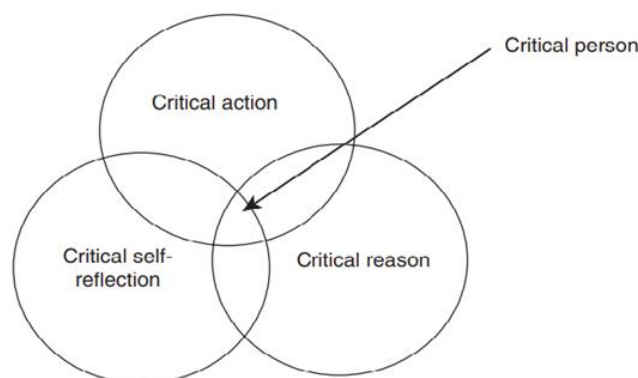
Note. (Barnett, 1997, p. 105).

Whether defined as skill-only or skill-dispositions, educational interventions are found to be effective in teaching how to think critically (Harrell, 2011; Hitchcock, 2015; Jones, 2015; Moore, 2013). Ennis made important contributions in the field of education by introducing four instructional approaches to teach CTS: general, infusion, immersion, and mixed (1989). The general approach indicates direct and explicit instruction in which CTS is emphasized outside the context of a specific subject matter. The infusion approach entails in-depth instruction in the subject matter plus explicit instruction on general CT principles. In the third approach, the immersion approach, CTS is included in the content of the subject matter; however, there is no explicit instruction as in the general approach; that is, students are expected to gain those skills naturally through the instructional process. The last approach brings together the aspects of others with an eclectic perspective.

As the other prolific design, Halpern's four-part model includes "(a) a dispositional or attitudinal component, (b) instruction in and practice with critical-thinking skills, (c) structure-training activities designed to facilitate transfer across contexts, and (d) a metacognitive component used to direct and assess thinking" (1998, p. 451). She enunciates that better thinking can be taught through the means of instruction that allows the transfer of learning to out-of-the-classroom contexts.

Following the critical genre of literature, in this paper, we mainly share the views of critical pedagogues. We accept that teaching to think critically requires the development of certain skills and dispositions and reflecting upon them. Nevertheless, while doing so, we argue that contested issues and multiple perspectives that provide explanations to those issues should be presented. Learners should be provided with opportunities in which they practice critical participation in society. This will enable learners to question the hegemonic powers in society and encourage them to actively participate in opposing injustices in society.

We argue that teachers have a critical role in accomplishing such a goal. They should act as transformative intellectuals who:

> develop counterhegemonic pedagogies that not only empower students by giving them the knowledge and social skills they will need to be able to function in the larger society as critical agents, but also educate them for transformative action. That means educating them to take risks, to struggle for institutional change, and . . . empowering students so they can read the world critically and change it when necessary (Giroux, 1988, p. xxxiii, xxxiv)

It is the key to achieving democratic and just societies since pedagogy is a moral and political practice that mirrors the power relations in society while reproducing certain knowledge as the official one (Apple, 1993; Giroux, 2010). Therefore, as agents of change, teachers should be empowered to resist any kind of oppression that depresses teacher autonomy. Of course, it is not an easy task. Most teacher education programs do not allow for such practices (Kirk, 1986) as "in these programs, teaching is not viewed as a democratizing or counter-hegemonic activity" (Fernandez-Balboa, 1993, p. 68). Therefore, training future teachers as transformative intellectuals who i) are willing to take part in the transformation of their societies and schools, ii) reflect on their pedagogical practice, and iii) encourage students to critically reflect on their learning and experiences (Aronowitz & Giroux, 2003) should be a priority of teacher education programs.

Method

This is a systematic review study. Different from the existing review studies that bring only the quantitative studies together, in this paper, both qualitative and quantitative studies are reviewed to provide a holistic portrayal of the literature (Dixon-Woods et al., 2005). A systematic review is "a systematic process governed by a set of explicit and demanding rules oriented towards demonstrating comprehensiveness, immunity from bias, and transparency and accountability of technique and execution" (Dixon-Woods, 2011, p. 332). Review studies have an important role in advancing our knowledge by providing a holistic depiction of the existing work. They allow the researchers to identify gaps in the literature, test a specific hypothesis and/or develop new theories (Xiao & Watson, 2019). They further act as an information source for

policymakers, researchers, and practitioners when making decisions (Harden & Thomas, 2005).

In this paper, our intention was not to evaluate the quality of the studies we examined (Peters et al., 2015); instead, we aimed to portray the literature on CTD and CTS of pre-service teachers in Turkey. However, in scoping the review, we examined various areas of information specified in each study, including their methodology, findings, and independent variables (Arksey & O'Malley, 2005). Adopting the steps specified by Xiao and Watson (2019, p. 103), we employed the following actions: formulate the problem, develop and validate the review protocol, search the literature, screen for inclusion, assess quality, extract data, analyze and synthesize data, and report findings (Figure 2).

Figure 2

The Steps We Followed in Systematic Review of Research

Formulation of the Problem

Development and Validation of the Review Protocol

Literature Search

Inclusion and Exclusion Criteria and Review Procedure

Data Analysis

Synthesis of the Reviewed Studies and Reporting
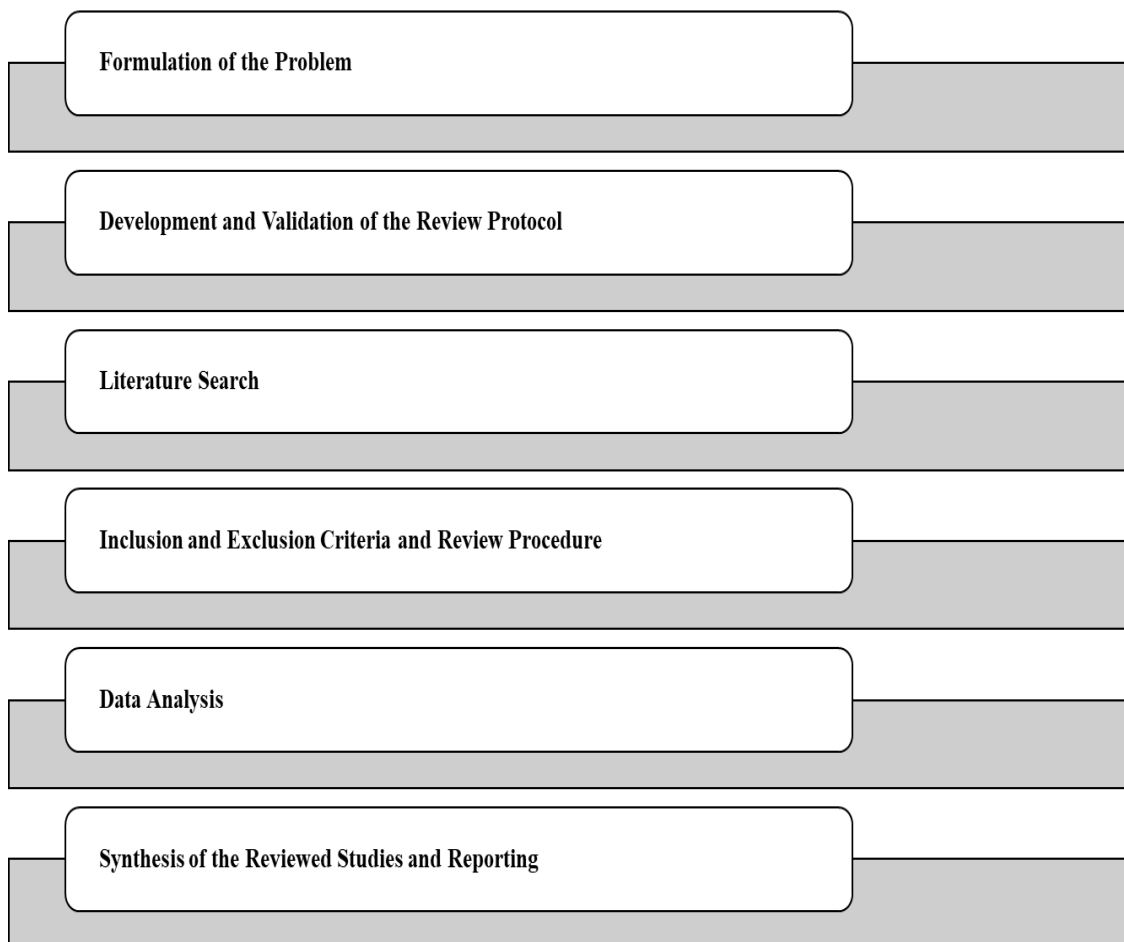
Development and Validation of the Review Protocol

Validity and reliability are of primary importance to be considered in a systematic review. The use of review protocol ensures reviewers conduct a rigorous review (Kitchenham & Charters, 2007) and eliminates researcher bias (Okoli & Schabram, 2010). It also allows other researchers to repeat the study by using the same protocol (Xiao & Watson, 2019). For this reason, one of the authors developed a review protocol that included information regarding i) the purpose of the review and the research questions, ii) inclusion criteria, iii) search strategies, iv) exclusion criteria, and

v) how to synthesize and report the findings. The second author, who is an expert in conducting review studies that are used as a reference source, examined the protocol and the authors both agreed on the information to be included in our review protocol (e.g., inclusion and exclusion criteria)

Literature Search

The educational research regarding Turkish pre-service teachers CTS and CTD was investigated in electronic national and international databases via EBSCOHOST service, Academic Search Complete, Education Source, ERIC, Humanities International Complete, MasterFILE Complete, Social Sciences Index Retrospective, Teacher Reference Center, and TR Dizin. The search was limited to the accessible full-text empirical articles that were published in academic journals. Theses, dissertations, conference papers, scale/rubric development, and program development/evaluation studies were not included for the feasibility of the study. The review was, moreover, restricted to the years from January 2010 to May 2020 to represent a recent portrayal of research conducted about teacher candidates' CTS and CTD within the last decade's educational context in Turkey.

While searching for the available studies, we first used "critical thinking and teacher candidate/pre-service teachers" descriptors. We reached 460 studies. After excluding studies that examine related concepts such as problem-solving and epistemological beliefs, we reached 93 studies written in the Turkish context. In the second search, we utilized "critical thinking skills and teacher candidate/pre-service teachers" as search terms resulting in 150 studies conducted with Turkish teacher candidates. Our search for the terms "critical thinking dispositions and teacher candidate/pre-service teachers," on the other hand, yielded 113 studies. We added eight studies to our search while examining the references of the studies we reached. Then, after a thorough review of the studies we reached, we omitted some of the studies in our review study as they do not pertain to CTS and CTD of pre-service teachers directly (e.g., studies conducted about reflective thinking skills, problem-solving skills, metacognition) or overlap with each other. Finally, we included 88 studies in this present review (Figure 3).

Figure 3

The Literature Review Process
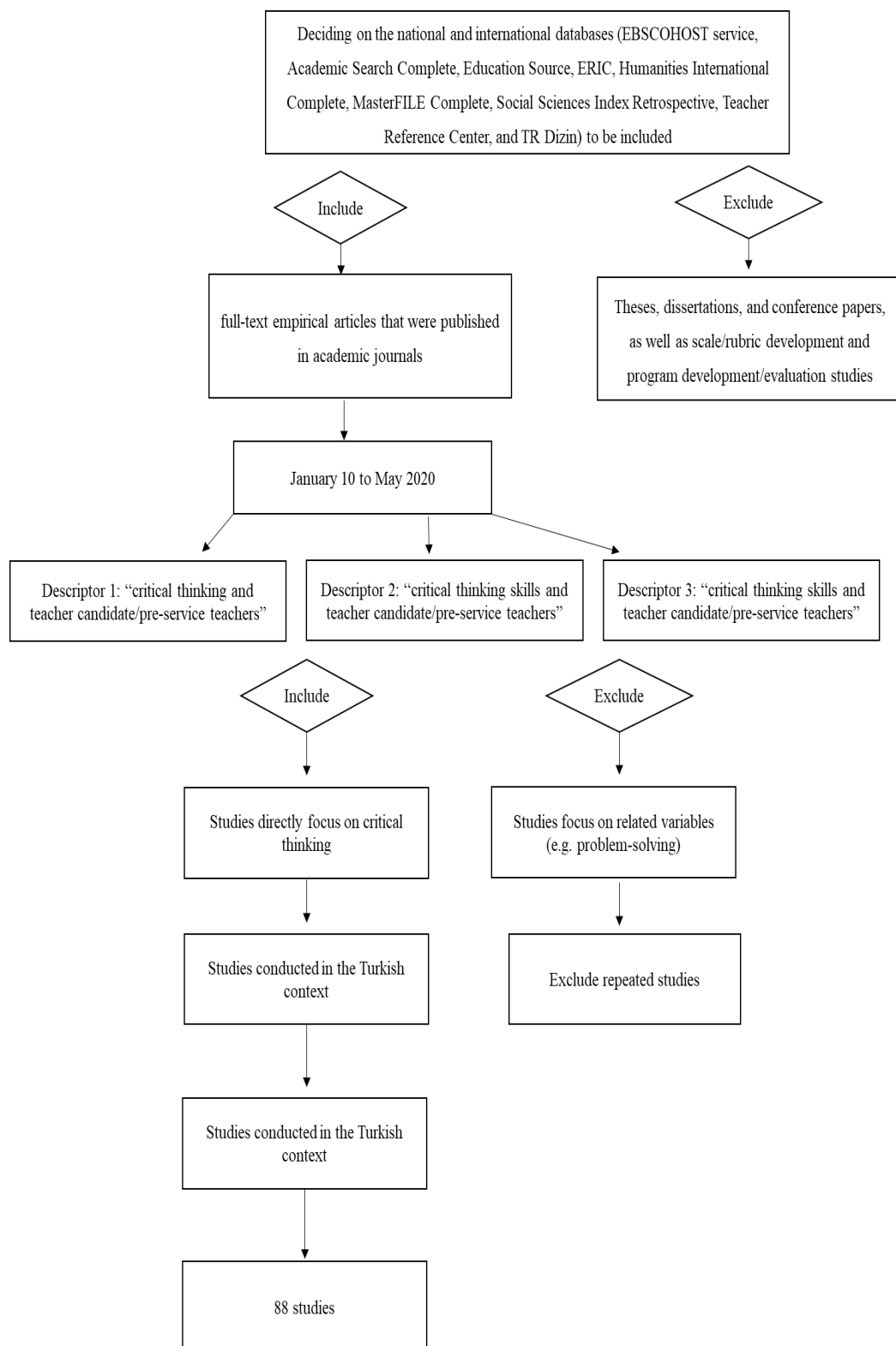
Inclusion and Exclusion Criteria and Review Procedure

This study adopted an eclectic approach to defining CTS and CTD. We define CTS as a set of skills that include critical questioning, analysis, evaluation, making reasonable decisions, and finally, engaging in deliberate action. The term CTD is used to describe the willingness and awareness of using CTS consciously. However, as we detailed above in the conceptual background section, we also add that different than

these definitions, CT requires critical examination of critical issues in societies (e.g., power relations in society) and acting upon them to transform societies.

With these definitions in mind, the authors reached a consensus on the studies included in this review. The following criteria were employed as inclusion criteria:

- ✓ studies conducted years between 2010-2020,
- ✓ studies published in refereed journals indexed in the databases listed above,
- ✓ studies conducted with teacher candidates in Turkey,
- ✓ studies that directly examine CTS and/or CTD of teacher candidates,
- ✓ studies that are designed as survey, correlational survey, longitudinal, experimental, and quasi-experimental research,
- ✓ studies that employ qualitative research methodologies,
- ✓ studies that are written in English or Turkish.

If any of these criteria were not met, we excluded the study in our review. As a result, a total of 88 studies were included in our review (see Appendix for the list of the reviewed studies).

Data Analysis

In this review study, we employed a two-stage analysis. In the first stage, we completed the descriptive analysis of the studies included in this systematic review. In doing so, we examined various information such as the research design, data collection instrument, majors of the participants, variables, and key findings of the studies. Then, we content analyzed the studies to generate codes and themes (Miles et al., 2014) through careful reading of each article and bringing the studies together under relevant themes. In this stage, we completed a thorough examination of the conceptual framework adopted in the reviewed studies. Then, we both generated themes and compared our categorizations. We reached a consensus on the final themes through negotiations and following an iterative process to determine the themes. We list our findings under two main themes: traditional and critical perspectives. The first includes the following categories: CT as a higher-order thinking skill, CT as a self-controlled thinking process, CT as a developing skill, CT as a personal attribute, CT from a functionalist perspective, and CT as part of language skills. The categories CT as part of democratic citizenship and CT as a socially constructed skill are listed under the second theme.

Synthesis of the Reviewed Studies and Reporting

After a thorough analysis of the reviewed studies, we presented both descriptive and thematic findings. While doing so, we provided frequencies when necessary. We tried to follow a reader-friendly flow in our reporting. In the findings section, we presented what we found after reviewing the studies; however, we compared and contrasted our findings with the available national and international studies in the discussion and conclusion section. We also make conclusions considering our conceptual framework.

As for the reporting, we begin with an introduction to CT and its place in the field of education, particularly teacher education. Further, we briefly describe the context in Turkey. Then, we explain the conceptual framework we used to explain CT.

The second section presented the method we used to conduct our systematic review. Then, we reported both descriptive and thematic findings. Lastly, we discussed our findings. This last section made conclusions and suggestions for further research and practice.

Ethical Procedures

Since this is a systematic review study, ethics committee approval is not required. However, the ethical principles and rules in the Higher Education Institutions Scientific Research and Publication Ethics Directives are strictly followed during the study.

Results

This section presents our analysis of 88 studies under two main titles: descriptive results and thematic findings.

Descriptive Results

Under this title, we display the methodology used in the reviewed studies, as well as their key results on CT levels of pre-service teachers.

Research Design of the Reviewed Studies

To begin with the methodological results, our descriptive analysis revealed that most of the studies employed quantitative research designs (see Table 1).

Table 1

Type of Research Designs

Research design	Studies we reviewed
Correlation	1, 2, 3, 7, 11, 12, 13, 16, 18, 19, 20, 23, 24, 28, 32, 34, 35, 37, 40, 41, 43, 46, 47, 48, 50, 52, 54, 55, 56, 60, 63, 65, 67, 68, 70, 71, 72, 73, 78, 81, 87
Survey	5, 8, 10, 15, 21, 22, 25, 27, 31, 33, 36, 39, 45, 51, 53, 58, 62, 69, 74, 76, 77, 79, 82, 84, 85
Experimental	6, 9, 14, 17, 26, 30, 38, 42, 44, 49, 57, 64, 75, 80, 83, 86, 88
Qualitative	4, 29, 59, 61, 66

As displayed in Table 1, almost half of the studies we reviewed were designed as correlational research (n=41). The second most used research design was survey research (n=25). The others employed the following research designs: experimental research (n=17), case study (n=3), longitudinal study (n=1), and action research (n=1).

Participants of the Reviewed Studies

The participants included in the reviewed studies were students of different teacher education programs in Turkey (see Table 2).

Table 2

Participants of the Reviewed Studies

Departments	Studies we reviewed
Faculty of education	7, 8, 12, 13, 18, 34, 37, 48, 56, 62, 63, 67, 72, 73, 74
Primary school teacher education	1, 2, 3, 5, 11, 21, 23, 26, 31, 41, 45, 46, 47, 54, 55, 58, 65, 70, 71, 79
Science education	1, 16, 28, 38, 42, 44, 46, 47, 51, 70, 81, 83, 84
Elementary math education	16, 31, 35, 44, 45, 58, 66, 79, 83, 85, 88
Turkish language teacher education	9, 15, 25, 33, 47, 50, 58, 66, 79
Social studies teacher education	14, 20, 46, 47, 61, 82
Early childhood education	16, 21, 52, 57, 70, 75
English language teaching	17, 40, 77, 86, 88
Computer education and instructional technologies	6, 10, 16, 64, 68
Physical education and sports	19, 24, 54, 79
Religious culture and ethics teacher education	22, 27, 36
Psychological counseling and guidance	32, 65, 79
Biology education	71, 78
Music	53, 69
German language teaching	86
Arabic language teaching	30
Geography teacher education	39
Chemistry education	78
Physics education	78
Secondary school math education	78
History	4
Fine arts education	76
Visual arts education	80
Vocational education faculty students	87
Teacher candidates enrolled in a pedagogical formation program	43
Freshman students taking computing ii course and studying in the faculty of education	49
Pre-service teachers taking an intercultural communication course	59

As displayed in Table 2, the studies we reviewed included various departments to examine the CTS and CTD of the pre-service teachers. Among them, the math and

science departments were mostly involved in the studies. Nevertheless, pre-service teachers from a wide range of other departments, such as early childhood education and visual arts also participated in the research literature we reviewed.

Data Collection Instruments Used in the Reviewed Studies

The main instrument used in most of the studies was the California Critical Thinking Disposition Inventory (CCTDI), developed by Facione et al. (1994) and adapted to Turkish by Kökdemir (2003). There were also other instruments, as displayed in Table 3.

Table 3

Data Collection Instruments Used to Measure CTD of Pre-service Teachers

Data Collection Instrument	Studies we reviewed
California Critical Thinking Disposition Inventory (CCTDI) developed by Facione, et al. in 1994 and adapted to Turkish by Kökdemir (2003)	1, 2, 5, 6, 7, 8, 9, 14, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 30, 33, 34, 38, 39, 40, 41, 42, 43, 44, 45, 51, 52, 53, 54, 55, 57, 60, 62, 64, 65, 68, 69, 70, 72, 73, 76, 78, 79, 80, 81, 82, 84, 85, 86, 87, 88
Critical Thinking Standards Scale for Teacher Candidates' developed by Aybek et al. (2015)	31, 32, 35, 48, 49
Scale of Critical Thinking Tendency, developed by Ricketts and Rudd (2005) and adapted by Demircioğlu (2012)	12, 13
Critical Thinking Scale developed by Özdemir (2005)	15, 46, 50
Critical Thinking Disposition Scale developed by Akbıyık (2002)	23, 47
Critical Thinking Scale developed by Semerci (2000)	11, 67
Critical Thinking Disposition Scale developed by Sosu (2013) and adapted into Turkish by Akın et al. (2015).	56, 63
Scale of Critical Thinking Dispositions developed by Uluçınar (2012).	3
Critical Thinking Scale further developed by Semerci (2016)	77
Critical Thinking Scale developed by Saracaloğlu and Yılmaz (2011)	58
A questionnaire developed by the researchers & Rubric for analysis of the first-hand historical resources	4
Multidimensional 21th Century Skills Scale by Çevik and Şentürk (2019)	10
California Critical Thinking Disposition Inventory (CCTDI) developed by Facione, et al. in 1994	16

California Critical Thinking Disposition Inventory adapted to Turkish by İskifoğlu and Ağazade (2013)	36
CCTDI adapted to Turkish by Ertaş et al. (2014)	37
Cornell Critical Thinking Tests	71
Critical Thinking Skills Scale developed by Yoldaş (2009)	74
Watson-Glaser Critical Thinking Appraisal adapted to Turkish by Çıkrıkçı (1992)	75
California Critical Thinking Disposition Inventory adapted to Turkish by the authors	83
Interviews	17, 38, 59, 66
Pre-service teachers' comments and answers in the online community of practice	44
An open-ended question: "What does the concept of critical thinking mean for you?"	29
Reflective writing assignments	59
Preliminary and final assessment forms consisting of open-ended questions/individual & group reflective diaries.	61

Independent and background variables used in the reviewed studies

Our review of the studies showed that various variables were included as the unit of analysis in relation to CTD of pre-service teachers. They are listed below (Table 4 and Table 5).

Table 4

Independent Variables Used in the Reviewed Studies

Variables	Correlation	
	Significant	Non-significant
Learning style/approach	1, 18, 20, 33, 78, 84	
Metacognitive thinking skills and beliefs / problem-solving skills / locus of control / independent decision-making / reflective thinking	5, 11, 35, 48, 50, 56, 63, 72	
Educational beliefs / educational philosophy/attitude toward the teaching profession	7, 12, 43, 52	7
Reading habit	7, 19, 40, 41, 50, 53	
Media literacy	23, 37	
Academic self-efficacy	48, 56	
Reading strategies	50	
Attitude toward reading humor	74	
Moral judgment	71	

Epistemological beliefs	81	
Environmental ethics approach	70	
Individual innovativeness		68
Leadership orientations	65	
Multiculturalism values	3	
Attitudes toward multicultural education	13	
Empathy	34	
Personal values	60	
Social values	32	
Web 2.0 competencies	73	
Language competences	15	15

The independent variables used in the studies we reviewed are listed above in Table 4. As displayed, learning style/approach, metacognitive thinking skills and beliefs/problem-solving skills/locus of control/independent decision-making/reflective thinking, and educational beliefs/educational philosophy/attitude toward the teaching profession are some of those variables. While some are significantly correlated with CTS/CTD of the pre-service teachers, others reveal any significant relation, at all. For instance, plenty of studies investigated the relationship between learning style/approach/strategies. Among them, four studies (1, 33, 78, 84) report that there is a positive correlation between learning style and CTD scores of the pre-service teachers. However, in one of them (84), it was claimed that the relationship was negative for pre-service teachers with converger learning styles. Adopting a different categorization for learning styles, a study (18) reveals that pre-service teachers with tactile and kinesthetic learning styles had higher CTD scores. In the same study, CTD scores of the pre-service teachers were reported to be positively correlated with adopting a deep learning approach while it is negatively correlated with the surface learning approach. In another study (20), it was disclosed that there is a positive significant correlation between learning strategies (attention, development of short-term memory, retention enhancement, monitoring-guiding, and encoding) and CTD scores of the pre-service teachers. These variables; however, fall short in explaining the context and contingent nature of CT. Henceforth, some of the studies we reviewed also included background variables as the unit of analysis to examine CTS/CTD of pre-service teachers (Table 5).

Table 5

Background Variables Used in the Reviewed Studies

Variables	Correlation	
	Significant	Non-significant
Gender	2, 7, 12, 13, 21, 23, 25, 31, 35, 40, 51, 62, 63, 65, 74, 79, 84, 85, 88	1, 5, 10, 11, 15, 19, 22, 24, 27, 30, 32, 37, 39, 41, 45, 46, 47, 50, 53, 54, 55, 58, 69, 71, 72, 76, 77, 78, 81,

		86
Age	84	1, 16, 27, 30, 53, 65
University	65	1, 5, 50
Grade level	1, 2, 21, 23, 25, 33, 41, 45, 51, 55, 63, 74, 77, 84, 85	5, 7, 10, 11, 12, 13, 31, 32, 34, 35, 37, 39, 50, 55, 58, 62, 65, 69, 78, 79, 81
Achievement level	35, 40, 47, 58, 67, 71, 74, 76, 78	10, 15, 51, 86
Department / Subject area (discipline)	7, 12, 21, 47, 54, 58, 62	13, 27, 31, 34, 37, 40, 46, 65, 71, 76, 86
Department & Grade level	65	8
Success in the school practicum course	88	
Teaching experience		39
Receiving academic guidance from faculty members	5	
Education time (day classes/evening classes)	21	77
The field that pre-service teachers took the university entrance examination	79	
High school type	18, 69	1, 10, 22, 25, 27, 38, 39, 47, 53
Parents' occupation	22	51
Achievement level	35, 40, 47, 58, 67, 71, 74, 76, 78	10, 15, 51, 86
Department / Subject area (discipline)	7, 12, 21, 47, 54, 58, 62	13, 27, 31, 34, 37, 40, 46, 65, 71, 76, 86
Department & Grade level	65	8
Success in the school practicum course	88	
Teaching experience		39
Receiving academic guidance from faculty members	5	
Family income	22	47, 51
Perceived economic status		24, 53
Attitude of the family		24, 53
Number of siblings		22
Authority at home	5	
Place where the participants lived more /lived before starting at the university		22, 32, 65
Born city	22	

Region	22	
Childhood place	27	
Doing sports		24
Internet use		73
Blog use	73	
Daily TV watching		53
Book reading frequency	53	
Newspaper reading frequency	53	

A myriad of background variables used in the studies we reviewed were presented in Table 5. To illustrate, gender was one of the background variables used in the studies we reviewed. Our analysis showed that while gender was a significant determinant of CTD of pre-service in some of the studies (2, 7, 12, 13, 21, 23, 25, 31, 35, 40, 51, 62, 63, 65, 74, 79, 84, 85, 88), more studies did not find any significant difference between gender and CTD scores of the participants (1, 5, 10, 11, 15, 19, 22, 24, 27, 30, 32, 37, 39, 41, 45, 46, 47, 50, 53, 54, 55, 58, 69, 71, 72, 76, 77, 78, 81, 86). In addition, almost two-thirds of the studies that report the significant correlation between the two variables also note that the correlation was significant in favor of female pre-service teachers (7, 18, 21, 23, 25, 31, 35, 40, 62, 74, 78, 79, 84, 88). Competing findings were reported also for grade level, achievement level, department, and other variables listed above in Tale 4. These findings indicate that it is not possible to explain CT by means of a single variable. We need a more holistic approach in the investigation of CT. For instance, the joint impact of independent and background variables might be examined.

CTS and CTD Levels of Pre-service Teachers

CTS and CTD levels of pre-service teachers were also examined in the studies we reviewed (Table 6). Here, it is important to note that although the researchers used the term CTS in their papers, the instruments they used in their studies originally measure CTD. Nevertheless, we presented the findings as they reported.

Table 6

CTS and CTD Levels of Pre-service Teachers

CTS and CTD levels	Studies we reviewed
Low-level	1, 2, 5, 6, 7, 8, 9, 10, 11, 14, 16, 17, 21, 25, 30, 32, 34, 36, 39, 40, 42, 43, 44, 52, 54, 63, 65, 67, 70, 71, 76, 78, 80, 81, 82, 83, 84, 87, 88
Medium-level	3, 15, 18, 19, 20, 23, 24, 26, 27, 28, 37, 41, 45, 55, 60, 62, 69, 73, 74, 77, 79, 85, 86, 88
High-level	12, 13, 22, 26, 31, 33, 36, 38, 46, 47, 48, 49, 50, 51, 57, 58, 64

As demonstrated in Table 6, pre-service teachers have mainly low-level of CTS and CTD. In contrast, less than one of five studies report high-level of CTS and CTD of pre-service teachers.

Results of the Studies that Employ Experimental Research

Our review yielded that some of the studies implemented educational interventions to improve CTS or CTD of the participants. While most of those interventions were reported as effective, some of them disclosed the non-significant impact of the treatment on CTS or CTD of the pre-service teachers (Table 7).

Table 7

Educational Interventions Used in the Reviewed Studies

Educational Interventions	Studies	
	Significant	Non-significant
Critical analysis of first-hand historical resources	4	-
Metacognitive guidance	6	-
Microteaching	9	-
Edward De Bono's skill-based thinking programme and content-based teaching	14	-
WebQuest-supported critical thinking instruction	17	-
Discussion and decision-making based activities	26	-
Online argumentation implementation	38	-
Socioscientific issues based instruction model	42	-
Community service learning	57	-
Video-based Reflection	59	-
Content-based critical thinking teaching on CTS	64	-
The effects of thinking skills education	75	-
The effect of different teaching styles	83	-
The impact of scenario teaching method on CTD	88	-
A program developed by the researcher	-	30
Online communities of practice	-	44
Use of feedback form	-	49
Incorporating critical thinking in the pedagogical content of a teacher education programme	-	86

When we examined these studies, we found that educational interventions were employed within a course. Only a few studies were designed as a separate course or treatment. On the other hand, the treatments were mainly grounded on the tenets of problem-solving or argumentation in order to cultivate CT among the participants.

Thematic Findings

Our analysis of the studies included in this paper yielded two main themes: traditional perspectives and critical perspectives. The first theme is presented under six categories: CT as a higher-order thinking skill, CT as a self-controlled thinking process, CT as a developing skill, CT as a personal attribute, CT from a functionalist perspective, and CT as part of language skills. The second theme is displayed under two categories: CT as part of democratic citizenship and CT as socially constructed skill (Figure 4).

Figure 4

Thematic Findings
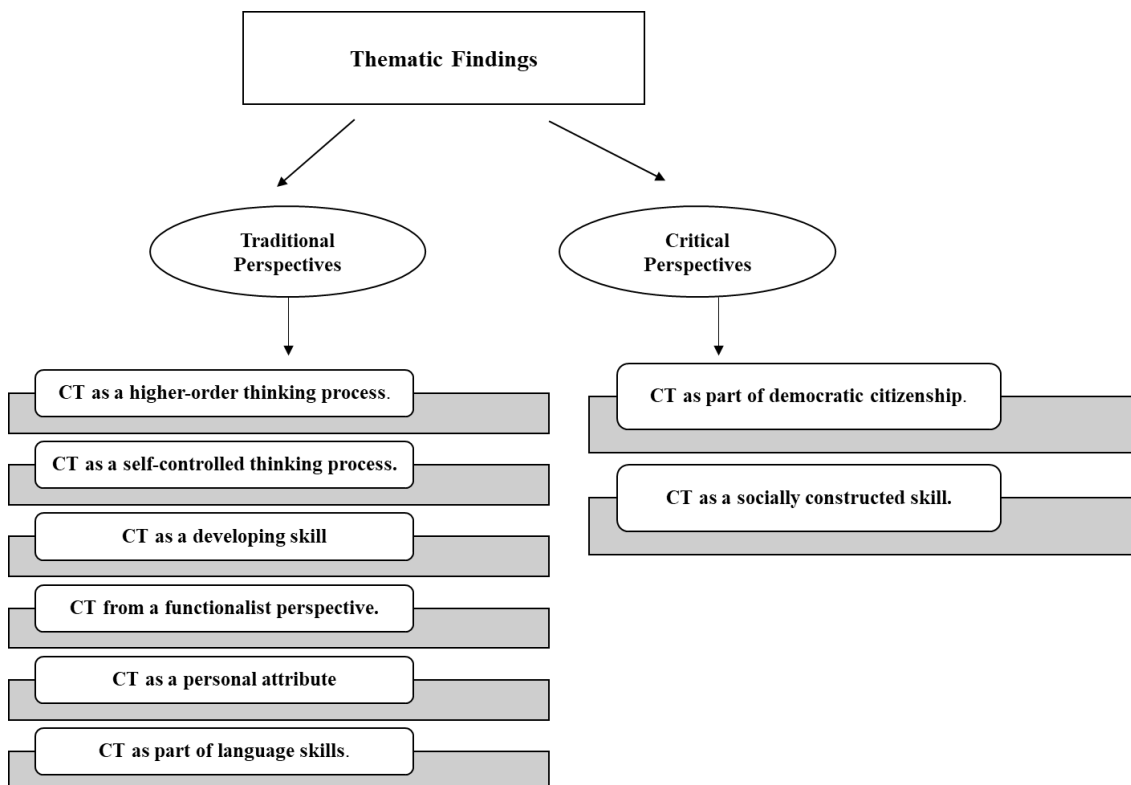
Traditional Perspectives

This theme includes studies that adopt the traditionalist approach to define CT. As defined in those studies, CT is mainly perceived as a cognitive process that includes thinking skills such as reasoning and problem-solving. Although we presented the theme under different categories, it is important to emphasize that those categories are not independent of each other, rather represent interwoven aspects of CT. Therefore, some of the studies are listed in more than one theme.

CT as a Higher-Order Thinking Process. The review results indicated that CT was specified as a higher-order thinking process in almost half of the studies (*n*=37) (9, 11, 12, 14, 17, 21, 23, 24, 25, 26, 27, 28, 29, 31, 32, 35, 36, 38, 41, 45, 50, 51, 52, 55, 56, 60, 69, 70, 71, 72, 74, 76, 77, 84, 85, 87, 88). For instance, in study 14, the CT definition of Facione et al. (1994) was adopted: "higher-order reasoning used in reaching professionally informed judgments in high-stakes, time-constrained, and many

times, novel problem situations" (p. 41). Moreover, some of these studies (e.g. 24, 31, 41, 45, 69) note that CTS, as a higher-order thinking skill, was among the demanding skills of the information era. CTS was also perceived as an important skill in students' learning in some of the studies we reviewed (e.g. 35, 36, 55). On the other hand, in some of the studies (e.g. 1, 52, 57), CTS was claimed to be an essential component of the teacher education programs and the teaching profession.

CT as a Self-Controlled Thinking Process. The findings of our review also reveal that CT is categorized as a self-controlled thinking process. These studies point that CT is a self-organized and self-controlled thinking process that yield a purposeful decision-making (*n*=45) (1, 2, 3, 7, 8, 11, 15, 18, 20, 21, 22, 23, 24, 25, 26, 27, 29, 30, 33, 35, 36, 38, 39, 40, 43, 44, 47, 48, 50, 51, 53, 55, 56, 58, 62, 64, 65, 66, 72, 73, 77, 83, 84, 87, 88). In these studies (e.g., 2, 3, 7, 8, 21, 29), it was reported that CT requires deliberate actions such as problem-solving and seeking evidence and using those skills in different contexts. In other words, as most cited in these studies, CT is an active and organized mental process that enables us to understand our own thinking and decision-making processes). The underlying actions in these definitions include analyzing, rational thinking, seeking evidence, and making informed decisions. Additionally, it is exclaimed that CT is a self-controlled process that also contains one's reflecting on her/his own thinking process and decision (e.g., 72, 73, 87). On the other hand, some of those studies (e.g., 1, 33, 44) underline that CT is an important aspect of teaching and learning because teachers who are aware of their own teaching styles and strategies can effectively organize learning environments. Besides, in study 23, it was claimed that CT is a prerequisite of media literacy as individuals who can think critically, question and seek to understand the causes of events.

CT as a Developing Skill. Another theme that emerged in our review was CT as a developing skill (*n*=69) (4, 6, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 21, 22, 24, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 44, 45, 46, 47, 48, 51, 52, 53, 54, 55, 56, 57, 58, 59, 61, 62, 63, 64, 65, 66, 67, 69, 70, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 87, 88). Almost all of these studies (e.g., 6, 9, 15, 18, 22, 24, 27, 51, 61, 66) emphasize that educating teachers as critical thinkers is instrumental since teachers who have CTS are reported to be more effective in the teaching of CT. Those studies also suggest ways of improving CTS of pre-service teachers. For instance, in study 88, it was reported that CT could be developed through implementing a problem-based learning method in the classes. Similarly, in study 87, it was claimed that incorporating CT in teacher education programs might help pre-service teachers to develop CTD. Another genre of studies listed under this theme draws our attention to the importance of developing CT as one of the 21st-century skills (e.g., 10, 45, 62). Some of the studies (e.g., 11, 14, 21, 26, 47, 58, 63, 79) report that the national curricula in Turkey aim to equip students with CTS. These studies also support the idea that to help students develop CTS, teachers should be educated to have those skills.

CT from a Functionalist Perspective. Our review unveil that a considerable amount of studies adopts a functionalist perspective to explain CT (*n*=39) (2, 10, 12, 22, 23, 24, 27, 28, 29, 31, 32, 34, 35, 36, 37, 40, 41, 44, 45, 47, 51, 53, 56, 58, 60, 62, 63, 66, 68, 70, 71, 75, 76, 77, 80, 82, 83, 84, 85). Almost all of these studies underline that people should have certain skills (mostly referred to as the 21st-century skills) such as CT in order to survive in this information and communication era as a global citizen

(e.g. 10, 22, 23, 24, 27, 28, 29, 31, 35, 36, 37, 40, 44, 53, 63, 77). It is further noted that individuals with CTS contribute to social and economic development of their society (e.g. 2, 12, 28, 60). Built on this assumption, CTS and CTD are perceived as vital skills demanded in the market (34, 37, 75, 85). In this regard, teachers are attributed a critical role in developing students' CTS and CTD (32, 56, 68, 82).

CT as a Personal Attribute. Contrary to those studies that perceive CT as a developing skill, some of the studies (1, 5, 7, 18, 27, 43, 52, 54, 56, 68, 76, 78, 81, 85) define CT as a personal attribute. These studies mark that individual differences are important in CTD (e.g., 1, 7, 56, 76). Some of them contend that CTD is a gender-related personal attribute (e.g., 27, 45, 78). Besides, those studies address that teacher characteristics affect the efficiency of teaching-learning processes, particularly in the teaching of CTS (e.g., 1, 52).

CT as Part of Language Skills. The last category under traditional perspectives is CT as part of language skills. These studies note that CTS is critical in acquiring language skills (15, 16, 33, 40, 50, 54, 59). For example, it was argued that teacher candidates' CTS is significantly correlated with their self-efficacy beliefs in reading and speaking skills. In study 33, furthermore, it is claimed that CTS has an important role in teaching basic language skills (reading, writing, listening, speaking).

Critical Perspectives

This theme represents the views that are relatively critical in their approach to CT. Two categories are displayed under this theme: CT as part of democratic citizenship and CT as a socially constructed skill.

CT as Part of Democratic Citizenship. The review results show that CT was defined as part of democratic citizenship in some of the studies (3, 13, 14, 27, 39, 42, 51, 62, 71, 78, 82). These studies emphasize that citizens who can think critically contribute to the development and sustainment of democratic societies (e.g., 27, 39, 62) since they do not have dogmatic thoughts yet are socially responsible and willing to take action (39) through applying various CTS such as constructing their own thoughts, seeking for evidence, and evaluating information to make informed decisions. The studies also remark that teachers play a critical role in educating students as critical thinkers who ask questions, are open-minded, and are aware of real-life issues (e.g., 51, 82). In one of these studies (13), multicultural education was enunciated as part of democratic citizenship education that prioritizes democratic values, cultural pluralism, and social justice, all of which can be achieved by educating critical thinkers. Another study (71) argued that democratic citizenship requires CTS and moral judgment competences. The author explicates that in this era, these skills are crucial in creating an ethical world culture.

CT as a Socially Constructed Skill. We reviewed a few studies that designate CT as a socially constructed skill (5, 13, 39, 40, 48, 52, 82). These studies remark that social factors influence CTS and CTD of pre-service teachers. For instance, it was delineated that the culture individuals are born and grew up shapes CTS and CTD of individuals (13, 40). Other studies draw our attention to the family background (39, 52, 82), media and political authority (39), interaction among individuals (48), and socioeconomic status (82) as background variables that impact CTS and CTD of pre-service teachers.

Discussion and Conclusion

CT is one of the pivotal skills of the 21st century that enables individuals to ask questions and make reasonable decisions. Schools, in this regard, are accepted as the key institutions in which the youth learn how to think critically through engaging in an organized process and teachers are attributed a critical role in facilitating that process (Lewis & Smith, 1993). The process is also highly dependent on teachers being trained on the teaching of necessary skills (Kong, 2001). Inherent to this argument, teacher education programs attempt to integrate CT into their curricula to furnish future teachers as critical thinkers. This systematic review aimed to situate the current literature on CTS and CTD of pre-service teachers in Turkey and make connections for further research and practice.

A salient finding of our review was that despite the growing attention of CT in teacher education, pre-service teachers in Turkey have mainly low- or medium-level of CTS and CTD. Both traditional and critical perspectives explicate their arguments for the low level of CTS and CTD. From the traditionalist perspective, the endurance of low-level CT is two-fold. The first is derived from the inadequacy of educational experiences in leading to higher-order thinking skills (Lai, 2011; Paul, 1992). This problem directs our attention to the curricula and mundane practices at the school and classroom levels and how or whether they foster CT. The second is related to the educators' lack of a "knowledge base with respect to thinking skills and the mechanisms that govern their development" (Kuhn, 1986, p. 496). This statement urges a need for designing teacher education programs to empower teacher candidates as critical thinkers and provide learning environments in which they learn how to integrate those skills and dispositions into their teaching. On the other hand, from a critical perspective, it is argued that CT embraces a more holistic meaning than it is defined by positivist perspectives (Burbules & Berk, 1999). It requires providing learners and educators with opportunities in which they realize and question power relations in their society to change them (Sibbett, 2016). In the case of student teachers, we argue that teacher education programs should foster teacher intellectuality by enabling them to discuss and reflect on critical issues in their society. We should also teach them how to remove the barriers restricting teacher autonomy, such as high-stakes testing (Apple, 2001; Au, 2009).

Another important finding was that, adopting the traditional perspective, most of the papers employed quantitative methods in their research design. Among them, correlational and survey studies dominate the field, and only a few studies adopted a qualitative approach. In recent reviews of CT tendencies (Cansoy et al., 2018; İşlek & Hürsen, 2014), similar findings were reported. The international literature also supports these findings (Abrami et al., 2008; Pithers & Soden, 2000). These studies mainly adopt a generalist view that defines CTS as a set of generic skills that can be applied to any context (Davies, 2011).

Entrenched with the domination of quantitative research methods, we found that mainly standardized tests or surveys (i.e., California Critical Thinking Disposition Inventory, Watson-Glaser Critical Thinking Appraisal, and Cornell Critical Thinking Tests) were used as the data collection instrument. In their review of CT assessment in higher education, Liu et al. (2014) report identical findings. They list the widely used instruments as California Critical Thinking Disposition Inventory, Watson–Glaser

Critical Thinking Appraisal, Ennis–Weir Critical Thinking Essay Test, and Cornell Critical Thinking Test. Nevertheless, the use of these instruments may not yield reliable and valid results for every context (Moss & Koziol, 1991). In his early research, Ennis (1964) draws our attention to subject-specific assessment. He explicates that subject-specific tests should be developed since CT is, to some extent, a field-specific ability. Supporting him, Facione (1990) remarks that focusing on only the skills falls short in capturing the fullness of CT. He further recommends that:

> Different kinds of instruments should be employed, depending on which aspect of CT is being targeted and where students are in their learning -the introductory stage, the practice stage, the integration stage or the generalized transfer stage. Although the veteran CT instructor can assess students continuously, CT assessment should be made explicit to reinforce its worth in the eyes of the students, their families, and the public. It should be made explicit to support the goals of educators seeking to improve the curriculum. And it should be made explicit to properly inform educational policy formation (pp. 35-36).

Hereof, Lai (2011) draws our attention to the various challenges in assessing CT and suggests alternatives such as the use of i) open-ended questions instead of multiple-choice items, ii) authentic problem contexts, iii) ill-structured problems, and iv) materials that require judgment.

Due to the challenges in assessing CT, a genre of literature examines the relationship of CT with some other variables to better understand the nature of CT. In our review, we realized that both independent variables, that are accepted as part of higher-order thinking (i.e., metacognition, problem-solving, etc.), and background variables (i.e., gender, grade level, etc.) were investigated in relation to CT. Metacognition was one of those variables. It is defined as "the knowledge and control children have over their own thinking and learning activities" (Cross & Paris, 1988, p. 131). It requires one's awareness of own thinking (Hennessey, 1999). By definition, it is widely used in the studies we reviewed and in the international literature (e.g., Halpern, 1998; Kuhn, 1999; Sternberg, 1986). This strand of literature presents metacognition as an umbrella term that captures CT. Nevertheless, some studies address CT and metacognition as interrelated but distinct constructs (e.g., Lipman, 1988; McPeck, 1990).

Creativity was another independent variable that made connections to CT in our review and international literature (e.g., Bonk & Smith, 1998; Ennis, 1985; Paul & Elder, 2006). It is argued that "critical thinking without creativity reduces to mere skepticism and negativity, and creativity without critical thought reduces to mere novelty" (Paul & Elder, 2006, p. 35). In the studies we examined, the other most used variable as the unit of analysis in relation to CT was problem-solving. The international literature (e.g., Fisher & Scriven, 1997) reports that since problem-solving is a process in which one engages to solve an unfamiliar situation, it is an important aspect of CT. Nonetheless, it is important to differentiate CT from other forms of thinking. Bailin and Siegel (2003) criticize the psychological view to explain CT in many ways. First, the authors list, it is almost impossible to claim a correlation between mental operations and good thinking. Second, CT does not refer to performing a predetermined set of procedures rather it is contextual. Third, the terms used to define CT refer to tasks requiring thinking. Considering these arguments, investigation of CT as a stand-alone phenomenon that is closely related to forms of higher-order thinking is essential. Such a

perspective will be useful in understanding the context-dependent and complex nature of CT.

Moreover, a growing body of literature has used background variables to contribute to the field. The study of the background variables is important to understand how individuals with different backgrounds engage in CT and how CT becomes part of their identity (ten Dam & Volman, 2004). Chief among those variables is gender. Our review yielded conflicting results, in this context. In 52 of the studies that included gender as the unit of analysis, more than half of the studies reported the non-significant effect of gender. This finding is supported in a previous review of teacher candidates' CTS (Cansoy et al., 2018). Likewise, Üredi and Kösece (2020) recently reported the non-significant impact of gender on CT. In contrast, the significant effect of gender was reported in 22 of the studies we reviewed. An intriguing finding was that contrary to the studies that claim the possible gender bias in favor of males (Wheary & Ennis, 1995), more than half of those studies found a significant difference in favor of females. In explaining this finding, we refer to Belenky et al. (1986). The authors remark that CT does not fit in the woman's way of knowing as an androcentric concept. Women, rather, prefer connected knowing that enables one to think beyond her/his knowledge, share and collaborate. The nature of women's knowledge, in this regard, enables women to think of alternatives and reflect on their thinking that is part of CT. This fact might explain the significant, though slight, difference in CTS between female and male students.

Some of the other background variables included grade level (significant, $n=15$; non-significant, $n=21$), achievement level (significant, $n=9$; non-significant, $n=5$), department (significant, $n=7$; non-significant, $n=10$), age (significant, $n=1$; non-significant, $n=6$), high school type (significant, $n=2$; non-significant, $n=9$), and family background (significant, $n=4$; non-significant, $n=8$). As the results indicate, it is not possible to claim that a single variable, no doubt, explains CT. According to Roohr et al. (2019), there are both individual and institutional variables that affect CT of students in higher education. The authors assert that institutional variables such as student-faculty ratio explain 15% of the variance between estimated CT scores, while demographic variables such as gender and race all added less than 2.5% variance. Indeed, the inconsistent results might be attributed to the complex nature of CT. Other factors should be investigated about CT to capture the fullness of CT. In this regard, Gellin's (2003) meta-analysis reveals that factors such as involvement in clubs/organizations and peer interaction might influence CT of students. Likewise, it is noted that out-of-class activities are likely to foster CT of college students (Twale & Sanders, 1999). This finding implies that teacher education programs can integrate these promising learning experiences to foster teacher candidates' CT.

Considering the findings mentioned above, it is possible to conclude that the complexity of CT does not allow for robust findings across studies. The predicament in understanding CT has directed scholars to find effective ways of teaching CT. In our review, 17 studies employed experimental research designs to empower teacher candidates as CT. The treatments include but are not limited to metacognitive guidance, microteaching, Edward De Bono's skill-based Cort1 thinking program, WebQuest-supported critical thinking instruction, and discussion and decision-making-based activities. Most of those treatments are found to be effective in fostering CT. The

common features of these studies can be listed as i) empowering students to discuss, analyze, and reflect on their thinking, ii) fostering peer interaction, and iii) enabling the participants to practice the theoretical knowledge. The other characteristic these studies share is that the treatment is implemented within an existing course. Supporting our interpretation, it is claimed that a collaborative or cooperative learning environment fosters CT (Bailin et al., 1999; Bonk & Smith, 1998; Paul, 1992; Thayer-Bacon, 2000). In their review, Pithers and Soden (2000) report the consensus among scholars about the effectiveness of learning environments in which learners construct and reflect on their learning, as well as develop metacognitive knowledge and skills. Specifically, Dennick and Exley (1998) note that small group teaching is effective in enhancing CT. Similar procedures, including fish bowling, the creative-controversy model, are promoted by Baloche et al. (1993). The authors argue that cooperative learning environments lead to improvement in CT.

Given the contradictory results regarding the effective teaching of CT, it is possible to conclude that although it is evident that certain learning activities such as discussion and collaboration foster CT, there is not a standardized way of teaching for CT. In his prolific article, Willingham (2008) asks and answers why it is so hard to teach CT, so here it is worth quoting him:

> First, critical thinking (as well as scientific thinking and other domain-based thinking) is not a skill. There is not a set of critical thinking skills that can be acquired and deployed regardless of context. Second, there are metacognitive strategies that, once learned, make critical thinking more likely. Third, the ability to think critically (to actually do what the metacognitive strategies call for) depends on domain knowledge and practice (p. 26)

That is, the context-dependent nature of CT should be considered in the teaching of CT and learners should be empowered to apply the strategies they learn. Further, it is important to note that CT also embraces certain attitudes and values, as well as the willingness to think critically. Therefore, CT can be categorized as a competence rather than a set of generic skills.

Our review mainly yields that CT is defined from a traditionalist perspective in most of the studies focusing on CT as a higher-order thinking process, a self-controlled process, a developing skill, a functionalist perspective, a personal attribute, or a part of language skills. These studies presume that CT is one of the key, the topmost, skills that require higher-order thinking (Doğanay et al., 2007; Seferoğlu & Akbıyık, 2006; Semerci, 2000). CT as a self-controlled process was also investigated in most of the studies we reviewed. Earlier research in the Turkish context also defines CT as a disciplined and self-controlled thinking process (Gök & Erdoğan, 2011). Similarly, in defining CT, Kuhn and Dean (2004) emphasize being aware of one's own thinking and reflecting on the self-thinking and others' thinking as well.

Our review shows that CT is also perceived as a skill that can be developed. These studies note that one can develop CT through attending educational settings that promote CT (Doğanay &Yağcı, 2011; Halpern, 2001). Those studies attribute teachers to a critical role (Evans, 2010; Paul et al., 1997). They also mark that it is therefore important to train pre-service teachers as CT. In this regard, the Turkish Council of Higher Education (TCoHE) has also revised the teacher education programs to integrate CT into the programs in 2006.

From a functionalist perspective, CT is accepted as one of the pivotal skills of the 21st century. This perspective is based on the assumption that individuals who can think critically can contribute to the development of their society; henceforth, CT is listed among the topmost skills all professions require. In their influential report, Casner-Lotto and Barrington (2006), in collaboration with the Conference Board, Corporate Voices for Working Families, the Partnership for 21st Century Skills, and the Society for Human Resource Management, remark that although the three Rs remain important to a new beginner, applied skills such as Teamwork/Collaboration and Critical Thinking are listed as critical indicators of success at work. This shifts our attention to the role of education in the teaching of CT. Educating active citizens cannot be achieved without critical teachers. Therefore, CT is stated as one of the key teacher competences that should be part of teacher education and professional development (European Commission, 2013).

Another strand in our review addresses CT as a personal attribute. These studies claim that critical thinkers think differently than those who do not think critically. They tend to look behind the scenes, search for further information to reach the truth, and are willing to provide solutions to the problems they face (Özdemir, 2005). This reminds us that CT is a thinking process in which skills and personal traits are interwoven. Supporting these assumptions, Siegel (1999) remarks that having skills does not guarantee their application. Put differently, CT require not only certain skills but also the awareness of when to use those skills and willingness to use them (Facione, 2000; Halpern, 1998).

The studies viewing CT as a part of language skills argue that the development of language skills and CTS are highly correlated (e.g., Moore, 2011) since critical thinkers are aware of their progress and are more autonomous in language learning (Atkinson, 1997). Much of the existing scholarly work examines CT in relation to writing and reading skills (e.g., Auerbach & Paxton, 1997; Daud & Husin, 2004). These studies indicate that there are CT and language skills at the core of higher-order thinking. On the one hand, the development of language skills is dependent on CTS which enables one to understand and make inferences. On the other hand, CT requires effective use of language skills in communicating thoughts.

Despite the prevailing impact of the traditional perspective, critical voices have also been included in the academic sphere. According to Farber (1991), the traditional perspective of CT set boundaries between the truth and the self in the name of objectivity while underestimating emotional and physical aspects of thought. Echoing Farber's arguments, Fernandez-Balboa (1993) problematizes the taken-for-granted interpretations of CT. In doing so, the author asks a list of questions such as:

> Who determines what phenomena, situations, questions, or problems need to be critically examined? ...When we talk about available information, whose information are we referring to? ...When we say that a particular phenomenon is being convincingly justified, according to whose viewpoint or standard would it be convincing or justified? (p. 63)

These criticisms open new rooms in the scholarly literature while allowing for flexibility in the interpretation of what CT is. Democratic citizenship, amongst the critical perspectives, embraces that CT is a key aspect of democratic societies (Facione, 1990) since individuals who can make informed decisions can contribute to the development of democracy (Paul et al., 1997). This is where democratic competence, as

defined in the Reference Framework of Competences for Democratic Culture (Council of Europe, 2018), and CT overlap. Here, it is important to underline that although traditional perspectives of CT mention democratic citizenship, our categorization fits under the critical perspectives since, while talking about democratic citizenship, we not only refer to pluralism or voting but also do capture the solidarity and commitment to social justice, as Sibbett (2016) puts it. Following the critical educators, we contend that schools are political, moral, social, cultural, and instructional institutions in which students learn how to participate in the building of a democratic society as active transformative agents (Apple & Beane, 2007; Giroux, 2010). Accordingly, empowering teachers as transformative intellectuals, in Giroux's (1988) terms, who create learning environments in which critical problems of society are presented and students exchange ideas with an awareness of multiple perspectives, is crucial. Put differently, teachers who are trained to think critically as part of intellectuality can foster students' CT and stimulate student engagement in solutions to the critical problems of their societies.

CT as a socially constructed skill under critical perspectives, views CT as a skill that is dependent on the social environment and the culture we interact with. Contrary to the traditional perspectives that attribute certain personal and genetic characteristics, this strand of literature puts that background variables such as family background are influential in one's ability to think critically. Atkinson's (1997) depiction of CT embraces supportive arguments. He exclaims that CT is a covert social practice and it is culture-dependent by writing that:

> what we commonly refer to as critical thinking maybe an organic part of the very culture that holds it up as an admirable achievement—more at the level of common sense than a rational, transparent, and—especially—teachable set of behaviors. (p.72)

This is important in two ways. First, the culture-dependent nature of CT limits the one-size-fits-all approach to thinking critically. That is CT can be better improved by considering the individuals' social/economic/cultural background. Heath's (1983) iconic study of middle-class children's early socialization provides evidence for this assumption. She reports that nonmainstream groups have difficulties in issues such as asking and answering questions in general, why, and how questions in particular, which results in failure in the classroom. Put differently, despite the traditional approach that casts certain individual attributes (e.g., gender and race) as indicators of better CT, her study bespeaks re-conceptualization of CT considering the social environment we are destined that causes "inequality at the starting gate" (Lee & Burkham, 2002).

Second, if CT is a socially-constructed skill, we should re-consider the aim of education in general, and the role of schools in particular. In his monumental "Class, Code, and Control," Bernstein (2003) depicts that schools reproduce class differences as "…children's consciousness is differentially and invidiously regulated according to their social class origin and their families' official pedagogic practice." (p. 206). His arguments become more visible in regards to CT that students of poverty are hardly expected to think critically at home. Moreover, schools reproduce their class while pacing/sequencing rules legitimize the schools' dominant pedagogic code. If we want our students to think critically, we should transform our schools to provide equality of educational opportunities to each student, other than designing them as institutions where students learn social norms and values; social coercion is secured; and division of labor is ensured. Nevertheless, this is not a taken-for-granted aim of education. Paulo

Freire (2018) remarks that there are some drawbacks in front of teachers and students critically. Teachers, Freire explains, are afraid of losing their job, being alone, and oppression by the dominant groups. Similarly, he continues, the students feel the pressure of the standardized tests and are obliged to develop certain skills and knowledge starred in the market to be employed right after graduation. One way of transforming schools as agents of change is to enable teachers and students to develop critical consciousness. This can be achieved only by teachers and students who question the sovereign powers and aim to build a just society. Therefore, re-designing teacher education programs is important to reflect those assets of CT.

As a corollary, our review unveils that the traditional perspectives dominate the field. Inherent to these standpoints, the studies mainly employ quantitative research methods and use ready-made scales to measure CTS and CTD of pre-service teachers. These studies report the low level of CTS of the participants. Furthermore, adopting the traditional perspective, most of the studies used independent and background variables in their unit of analysis to explain CT. These findings indicate that CT is mainly perceived as part of higher-order thinking that downgrades CT into a set of generic skills that are easily measurable. CTS is also defined as rational thinking and reasoning that reflects man's way of knowing. We further mark that the overemphasis on rationality attributes certain personality traits as indicators of being better at thinking critically. It also neglects the role of the social and cultural environment we are destined in shaping our ways of thinking. Although some studies utilize socioeconomic status or family background in relation to CT, they use numeric data in their explanation. To us, nonetheless, cultural habitus embraces a more complex meaning than presented through numbers. For instance, linking the number of books we read in a month might provide insights about CT but do not explain critical questions such as how we interact with books and why we read books.

In order to overcome the aforementioned problems, we should first change the way we define CT. That is, we should push the boundaries of the prescriptive perspective and capture a holistic perspective of CT by appreciating different forms of thinking and cultural influence on individuals' ways of thinking. Further, as critical educators, we should "construct an emancipatory curriculum which legitimates the postmodern condition of mass culture in order to help students both criticize and transcend its most disabling conditions." (McLaren & Hammer, 1989, p. 55). Critical pedagogy, in this regard, can help produce counter views to hegemonic meanings since:

> The future does not belong to those who are content to remain as they are, and who unwittingly unlearn the meaning of hope, but to those who can think and act as critical re-makers of history, and who choose to do so. (p. 56)

Therefore, we should redesign teacher education programs in order to train our future teachers as critical educators. We should explicitly include CT in teacher education programs by incorporating alternative content, classroom activities and assessment methods.

Implications

Regarding future studies, we urge curriculum development studies at teacher education programs with an emphasis on critical perspectives of CT. This will help educate pre-service teachers as critical educators to educate their students as critical

thinkers who actively participate in transforming their societies. Second, available empirical research was mainly short-term projects. There is a need for longitudinal studies since CT is not a ready-to-develop skill. Personal characteristics, cultural differences, and educational experiences are some of the predicaments behind thinking critically. To handle these barriers, educators need more time than a school semester. Besides, those studies mainly adopt the traditional perspective of CT. Future research might be formulated considering the critical perspectives of CT that emphasize critical participation in social practices. In this way, teacher candidates would be given the opportunity to experience critical agency in which they reflect on problems that are relevant to their cultural and personal identity. Such research would also allow us to (re)think about our educational practices that superior certain identities over others in terms of CT and change them to reflect an inclusive approach that favors pluralism and different modes of thought.

Statement of Responsibility

This article was written by two authors. The aim and scope of this study were determined by two of them. The conceptualization of the study was also completed by the two authors. The first author was responsible for the review of the studies to be included in the study, analysis of the studies, and writing original draft. The second author provided feedback for the methodology and analysis. He also reviewed and edited the original draft. The final version of the paper was prepared by the two authors.

Conflicts of Interest

The Authors declare that there is no conflict of interest.

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Ali Yıldırım is a full professor at University of Gothenburg Faculty of Education Department of Pedagogical, Curricular, and Professional Studies. His current research focuses on teacher education, teaching-learning processes and curriculum studies. He is the contact person for Didactic classroom studies research environment, and the research leader of a SRC funded project on development of novice teachers´ assessment literacy. The courses he teaches focus on theories and methods in educational sciences. He has been involved in the past ten years in numerous European Union Projects that focused on active citizenship, lifelong education, climate friendly schools, educational networks and assessment of informal learning outcomes. The most recent project, GREEN, aimed to establish a network among European schools on climate change education, and his current research on network learning is an extension of the activities of this project. He also served as curriculum development and research consultant at three large scale World Bank funded education development projects in Turkey.

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Appendix

List of the Reviewed Studies

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An Evaluation of the Preservice-Teacher Training for Children's Literature and Mathematics Integration[*]

Matematik ve Çocuk Edebiyatını Bütünleştirmeye Yönelik Hizmetöncesi Bir Öğretmen Eğitiminin Değerlendirilmesi

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ABSTRACT: This study aims to examine the change in intentions and views about the integration, mathematics teaching self-efficacy, and mathematical literacy self-efficacy after an online education about mathematics and children's literature to pre-service pre-school, primary school, and elementary mathematics teachers. The research participants consisted of fifty-four pre-service teachers who were selected by convenient sampling. A weak experimental pre-test and post-test design without control group was used. The data collection tools were the belief scale for the integration of mathematics, and children's literature, mathematics teaching self-efficacy belief, mathematics literacy self-efficacy scales and an open-ended question. The study findings revealed that the training enabled the pre-service teachers to gain positive inputs within the context of all the variables. Besides, the pre-service teachers' scores varied across their branches. A significant difference was identified between pre-service elementary mathematics teachers, and primary school and pre-school teachers in terms of the difference scores on intentions about integration. There are statistical differences between mathematics teaching self-efficacy and mathematical literacy self-efficacy pre-test and post-test scores. For further studies, various studies such as face-to-face, experimental studies on a single branch basis, may be conducted to examine the changes in beliefs and competences of pre-service teachers about mathematics and children's literature integration.

Keywords: Beliefs, children's literature, mathematics education, teacher training.

ÖZ: Bu çalışmada okul öncesi, sınıf ve ilköğretim matematik öğretmen adaylarına verilen matematik öğretimi ve çocuk edebiyatı bütünleştirmesine yönelik bir çevrimiçi eğitim sonrasında öğretmen adaylarının bütünleştirme niyetleri ile görüşlerinde, matematik öğretimi özyeterliklerinde ve matematiksel okuryazarlık özyeterliklerinde meydana gelen değişimin incelenmesi amaçlanmıştır. Araştırmanın katılımcıları uygun örnekleme ile belirlenen 54 öğretmen adayıdır. Araştırmanın deseni ön test son test kontrol grupsuz zayıf deneysel desendir. Veri toplama araçları matematik öğretimi ve çocuk edebiyatı bütünleştirmesine yönelik inanç, matematik öğretimi özyeterlik inanç ile matematik okuryazarlığı özyeterlik ölçekleri ve açık uçlu bir sorudur. Bulgulara göre verilen eğitim, öğretmen adaylarının araştırma kapsamında incelenen tüm değişkenler bağlamında olumlu yönde kazanımlar elde etmelerini sağlamıştır. Ayrıca öğretmen adaylarının ölçeklerden elde ettikleri fark puanlarının alanlara göre değişkenlik gösterdiği görülmüştür. Buna göre ilköğretim matematik öğretmeni adaylarının bütünleştirme niyetine ilişkin inançlarının sınıf ve okul öncesi öğretmeni adayları ile istatistiksel olarak anlamlı bir farklılık gösterdiği belirlenmiştir. Matematik öğretimi özyeterliği ile matematiksel okuryazarlık özyeterliği ölçeklerinden elde edilen ön test son test puanları arasında istatistiksel olarak anlamlı bir farklılık bulunmuştur. İleride yapılacak araştırmalar için daha uzun süreye yayılmış bir eğitimle, tek bir alan bazında, yüz yüze ve tam deneysel çalışmaların gerçekleştirilmesi ve öğretmen adaylarının matematik ve çocuk edebiyatını bütünleştirmeye yönelik inançları ile yeterliklerinde meydana gelen değişimin incelenmesi önerilebilir.

Anahtar kelimeler: Çocuk edebiyatı, inançlar, matematik eğitimi, öğretmen eğitimi.

The integration of children's literature and mathematics is an approach in which literary products are used in mathematics teaching (Forbringer, 2004). This approach allows considering individual differences in mathematics teaching by using children's books (Forbringer et al., 2016). Considered as teaching mathematics through children's books in the relevant literature, this approach benefits teachers and students in various ways (Edelman et al., 2019; Ginsburg & Uscianowski, 2017; Jett, 2018; Young & Marroquin, 2006). The integration of mathematics teaching and children's literature contributes to the connection of mathematical concepts with each other and with daily life (Columba et al., 2005), the introduction of mathematical concepts (Wallace et al., 2006), the concretization of abstract concepts (Barone, 2011), the development of mathematical language (Hassinger-Das et al., 2015), relieving mathematics anxiety through methods such as bibliotherapy (Furner, 2018; Green, 2013), increasing students' interest in mathematics (Luedtke & Sorvaag, 2018), changing the students' attitudes positively (Mink & Fraser, 2005), presenting a natural context for mathematical language (McDuffie & Young, 2003), developing problem-solving skills (Cankoy, 2011), differentiating teaching depending on students' needs (Forbringer, 2004; Forbringer et al., 2016), diagnosing and eliminating misconceptions (Courtade et al., 2013; Skoumpourdi & Mpakopoulou, 2011), and increasing academic achievement (Capraro & Capraro, 2006; Lemonidis & Kaiafa, 2019).

Along with all its contributions, how this integration is made, which can be used as a rich teaching approach in mathematics classes, affects the learning outcomes in various aspects. All the actions such as the selection of appropriate books and the ways of integration along with personal characteristics of the practitioners who are eager to integrating their lessons with children's literature play a decisive role in this (Durmaz et al., 2022). Therefore, one of the remarkable issues influencing the quality of the integration process is the practitioner's intentions which are shaped by their beliefs about applying the integration in the classroom. As in many other behaviors, teachers' beliefs are also effective in their behaviors to transform their content knowledge into teaching (Ajzen, 2020; Kutaka et al., 2018). That is also the case for the integration of children's literature in mathematics teaching. Therefore, practitioners' beliefs about integration affect not only their instructional decisions (Staub & Stern, 2002) but also the frequency and manner of transferring this practice to their classrooms (Edelman, 2017). While this situation is a facilitator for the benefits and gains that can be obtained from the integration process, it sometimes becomes much more difficult (Prendergast et al., 2019).

Literature Review

Children's Literature and Mathematics Integration

The idea of integrating mathematics lessons with stories or children's books, which is becoming increasingly significant in mathematics education, is not a new practice (Koellner et al., 2009). However, the related literature indicates that it is still unlikely to draw the definite boundaries of a good integration (Luedtke & Sorvaag, 2018). One of the most crucial issues for the integrated courses to reach their purpose is the quality and appropriateness of the selected books. Because an unqualified book containing mistakes or misconceptions may harm students in numerous ways (Columba

et al., 2005; Flevares & Schiff, 2014; Nurnberger-Haag, 2017). However, choosing a high-quality book does not always warrant a perfect integration process (Edelman, 2017; Flevares & Schiff, 2014). Therefore, what the practitioners do in the process is as critical as the books chosen for integration in achieving the purpose of integration and being effective for instruction (Edelman, 2017). Hence, teacher competences have a key role in this process.

The related literature has discussed various ways of integrating mathematics teaching and children's literature. Some are mentioned as follows: providing meaningful contexts for learning mathematics, modeling mathematical experiences, creating problems, introducing materials related to the book, preparing or developing the teaching of a mathematical concept or skill, measurement, and evaluation, and showing the use of mathematics in different fields and daily life as well as introducing mathematical words to students (Hong, 1996; Welchman-Tischler, 1992). Integrating mathematics with children's literature has some benefits for mathematics education, such as mathematics and geometry success (Capraro & Capraro, 2006; Durmaz & Miçooğulları, 2021; Lemonidis & Kaiafa, 2019), motivation and attitudes (Mink & Fraser, 2005; Munro, 2013), and mathematics anxiety (Green, 2013).

Even though its benefits, the studies conducted with teachers pointed out that teachers rarely considered practices such as writing students' own mathematical stories in collaboration with role-playing or games, with hands-on or outdoor activities that can be used in addition to these integration ways (Larkin & Trakulphadetkrai, 2019). Regrettably, both pre-service and in-service teachers make use of integration superficially. To exemplify, pre-service teachers benefit from integration as reinforcement, while teachers for the introduction or evaluation part of the lesson (Can et al., 2020; Rogers et al., 2015). Such practices, conducted without aligning the entire course, can be considered ineffective integration (Rogers et al., 2015). Another ineffective practice is focusing on the subject rather than the quality of the books during the integration process, which is frequently encountered (Can et al., 2020; Cooper et al., 2020). Besides, both pre-service and in-service teachers attached less importance to the contributions of integration in terms of the cognitive domain by prioritizing the affective domain; moreover, they indicated that this practice is more suitable for younger children and basic mathematical skills (Farrugia & Trakulphadetkrai, 2020; Larkin & Trakulphadetkrai, 2019). Such erroneous thoughts or beliefs may dwindle the potential contribution of integration and integration intentions. Because both pre-service and in-service teachers are concerned about the possibility of moving away from the focus of the mathematics course in integrated courses where mathematics and literature are integrated (Durmaz, 2018; Prendergast et al., 2019) even though they have positive views on integration, which will increase students' interest, motivation, etc. (Can & Durmaz, 2022; Can et al., 2020). Therefore, the study results addressing these points also ensure to understand the beliefs behind the actions/intentions of teachers as the tasks presented in the instructional processes are influenced by the teacher's knowledge, attitudes, beliefs, goals, aims, and obstacles related to these tasks (Sullivan et al., 2012).

Similar (Sullivan et al., 2012), studies confirmed that although teachers believe in the positive contributions of integrating children's literature in mathematics teaching, they do not use it in their classes too much (Farrugia & Trakulphadetkrai, 2020). The role of the beliefs is considered significant among the various factors that lead to the

emergence of this situation and the intentions of integration. The studies analyzed the underlying factors behind the behaviors of in-service or pre-service teachers for integrating literature in mathematics lessons within the context of Theory of Planned Behavior (Ajzen, 2020; Farrugia & Trakulphadetkrai, 2020; Larkin & Trakulphadetkrai, 2019; Prendergast et al., 2019).

Theoretical Background

Theory of Planned Behavior (TPB)

For investigating behaviors there are some useful theoretical frameworks. One of them, which is especially practical and important for examining teacher behaviors, is the theory of planned behavior (Dunn et al., 2018). This theory was used so many times to explain teacher intentions about children's literature and mathematics integration in the literature (ex. Can & Durmaz, 2022; Farrugia & Trakulphadetkrai, 2020; Yang et al., 2021). To this theory, teachers' behavioral intentions are shaped by attitudes towards the behaviors, subjective norms about these behaviors, and perceived behavioral control (Ajzen, 2020). According to this theory, there is a strong relation between intention and the behavior.

The perceived barriers to the integration of children's literature in mathematics teaching mentioned within the framework of TPB were classified as attitude towards behavior, social norms, and perceived behavioral control. These barriers preventing teachers from the integration are the selection of appropriate books for the integration process, the teaching methods, the lack of sufficient books for each grade and mathematics skill, the hesitation to break away from the focus of mathematics lessons, and the possibility of hindering students from discovering mathematics on their own (Whitin, 2002). Teachers' misconception about the suitability of this integration for younger children and basic mathematical concepts is an example of their attitudes towards integration. However, this practice is an effective way for teaching levels except the pre-school period and for teaching complex concepts, and even for students of all ages and grades, including those with reading and comprehension difficulties (Ibarra et al., 2019; Miller, 1998; Moore, 2008; Movshovitz-Hadar & Shriki, 2009). The perceived barrier in terms of social norms is that teachers' attempt to integrate children's literature into mathematics teaching might not be received positively by parents or the school's senior administration (Farrugia & Trakulphadetkrai, 2020). This may negatively affect teachers' intention to perform the behavior. Barriers in terms of perceived behavioral control are the limited time for integration, anxiety about keeping up with the curriculum, a lot of time to prepare and implement lesson plans, and the feeling of inadequacy in pedagogical knowledge and confidence. Many issues within the scope of the perceived behavioral control also play a key role in teachers' acquisition of a new skill or incorporating any innovative approach in their classrooms (Smith et al., 2016; Xie & Cai, 2021) because teachers need to overcome the barriers of accessing to resources and developing appropriate beliefs (Smith et al., 2016). When evaluated in terms of access to resources, which also refers to access to information, teachers believe that their awareness, experience, and knowledge about children's literature required for integration is insufficient (Farrugia & Trakulphadetkrai, 2020;

Trakulphadetkrai, 2017). Such thoughts and beliefs may cause teachers to be ambiguous about integrating literature in their mathematics classrooms.

Perceived enablers of the integration process are examined under the categories of attitude towards behavior, subjective norms, and perceived behavioral control. Teachers' views on integration are mostly focused on its affective contributions in terms of attitude towards behavior. Subjective norms include teachers' expectations that they are validated for integrating practices. On the other hand, perceived behavioral control defines teachers' intentions to receive training on integrating children's literature in mathematics teaching (Farrugia & Trakulphadetkrai, 2020). As seen from the theory and the literature, teacher competences are also important for effective mathematics and children's literature integration.

Teacher Competences

Like all approaches, teachers need to have some competences in the content area to teach effectively. From this point of view, Edelman (2017) examined pre-service teachers' practices for the integration of mathematics teaching and children's literature and presented a competency framework. The factors influencing the integration process are explained within the context of pedagogical content knowledge. Accordingly, knowledge of content and student refers to skills such as being able to listen to student responses and being aware of misconceptions; knowledge of content and teaching indicates such skills as knowing how teaching can be planned; knowledge of content and curriculum includes the ability to critically analyze lesson plans and literary texts. With this framework, Edelman (2017) drew attention to the fact that no matter how qualified books are chosen for the integration of children's literature in mathematics teaching, they cannot save the process alone if the teacher's content knowledge is insufficient. Studies conducted in the context of competences revealed that both in-service and pre-service teachers used integration as an introductory activity to attract more attention, so they need more practice and guidance on different and rich ways of integration (Can et al., 2020; Edelman, 2017; Edelman et al., 2019; Farrugia & Trakulphadetkrai, 2020; Rogers et al., 2015). Thus, it is recommended to model different ways of integration in teacher education programs, to conduct discussions on them, and offer the opportunity to observe an integrated mathematics lesson by asking pre-service teachers to prepare lesson plans in which they use different ways of integration (Rogers et al., 2015). For this reason, it is important for both pre-service and in-service teachers to facilitate the integration of children's literature in mathematics lessons (Prendergast et al., 2019). In this study, the online training content is shaped according to this framework and TPB components. Also, teachers' awareness levels about mathematics content in the children's books and the ability to find mathematics in the context are also important for the sake of this integration. So, it is thought that pre-service teachers' mathematics teaching self-efficacy and mathematics literacy self-efficacy may be developed through the training because they would attend a training which is focused on these competences about integration.

Mathematics Teaching Self-Efficacy

A strong self-efficacy supports teachers in overcoming difficulties they face (Smith, 1996). While integrating mathematics and children's literature, teachers face a lot of problems such as finding appropriate books, support from school administration

and parents, etc. (Prendergast et al., 2019). In the literature, there are many studies about teacher beliefs and self-efficacy (Sezgin-Memnun & Katrancı, 2012; Zehir et al., 2019). These are focused especially on the related variables with self-efficacy and are designed as a survey model. The literature shows that integrated lessons support not only students but also teachers. Studies revealed that teachers' self-efficacy towards mathematics increases by virtue of integrated mathematics lessons, they are motivated to use innovative approaches to mathematics lessons, and their mathematics teaching anxiety decreases (Ginsburg & Uscianowski, 2017; Jett, 2018). But it is not very clear that an integration focused instruction's effect on pre-service teachers' mathematics teaching self-efficacy. So, in this study, one of the variables is mathematics teaching self-efficacy because teacher competences play a crucial role in mathematics and children's literature integration and behavior intentions.

Mathematics Literacy Self-Efficacy

Mathematics literacy self-efficacy and mathematics teaching self-efficacy have a mixed relation with each other (Dinçer et al., 2016; Karalı, 2022). Some studies show that teachers' mathematics literacy self-efficacy affects mathematics teaching self-efficacy (Karalı, 2022). Like mathematics teaching self-efficacy, research on mathematics literacy self-efficacy is mostly designed as a survey method and conducted with teachers (ex. Usta et al., 2019). But this variable may also affect the pre-service teachers' integration intentions because it is aligned with teacher competences such as seeing the world with mathematical eyes. Pre-service and in-service teachers need to be good at finding high-quality books and mathematics content in the books etc. These kinds of competences are related to mathematics literacy and mathematics literacy self-efficacy. If pre-service teachers feel that they are enough to teach effectively and find good books for teaching mathematics, then they may utilize this integration. That is why these three variables are taken into consideration together in this work.

Aim and Significance of the Study

Studies showed that both pre-service and in-service teachers faced some barriers in integrating mathematics and literature. The barriers and the beliefs about these barriers affect the intentions of the individual to perform the relevant behavior about this integration (Ajzen, 2020). Therefore, it is of upmost importance to understand the pre-service and in-service teachers' beliefs as intentions' function to ensure their professional development (Qhobela & Moru, 2014). It is also known that teachers' beliefs about teaching might be changed through professionally designed training (Lane & Ríordáin, 2020). Besides, pre-service and in-service teachers encounter similar difficulties in terms of barriers to this integration (Can & Durmaz, 2022; Can et al., 2020; Prendergast et al., 2019), and the development of practitioner competencies regarding integration has become increasingly popular in recent years (Edelman et al., 2019). Upon analyzing the relevant literature, studies mostly focus on the views regarding the integration process, the analysis of the integrated lesson plans prepared without any training, or the effect of the pre-service education integrated into the method lessons of early childhood educators (Can & Durmaz, 2022; Can et al., 2020; Edelman, 2017; Prendergast et al., 2019; Trakulphadetkrai, 2017). No analysis was conducted regarding the change in the variables related to the practitioners' beliefs and

intentions towards integrating mathematics teaching and children's literature after any training. In addition to this, some of the competences of teachers' such as mathematics teaching self-efficacy and mathematics literacy self-efficacy, play a key role in the quality of this integration process. Because teachers need not only intentions but also necessary skills. The relevant studies unveiled those in-service and pre-service teachers gained favor from trainings on integration and would use this practice in their lessons (Edelman, 2017; Mink & Fraser, 2005). But in the literature, these characteristics of the teachers are not investigated together. Also, unlike other studies, this study was conducted with pre-service teachers who would work not only at the early childhood period but also at the middle school level, and a shorter, economical, and online education was carried out rather than covering a whole academic term. Hence, the change in the beliefs and intentions about the integration of pre-service and in-service teachers directly or indirectly related to the integration of children's literature in mathematics teaching will be examined within the context of training on integration practices. Thus, the research question was, "How does online training on the integration of children's literature in mathematics teaching influence the pre-service pre-school, primary and elementary mathematics teachers' beliefs and intentions about integration?." The sub-problems of the study are as follows;

1. What is the change in the pre-school, primary and elementary mathematics pre-service teachers' beliefs/intentions towards the integration of children's literature in mathematics teaching?

2. Does the change in the pre-school, primary, and elementary mathematics pre-service teachers' beliefs/intentions differ across their branches and sub-factors of the belief scale for the integration of mathematics teaching and children's literature?

3. What is the change in the pre-school, primary and elementary mathematics pre-service teachers' mathematics teaching efficacy levels?

4. What is the change in the pre-school, primary and elementary mathematics pre-service teachers' mathematics literacy self-efficacy levels?

5. What is the change in pre-service teachers' views about the advantages and disadvantages of children's literature and mathematics education integration after the instruction?

Method

This section includes information regarding the research design, the participants of the research, data collection tools, and data analysis.

Research Design

This study attempts to analyze the change in the beliefs namely intentions of the senior pre-service teachers receiving preschool, primary and elementary education related to the integration of mathematics teaching and children's literature at the end of an online training on the integration of children's literature in mathematics teaching. Therefore, the study used a weak experimental pretest-posttest design without a control group to test the effect of the training on the variables examined within the scope of the research. Experimental research is used to reveal the effect of a certain intervention process in solving a problem under controlled conditions within a systematic

methodology (Cohen et al., 2018; Fraenkel et al., 2012; Özmen, 2019). However, a weak experimental design was used in the present study since the criteria such as the presence of a control group required by the full experimental design, and random sampling cannot be provided (Fraenkel et al., 2012; Gopalan et al., 2020).

Participants of the Study

The study was conducted with the senior pre-service teachers who received preschool, primary, and elementary mathematics education in undergraduate programs throughout Turkey and who voluntarily applied for an online education on the integration of children's literature in mathematics teaching. The application form and information about training were shared with all universities via official letters and various social media accounts. All the participants attended all the classes and the participants' eagerness to learn a novel approach was important through the process. This may cause the selection bias and could be prevented by considering intent to treatment. Some criteria were used in the selection of the participants for the training. These were to be an active student in the relevant undergraduate programs, to be successful in the courses related to mathematics education, to have a GPA of 3.00 or above, and to have completed the third grade courses and moved up the 4th grade at the university. Those who studied at different universities and who met these criteria were chosen with great care.

The study was carried out with a total of 54 pre-service teachers, 17 of whom were in pre-school, 19 in primary education, and 18 in elementary mathematics education. Convenient sampling was used to determine the participants (Cohen et al., 2018; Etikan et al., 2016; Patton, 2014). This method is especially useful when the researcher has limited resources, time and workforce (Etikan et al., 2016; Patton, 2014). According to the criteria and the focus of the study, the participants were selected among those who would teach from pre-school to elementary (K-8 grades) level. Because both pre-service and in-service teachers have a general misconception that teaching mathematics with children's books is more suitable for younger students. So, this instruction was seen as an opportunity to reduce this misconception. Therefore, one of the objectives of this study is to make pre-service teachers realize that integration is an appropriate instructional approach for all age groups when planned correctly and effectively (Trakulphadetkrai, 2017).

Data Collection Tools

The study deployed four different data collection tools to examine the change in the pre-service teachers' beliefs, intentions, and views related to the integration of children's literature in mathematics teaching with the knowledge and experience they gained from the training they attended. Each data collection tool is explained as follows.

Belief Scale for the Integration of Children's Literature in Mathematics Teaching

"The Belief Scale for the Integration of Children's Literature in Mathematics Teaching" was developed Can and Durmaz (2022). The tool is a 5-point Likert type and includes four factors and 33 items. The factors were identified as (i) positive pedagogical effects of integrating children's literature in mathematics teaching; (ii) the

role of resources influencing the integration process; (iii) teacher competencies complicating the integration process and social norms and (iv) teacher competencies facilitating the integration process. One of the items in the scale is as follows: *"I don't think there are enough books to support mathematics lessons."* The measurement reliability of the data obtained from this scale was calculated as .794 for the pre-test and .855 for the post-test. In addition to this, the subfactors' reliabilities are as follows .899 for factor 1; .659 for factor 2; .648 for factor 3; and .727 for 4. So, the Cronbach Alpha reliability coefficients are at a sufficient level (Can, 2020; Field, 2018; Pallant, 2020).

Mathematics Teaching Self-Efficacy Belief Scale

The second data collection tool of the study was the "Mathematics Teaching Self-Efficacy Belief Scale," which was adapted into Turkish by Hacıömeroğlu and Taşkın (2010). Although the adaptation of the scale was made especially for primary teachers, many studies indicated that it is a valid and reliable tool for elementary mathematics teachers, preschool teachers, and pre-service teachers (Ex. Zehir et al., 2019). Being a 5-point Likert type, the scale consists of twenty-one items and three factors: personal efficacy, the role of the teacher in effective teaching, and performance related to teaching. One of the items in the scale is as follows: *"When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort."* The measurement reliability of the data obtained from this scale was determined as .854 for the pre-test and .773 for the post-test. In addition to this, the subfactors' reliabilities are as follows .750 for factor 1; .866 for factor 2; and .575 for 3. So, the Cronbach Alpha reliability coefficients are at a sufficient level (Can, 2020; Field, 2018; Pallant, 2020).

Mathematics Literacy Self-Efficacy Scale

The last scale was the "Mathematics Literacy Self-Efficacy Scale" developed by Özgen and Bindak (2008), which contains items that may be paramount during the integration of children's literature in mathematics teaching. One of the items in the scale, composed of twenty-five items and a single factor, is as follows: *"I can use mathematical language in the expression of mathematical thoughts."* The measurement reliability of the data was identified as .966 for the pre-test and .965 for the post-test. So, the Cronbach Alpha reliability coefficients are at a sufficient level (Can, 2020; Field, 2018; Pallant, 2020).

Open Ended Question

An open-ended question was used to examine the change in pre-service teachers' views on integrating children's literature and mathematics teaching after instruction. The question on the form is: "*What are the changes in your views on the advantages and disadvantages of integrating children's literature with mathematics education? Please clarify your answer*." This form aims to support the data obtained through the scales because it is thought that it's very difficult to make changes in beliefs and intentions in a short-term instruction.

The Course Structure

The participants were provided online training for 6 hours per day for six days. The training content was planned to be 45 minutes for each session based on the data

obtained from the researcher's previous studies and teacher training as well as the studies on the relevant subject (Can et al., 2020; Durmaz, 2018, 2019; Rogers et al., 2015). The researcher investigated children's literature course content, serving only early childhood and primary education graduate programs, and examined the relevant studies (Prendergast et al., 2019; Rogers et al., 2015, Purdum-Cassidy et al., 2015) which are focused on teacher education about the integration of children's literature and mathematics education. Most of the sessions were 45 minutes long each and structured as the I Do-We Do-You Do approach. So firstly, the theoretical lecture (10-15 minutes) was made and then applications on mathematics education of the content was provided. The first day's sessions were mostly theoretical. Table 1 depicts the sessions of the training.

Table 1

The Sessions of the Training

First Day	1. Informing the Participants about the Training Content and Program
	2. The Relationship Between Children's Literature and Education
	3. Rationale for Integrating Mathematics Teaching and Children's Literature
	4. Pre-School Curriculum and Children's Literature
	5. Primary and Elementary Mathematics Curriculum and Children's Literature
	6. Completion of Evaluation and Learning Logs
Second Day	1. Book Selection Criteria and Ways of Integration
	2. During and After Activities of Interactive Read Aloud I
	3. During and After Activities of Interactive Read Aloud II
	4. Questioning Methods
	5. From Stories to Games from Games to Stories
	6. Completion of Evaluation and Learning Logs
Third Day	1. Writing in Mathematics Teaching
	2. Digital Storytelling Tools
	3. Writing Math Poems
	4. Problem Solving and Posing
	5. Children's Literature, Multiculturalism and Values Education
	6. Completion of Evaluation and Learning Logs
Fourth Day	1. Math Anxiety and Bibliotherapy
	2. Mathematics through Books with Family Participation
	3. Mathematical Talk and Number Sense
	4. A Journey to the Cultural History of Mathematics with Books
	5. One Book Doesn't Fit All: Creating Activities Suitable for Student Level I (Focused on Slow Learners)
	6. Completion of Evaluation and Learning Logs
Fifth Day	1. One Book Doesn't Fit All: Preparing Activities Suitable for Student Level II (Focused on Fast Learners)
	2. Numbers and Operations with Children's Books
	3. Patterns and Algebra with Children's Books
	4. Geometry and Measurement with Children's Books

	5. Data Analysis and Probability with Children's Books
	6. Completion of Evaluation and Learning Logs
Sixth Day	1. Evaluation of Digital Stories with Mathematical Context I
	2. Evaluation of Digital Stories with Mathematical Context II
	3. Evaluation of Integrated Lesson Plans I
	4. Evaluation of Integrated Lesson Plans II
	5. Evaluation of Developed Games and Stories
	6. Completion of Training and Final Evaluations (Performing Post-Tests)

Table 1 displays that the training included various contents associated with children's literature and mathematics teaching. The workflow for each day was briefly explained.

On the first day, the participants were presented information to build the theoretical framework of the integration process regarding how to use children's literature in educational areas except for mathematics; the reasons for integrating mathematics teaching and children's literature; how the learning outcomes of mathematics lessons might be connected with children's literature for the students from pre-school to the 8th grade.

On the second day, the selection criteria of the books, which significantly affected the quality of the integration process, how the books were classified according to their mathematical context and how integration could be made according to this classification were mentioned. On the same day, practical studies were conducted about when and how the questions should be asked by using the interactive read aloud process, which is a functional technique to make the integration throughout the whole class. Finally, the evaluation process was initiated by giving practical examples about the gamification of the story in the book or the storytelling of the games, one of the ways of integration in the related literature (Cutler et al., 2003).

On the third day, studies that would contribute to the creation of mathematical stories by the teachers or students as an alternative solution to the problem of finding suitable books for the purpose (Prendergast et al., 2019), which is a subject that pre-service and in-service teachers often have troubles in the integration process, were discussed. In this regard, poetry writing, which is more unusual than mathematical writing, digital storytelling tools, and other literary genres for mathematics lessons, was included in the training. On the same day, a problem solving and posing session was held as an example of using children's literary products as a useful source of problem solving and posing and allowing them to be connected with daily life (Welchman-Tischler, 1992). Lastly, a session was held on the potential of children's literature for a multicultural and values-based teaching in mathematics lessons.

The fourth day of the training included developmental bibliotherapy applications that teachers could use to relieve mathematics anxiety, studies that families can do to support students' mathematical development, number sense and math talk to support the use of mathematical language, the use of books related to the history of mathematics both to help students value mathematics and to teach mathematics, and finally, adaptation studies on the integration process for students with mathematical learning difficulties or slow learners.

The fifth day covered applied studies on the use of children's literature in the teaching of mathematics lessons, including all content areas in the curriculum such as Numbers and Operations; Patterns and Algebra; Geometry and Measurement, Data Analysis and Probability from pre-school to the 8th grade and integrated lesson plan samples in connection with the content standards defined by the National Council of Mathematics Teachers [NCTM] (2000) for the mathematics course after the adaptations that could be made in the integration process for gifted or advanced/fast learners.

On the sixth day, time was allocated to evaluate the integrated lesson plans prepared by the pre-service teachers in line with the training they received, digital stories with a mathematical context, and the games they developed depending on the book they chose for the integration process, and trainers and other pre-service teachers gave the pre-service teachers feedback.

Each session included scientific studies conducted with the pre-service and in-service teachers in the literature, the characteristics of the lessons integrated with children's literature based upon practical/wise knowledge and experience. Teacher education programs for the integration of mathematics teaching and children's literature recommend to model and discuss different ways of integration, and to offer the opportunity to observe an integrated mathematics lesson by asking pre-service teachers to prepare lesson plans in which they experience different ways of integration (Harding et al., 2017). All studies were conducted within the scope of this study except for the observation of a real class in which the integration was applied. Each session was conducted by expert instructors having academic studies and publications in that field, namely, the pre-service teachers received training from those who train teachers for different education levels. This provides them insight on how to use and adapt the content for different grade levels. These sessions presented information about why and how mathematics teaching and children's literature should be integrated. Besides, pre-service teachers were given the opportunity to experience what problems they might encounter during the integration process and how they could overcome them as they were asked to prepare an integrated lesson plan within the scope of the training. In the evaluation sessions held at the end of each day, the participants were asked to write a reflection based on the Know-Wonder-Learn (KWL) strategy that could also be used in the integration of mathematics teaching and children's literature. Thus, necessary arrangements could be made for the following sessions and the progress of the pre-service teachers could be followed individually day by day.

Data Analysis Procedure

Before the data analysis, negative items in data collection tools were coded in reverse. The data was collected through Google Forms, and answering all items was made mandatory for the pre-service teachers thanks to a feature offered by Google Forms. Because of this feature, pre-service teachers could not skip any question without an answer. Therefore, there is no missing data in the research. Then the researcher examined the distribution of the data within Kolmogorov Smirnov and Shapiro Wilk tests. After the normality tests, Cronbach Alpha reliability coefficients of each scale and sub-factors were calculated. In line with the results of the analysis to test the normality and reliability tests, it was decided which parametric or non-parametric tests would be applied. Then hypothesis tests were performed to answer research problems by

examining assumptions. For this purpose, the scores obtained from the scales were compared with the pre-test and post-test measurements. To compare the two measurements, paired-samples t-test (to identify the effect of the training on mathematics teaching and children's literature integration belief/intention and mathematics literacy self-efficacy), one-way analysis of variance from parametric tests (to examine if there is a difference between scores mathematics teaching and children's literature integration beliefs/intentions according to branches of pre-service teachers), Wilcoxon Signed Ranks (to examine if there is difference between sub-factor scores mathematics teaching and children's literature integration beliefs scale and mathematics teaching self-efficacy according to branches of pre-service teachers), and Kruskal-Wallis from non-parametric tests (to examine difference scores according to branches of pre-service teachers) were used. Other details about the scales and analysis details were given in the results section.

In the analysis of the data obtained through the open-ended question, descriptive analysis and content analysis were used. The data obtained from the pre-service teachers were expressed with themes, codes, and direct quotations about the opinions of the pre-service teachers were included. While presenting the quotations of the pre-service teachers, codes such as PT1, PT2, ..., and PT54 were used for each pre-service teacher. After the data were coded independently by two researchers (the author and another researcher who is an expert in the mathematics education field), a third researcher (a researcher who is an expert in mathematics education and qualitative research approach) was asked to encode 30% of the data to increase the reliability of the data analysis process. Disagreements have also been resolved to ensure consistency between the codes made by the researchers. In case of the author's researcher bias as an instructor in the course, the author asked another researcher who was not in the training or the project team to re-analyze and compare the results of the study.

Ethical Procedures

In this study, the rules specified in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" were followed during the research process; None of the actions specified under the title of "Actions Contrary to Scientific Research and Publication Ethics" were carried out. All necessary permissions were obtained Süleyman Demirel University Social and Human Sciences Ethics Committee with the ethical permission dated 05/24/2021 and 56/4 certificate issue number. All participants were informed about the study and were included in the study on voluntary basis.

Results

The analyzes made based on each data collection tool are presented in order. The normality of the distribution of the pre-test and post-test difference scores was initially examined to identify the tests to be used during data analysis (Can, 2020).

The Integration Intentions and Views About Mathematics Teaching and Children's Literature

The paired samples t-test was used to test the effect of the training as the difference scores obtained from the Belief Scale for the Integration of Mathematics Teaching and Children's Literature demonstrated normal distribution ($K\text{-}S_{diff.mtclibs}=.095$ and $p=.200>.05$). The normality of difference scores of the scale was investigated

because pre-test and post-test scores were not distributed normally, but this is not a problem when the number of participants is above 30 for using the paired samples t test. To overcome this problem, difference scores could be used for the analysis (Green & Salkind, 2005).

Table 2

Paired Samples t-Test Results Related To The Difference Scores Of MTCLIBS

	$\bar{X}$	N	SD	df	t	p
Pre-test	118.6852	54	8.55575	53	-2.910	.005
Post-test	125.2593	54	14.21823			

Table 2 reveals a significant difference across the pre-service teachers' scores regarding the belief scale for the integration of mathematics teaching and children's literature in favor of post-test [$t_{(53)}$=-2.910, *p*<.01]. The effect size (*d*=.40) indicates that this difference is at a low level (Can, 2020; Field, 2018; Pallant, 2020). The low level of effect may arise from the fact that the training takes place online and in a short period of time. To determine whether the pre-service teachers' scores differed across their branches, the data distribution was firstly tested. One-way analysis of variance was used during data analysis since the distribution of difference scores was normal (*S-W*$_{diff.\ mtclibsem}$=.971 and *p*=.811>.05; *S-W*$_{diff.mtclibsps}$= .943 and *p*=.351>.05; *S-W*$_{diff.\ mtclibsce}$=.951 and *p*=.404>.05) the assumption of the homogeneity of variance is met because Levene test result is .041 and *p*=.960>.05. Table 3 displays the results of one-way analysis of variance.

Table 3

One-Way Analysis Of Variance Results

Source of Variance	Sum of Squares	df	Mean of Squares	F	p	Sig. Difference
Between Groups	5897.203	2	2948.602	17.269	<.001	EM-Pre
Within Groups	8708.001	51	170.745			EM-PriE
Total	14605.204	53				

One-way analysis of variance conducted to determine whether the pre-service teachers' difference scores obtained from training on the integration of children's literature in mathematics teaching varied across their branches suggested a statistically significant difference in terms of difference scores [$F_{(2-51)}$=17.269, *p*<.01]. The calculated effect size (η^2=.403>.14) shows that this difference has a large effect size (Büyüköztürk, 2020; Pallant, 2020). As a result of the Tukey multiple comparison test, which was conducted to analyze which branches led to a statistical difference across the scores, a significant difference was identified between the pre-service elementary mathematics and pre-school teachers; and pre-service elementary mathematics and

primary education teachers. The relevant literature reported that in-service and pre-service teachers believed that the integration of mathematics teaching and children's literature was a more suitable approach for teaching mathematics to young children through more basic mathematical concepts. Therefore, it would be appropriate to examine the pre-service teachers' scores obtained from the factors of the belief scale for the integration of mathematics teaching and children's literature. In this respect, Wilcoxon Signed Ranks test was used to test the effect of the training on the difference scores obtained from the factors since the scores were not normally distributed (K-$S_{diff.mtclibs\ 1^{st}\ factor}$=.212 and p=.000<.05; K-$S_{diff.mtclibs\ 2^{nd}\ factor}$=.072 and p=.200>.05; K-$S_{diff.mtclibs\ 3^{rd}\ factor}$=.129 and p=.025<.05; K-$S_{diff.mtclibs\ 4^{th}\ factor}$=.140 and p=.010<.05). Table 4 shows test results.

Table 4

Wilcoxon Signed Ranked Test Results

Factor	Post-test Pre-test	N	Mean Rank	Total Rank	z	p
Positive Pedagogical Effects of Integration (PPEI)	Negative Ranks	11	14.50	159.50	-3.668	<.001
	Positive Ranks	31	23.98	743.50		
	No Difference	12				
The Role of Resources Influencing the Integration Process (RRIIP)	Negative Ranks	37	27.27	1009.00	-3.246	.001
	Positive Ranks	14	22.64	317.00		
	No Difference	3				
Practitioner Competencies Complicating the Integration Process and Social Norms (PCCIPSN)	Negative Ranks	23	26.54	610.50	-1.139	.255
	Positive Ranks	31	28.21	874.50		
	No Difference	0				
Practitioner Competencies Facilitating the Integration Process (PCFIP)	Negative Ranks	2	3.25	6.50	-6.345	<.001
	Positive Ranks	52	28.43	1478.50		
	No Difference	0				

As seen in Table 4, statistically significant differences were identified across all factors of the scale, except for the factor of practitioner competencies complicating the integration process and social norms [z_{ppei}=-3.668, p<.01; z_{rriip}=-3.246, p<.01; z_{pcfip}=-

6.345, *p*<.01]. The difference in all factors was found to be in favor of the post-test apart from the factor-the role of resources influencing the integration process. The Kruskal-Wallis test was used to determine whether the pre-service teachers' difference scores varied across branches as the difference scores were not normally distributed. The results are presented in Table 5.

Table 5

Kruskal-Wallis Test Results

Factor	Branch	*N*	Mean Rank	*df*	X^2	*p*	Sig. Difference
Positive Pedagogical Effects of Integration (PPEI)	Elementary Mathematics	18	22.28	2	4.067	.131	-
	Pre-school	17	32.91				
	Primary Education	19	27.61				
The Role of Resources Influencing the Integration Process (RRIIP)	Elementary Mathematics	18	15.17	2	16.859	<.001	EM-Pre-S EM-PriE
	Pre-school	17	34.97				
	Primary Education	19	32.50				
Practitioner Competencies Complicating the Integration Process and Social Norms (PCCIPSN)	Elementary Mathematics	18	16.92	2	12.876	.002	EM-Pre-S EM-PriE
	Pre-school	17	34.94				
	Primary Education	19	30.87				
Practitioner Competencies Facilitating the Integration Process (PCFIP)	Elementary Mathematics	18	24.44	2	1.411	.494	-
	Pre-school	17	30.74				
	Primary Education	19	27.50				

A statistically significant difference was determined across the scores of some factors in terms of pre-service teachers' branches (X_{rriip}^2=16.859, *p*<.01; $X_{pccipsn}^2$=12.876, *p*<.01). Mann-Whitney U test results and Bonferroni correction (*p*=.05/3=.017 and p_{ppei}=.054>.017; p_{rriip}=.000<.017; $p_{pccipsn}$=.001<.017; p_{pcfip}=.273>.017) indicated that this difference was between elementary mathematics teachers and preschool and primary teachers.

The Mathematics Literacy Self-Efficacy

The paired samples t-test was used to identify the effect of the training as the difference scores obtained from the Mathematical Literacy Self-Efficacy Scale were

normally distributed (K-$S_{diff.literacy}$= .066 and p=.200>.05). The results are presented in Table 6.

Table 6

Paired-Sample t-Test Results

	$\overline{X}$	N	SD	df	t	p
Pre-test	89.3704	54	18.54042	53	-4.836	<.001
Post-test	98.5556	54	18.05826			

According to Table 6, a significant difference was determined across the pre-service teachers' scores obtained from the mathematics literacy self-efficacy belief scale in favor of the post-test [$t_{(53)}$=-4.836, p<.01]. The effect size (d=.66) shows a medium level of difference (Can, 2020; Pallant, 2020). One-way analysis of variance was performed to determine whether the pre-service teachers' difference scores differed across their branches. In addition, the distribution of the difference scores showed normal distribution (S-$Wd_{diff.literacyem}$=.969 and p=.777>.05; S-$W_{diff.literacyps}$=.950 and p=.457>.05; S-$W_{diff.literacyct}$=.971 and p=.798>.05). The results of one-way analysis of variance are presented in Table 7.

Table 7

One-Way Analysis Of Variance Test Results

Source of Variance	Sum of Squares	df	Mean of Squares	F	p	Sig. Difference
Between Groups	823.226	2	411.613	2.209	.120	-
Within Groups	9502.923	51	186.332			
Total	10326.148	53				

Table 7 implied no statistically significant difference across the pre-service teachers' scores in terms of their branches [$F_{(2-51)}$=2.209, p>.05].

The Mathematics Teaching Self-Efficacy

The Wilcoxon Signed Rank test was used to test the effect of the training since the difference scores obtained from the Mathematics Teaching Self-Efficacy Scale were not normally distributed (K-$S_{diff.teaching}$=.126 and p=.031<.05). Table 8 depicts test results.

Table 8

Wilcoxon Signed Rank Test Results

Post-test Pre-test	N	Mean Rank	Total Rank	z	p
Negative Ranks	10	16.15	161.50	-4.809	<.001
Positive Ranks	42	28.96	1216.50		
No significance	2				

* Based on negative ranks

As observed in Table 8, a significant difference was found between the pre-test and post-test scores of the pre-service teachers [$z_{teaching}$=-4.809, p<.01]. The emergence of difference in favor of the post-test indicates that training has a significant effect on the pre-service teachers' mathematics teaching self-efficacy levels.

Lastly, the author asked the pre-service teachers' views about integration via an open-ended questions to support findings from the scales.

The Advantages and Disadvantages of Integrating Children's Literature wih Mathematics Education

The themes and codes related to the change in the views of pre-service teachers about the advantages and disadvantages of integrating children's literature with mathematics education are given in Table 9.

Table 9

Pre-Service Teachers' Views on CL And Mathematics Integration After the Instruction

Theme	Codes	f	Theme	Codes	f
Positive Views	Reduce math prejudice/anxiety	14	Negative Views	Having difficulty finding appropriate books	15
	Teaching fun	13		The possibility of not attracting every student's interest	14
	Intriguing/engaging	13		Time-consuming	13
	Acquisition of positive attitudes	9		Planning and implementation require time and effort	14
	Supporting recall	9		Moving away from the focus of the topic	6
	Effective teaching	5		Cost of the books/Accessibility problems	6
	Attracting attention	4		Integration requires expertise (in terms of adapting the book and seeking mathematical content in it)	6
	Connecting mathematics with daily life	4		Integration is not appropriate for every topic	5
	Increase success	4		Lack of appropriate books for	4

		every subject	
Interdisciplinary teaching	4	Negative reactions of parents and school administration	3
Active participation	4	Lack of number of books	2
Applying a constructivist approach /student-centered teaching	3	Not every lesson may be productive with integration	2
Ensuring concreteness	3	Integration is not suitable for all ages	2
Supporting social and emotional development	2		
Gaining reading habits/skills	2		
Teaching concepts	2		
Reducing misconceptions	2		
Facilitating learning	2		
Grasping students' interest who are not interested in mathematics	2		
Sharing experiences with both teachers and students	2		
Reinforcement of concepts	1		
Possibility to create different activities	1		
Allows the use of all kinds of books	1		
Increased motivation for teachers and students	1		
Reduce mathematics teaching anxiety	1		
Ability to handle multiple acquisitions	1		
Supporting creative thinking	1		
Facilitating classroom management	1		
Suitable for all learning areas	1		
Even though there are some limitations, I can overcome them	9		

When the views of pre-service teachers on integration after the instruction are examined, it is seen that their positive views spread to more diverse areas and, in relation to negative opinions, they focus on issues such as mathematics teaching and children's literature integration belief scale's sub-factors such as access to resources and social norms. Although pre-service teachers are aware of the limitations of integration,

they think that they are able to overcome these problems (*f*=9). Pre-service teachers think they have acquired the necessary skills for integration within the instruction. This can be evaluated as an indicator of the integration intentions that are aimed to be measured with the belief scale. The views of some pre-service teachers about the limitations of integration and the change in their knowledge levels within the instruction are as follows:

PT52: *... not much has changed in my thoughts, but the fact that I can use any book made me feel comfortable...*

PT49: *The biggest limitation is that there is not much material (book) in this area. Here it is up to the teachers. They would either integrate existing books with activities or create their own material using digital story applications.*

PT48: *... I did not even have such a thought. Now I am excited to use what I've learned...*

PT46: *... I thought that not every children's literary product could be integrated with mathematics. But since mathematics is involved in our daily life, I found out that we can even use mathematical context embedded books.*

PT41: *We use mathematics in our environment all the time, and almost all of the books have mathematics. Before the project, I was not that aware of them... Before it, combining books and mathematics was not very important and I had not seen many examples of it.*

PT40: *... At first, I was like, these fields are unrelated... Now I am planning to destroy/change perception in the child's mind like my own.*

PT39: *...I am looking for ways to integrate it into the lesson.*

PT36: *At first, I thought a lot about whether such a thing was possible, and I started to find mathematical terms in every book I got ... A book can be found or created for any subject desired to be covered...*

PT35: *I had no idea about this before and thought it would not fit, but now I am looking forward to the implementation.*

PT34: *... I had no idea before the project... I will definitely use it to ensure interdisciplinary connections...*

PT32: *... But if we can design the process correctly, we can use time effectively in the classroom.*

PT30: *I, who had never thought about literature and mathematics together, have now evolved to look for the answer to the question of how I can benefit from this context... I will definitely use it in my teaching life.*

PT24: *I am thinking of including children's literature in my lessons in some subjects, if not in every subject.*

PT23: *... I could not trust myself too much. I can say that it has made a meaningful contribution to my lesson plan integrations related to mathematics at this point...*

PT12: *When I applied for this project, I really could not reconcile children's literature with mathematics education at all... now my perspective has changed... I will definitely try to add my storybooks to my lesson in the future.*

PT6: *Since I am a preschool teacher candidate, I was always saying how this age group child will learn mathematics. Now I can teach.*

PT5: *… Even if it is no longer intended to teach mathematics, I will wonder if there is mathematics in a book.*

PT4: *… I do not think it is too hard to relate two fields anymore.*

PT3: *The maximum limitation is the time constraint. That is what I thought before the instruction. But I think it can be overcomed in various ways.*

It can be inferred that the intentions of the pre-service teachers to make integration changed positively after the instruction (PT48, PT39, PT35, PT34, PT30, PT24, PT12), that they were aware of the limitations of integration and that they believed that solutions could be found for them (PT49, PT46, PT36, PT32, PT24, PT5, PT3), that they thought that they improved in terms of mathematics teaching after education (PT52, PT36, PT23, PT6, PT4), that they thought that they were more aware of the mathematics contexts in the books (PT52, PT46, PT41, PT36, PT5). As a result, it can be concluded that pre-service teachers have improved through books, albeit indirectly, in terms of their self-efficacy in teaching mathematics, and their intention to apply integration and mathematical literacy self-efficacy after the training.

Discussion and Conclusion

This study examined the change in the pre-service teachers' intentions about integration through online training provided for the pre-service teachers who continue their education in the field of elementary mathematics, pre-school, and primary education to gain knowledge and skills about teaching mathematics and integrating children's literature. Thus, the change in pre-service teachers' intentions/beliefs about integrating children's literature in field education could be examined within the context of different developmental stages related to integration. The training program taught the pre-service teachers how to use children's literature in mathematics teaching. They also experienced the selection process of the appropriate book for the integration of these two fields. When they chose the book that was suitable for integration, they prepared an integrated lesson plan based on this book (Binns et al., 2020). The study results revealed that pre-service teachers achieved certain gains based on all the variables examined within the scope of the study. Namely, a statistically significant difference between the post-test and pre-test scores obtained from the pre-service teachers' beliefs about integrating mathematics teaching and children's literature, mathematics teaching self-efficacy belief and mathematics literacy self-efficacy belief scales was found to be in favor of the post-test. This paved the way for the fact that the short-dated training had a positive effect on the pre-service teachers' beliefs despite being conducted on an online platform. It is known that in-service and pre-service teachers increased the integration competencies after proper instruction (Wilburne & Napoli, 2008). But the findings obtained based on the scales were discussed respectively in line with the relevant literature.

The pre-service teachers' scores obtained from the scale of beliefs about integrating mathematics teaching and children's literature demonstrated that the training had a positive effect on beliefs namely integration intentions, albeit at a low level. Regardless of the branches, a positive change emerged in the pre-service teachers' beliefs towards integration after the training. This finding is convenient with the

literature. Teachers' planned behavior about the integration of children's literature and mathematics education was investigated by lots of detailed qualitative studies. In these studies, researchers found that teachers were hesitant about the benefits of this integration because of their lack of pedagogical knowledge (Farrugia & Trakulphadetkrai, 2020; Livy et al., 2021; Prendergast et al., 2019). So, with the training provided in this study, pre-service teachers may gain new insights into the integration process. However, a significant difference was identified between pre-service elementary mathematics teachers and primary education and pre-school teachers in terms of the difference scores. Pre-service elementary mathematics teachers may have experienced a different process of change compared to those in the field of pre-school and primary education since they did not experience such a process before. Because studies conducted with the pre-service and in-service teachers who ensured integration in their classrooms suggested that practitioners believed the inappropriateness of this approach for all age groups (Farrugia & Trakulphadetkrai, 2020; Larkin & Trakulphadetkrai, 2019; Trakulphadetkrai, 2017). In addition, research on this topic is mostly focused on the early childhood education period (Edelman et al., 2019). Pre-service elementary mathematics teachers may think that such a practice is not functional for older students, which is a general misconception about the integration in the literature (Larkin & Trakulphadetkrai, 2019). When compared to other participants, such a situation may be since they did not take the courses related to children's literature and that did not prepare an integrated lesson plan, which requires considering other disciplines. That the pre-service pre-school and primary teachers were free from such a difference supports this situation. Because the pre-service teachers who receive teacher education in both fields have experience on how this field can be used in the teaching of other fields/lessons by taking the children's literature course, and they may have more positive beliefs before the training thanks to their experiences as they teach different disciplines (Ministry of National Education [MoNE], 2013). The study results also suggested that pre-school teachers' beliefs on integration were more positive than other teachers (Can & Durmaz, 2022). Unlike this study, no statistically significant difference was determined across the primary and elementary mathematics teachers' beliefs in the related study. This may be due to the interdisciplinary connections in the Pre-School Education Curriculum (MoNE, 2013) and the emphasis on children's book-based activities. Besides, children's literature courses available in undergraduate programs do not focus much on how to use children's literature in the teaching of other disciplines (Kanat, 2020). In addition, pre-school teachers did not use different strategies except questioning while reading children's books in their classrooms (Adak-Özdemir et al., 2019).

Considering the pre-service teachers' scores obtained from the factors of the belief scale for the integration of mathematics teaching and children's literature, a significant difference was identified across all factors except for the practitioner competencies complicating the integration process and social norms. In other words, significant changes were observed in teachers' belief difference scores in terms of the positive pedagogical effects of the integration process, the role of the resources influencing the integration process, and the practitioner competencies that facilitate the integration process. However, the difference emerging in the factor of the role of resources influencing the integration process was in favor of the pre-test. Based upon

these findings, the following can be mentioned: After the online training they received, the pre-service teachers' beliefs in terms of the pedagogical contributions of integrating mathematics teaching and children's literature changed positively since they had the opportunity to evaluate the contribution of digital stories on mathematics to their students through their first-hand experiences with the integrated lesson plans, they have prepared. This may have had a positive effect on their beliefs because pre-service teachers could prepare effective integrated lesson plans when they are supported by their mentees, like relevant literature (An et al., 2019). Similar issues occurred in the factor of practitioner competencies facilitating the integration process.

Pre-service teachers may understand the importance of practitioner competencies as they observed that a qualified integration requires a lot of effort and time, such as choosing a book and preparing a detailed lesson plan, as well as successfully implementing this plan. These findings of the study are convenient with the literature because in most of the studies, in-service and pre-service teachers both underlined the time constraint and the limited resources such as books that are appropriate for mathematics education as barriers to the integration (Can et al., 2020; Farrugia & Trakulphadetkrai, 2020; Livy et al., 2021; Prendergast et al., 2019). With this training, they could see the potential of the other children's books that are not directly linked with mathematics. We can conclude that they learned to look at these books with a "mathematical lens" (Trakulphadetkrai, 2018), so they did not feel weak about finding appropriate books and needed much more time for planning an integrated lesson compared to the beginning. In addition, the factor of the role of resources influencing the integration process in the belief scale included negative items about accessing the books to be used in the process. It is noteworthy that the pre-service teachers' beliefs changed in favor of the post-test as they assumed that one of the biggest barriers to integration was the lack of books suitable for each topic and learning outcome/goal (Can et al., 2020; Prendergast et al., 2019). However, as I mentioned before, each book has an aspect that can be used in mathematics teaching when viewed with a careful eye and "mathematical lens" (Trakulphadetkrai, 2018).

Unlike the studies in the literature, the pre-service teachers were found to have more positive beliefs after the training they received than before the training in terms of access to resources, which is regarded as one of the important barriers to integration by practitioners. Various factors may have led to the emergence of this finding. To exemplify, the pre-service teachers were able to examine the samples of all types of books classified differently in terms of their mathematical context (explicit, embedded, and non-mathematical contexts) (Marston, 2010), and they had the opportunity to think about how these books could be integrated into mathematics teaching. As an output of the training, each pre-service teacher was requested to prepare a lesson plan for one of the content areas (numbers and operations; algebra and patterns; geometry and measurement; data analysis and probability) within the scope of the training. However, they were divided into groups of three and produced ideas as a group on a book with different levels of mathematical context that could be associated with the relevant content area. Thus, group members working together for the same content area determined how different types of books by means of mathematical content could be used in integration according to their mathematical context, advantages, and disadvantages.

Contrary to the studies in the related literature, some of the pre-service teachers stated that they experienced more difficulty and felt limited in preparing the lesson plans by using books with explicit mathematical context and purpose-written books (Edelman, 2017). They also found such books dull in a literary sense and that their students would not enjoy it, either. This may be explained by the fact that literary arts lag a little more in books that teach mathematics and that pre-service teachers limited their creativity in preparing lesson plans. It is an important finding because one of the biggest threats to this integration is not balancing these two fields: children's literature and mathematics (Austin, 1998). The cause of the pre-service teachers' approach to the different types of children's books may be that there were a lot of researchers from different fields. It is likely that researchers studying integrating children's literature with fields other than mathematics play a key role in positively changing the pre-service teachers' beliefs through activities modeled on books without a mathematical context. Therefore, more than one expert working together and collaborating in integrated courses where different fields such as mathematics education and children's literature are employed at the same time may have positive results in changing the pre-service teachers' beliefs. In addition, studies may be conducted to gather more detailed data on the books that the pre-service teachers prefer to use during the integration process and to examine the relations between pre-service teachers' book choices and their beliefs about integrating. Both pre-service and in-service teachers can focus on different features of the books they would choose for integration or on those independent from the book such as the book's connection to the subject (Can & Durmaz, 2022; Can et al., 2020; Cooper et al., 2020; Leonard et al., 2014). Both pre-service and in-service teachers stated that they had difficulties in the book selection process and that they mostly used the knowledge that they gained during their university education (Can et al., 2020; Cooper et al., 2020; Kanat, 2020). This may be explained by the fact that the pre-service teachers in the field of elementary mathematics education had more difficulties in this regard. Furthermore, various studies may be carried out to analyze how book choices and beliefs/intentions about integration influence each other.

Upon analyzing the scores obtained from the scale factors in terms of branch, significant differences were identified across the factors, such as the role of the resources influencing the integration process and practitioner competencies complicating the integration process and social norms. Accordingly, a difference was found between the pre-service elementary mathematics and primary teachers and pre-school teachers. This can be explained by the fact that the books used in the integration process may not have been sufficient for pre-service elementary mathematics teachers in terms of quality and quantity, and they do not find themselves sufficient yet in the selection of these books and their integration with the mathematics teaching because the pre-service elementary mathematics teachers stated that they had difficulties in the book selection process and in preparing integrated lesson plans more often than the others. In addition, children's literature or a compulsory course that requires preparing an integrated lesson plan is not included in the undergraduate mathematics curriculum of elementary education (Higher Education Council-HEC, 2018). Moreover, studies highlighted that pre-service elementary mathematics teachers did not believe in the importance of content-area reading skills in mathematics lessons (Spitler, 2011). Still, teaching content-area reading skills is the responsibility of all teachers working closely

with students (Franz & Hopper, 2007). So, it is only possible to eliminate such negative beliefs and change the instructional engagements of pre-service teachers with appropriate pre-service training (Prendergast et al., 2019; Purdum-Cassidy et al., 2015; Spitler, 2011).

Another variable discussed within the scope of the study was mathematics teaching self-efficacy. Various reading strategies such as interactive read-aloud can be used to integrate mathematics teaching and children's literature. Such strategies also contribute to the creation of a classroom climate based upon sociocultural constructivism in mathematics classrooms by employing skills such as mathematical reading, speaking, and writing (Van den Heuvel-Panhuizen & Van den Boogaard, 2008). The quality of interaction and sharing is not independent of the teacher's practices in mathematics lessons, where in-class interaction and sharing are at the forefront. Thus, teacher self-efficacy, which is associated with the average success of the class and the quality of interaction, is of great importance in this respect (Perera & John, 2020). This study revealed that the training had a positive effect on the pre-service teachers' mathematics teaching self-efficacy beliefs. Because they did not only gain knowledge regarding the integration of mathematics teaching and children's literature, but they also endeavored to prepare lesson plans using the books they chose. The lesson planning process became more concrete for them as they received feedback on lesson plans from both groupmates and instructors. Hence, pre-service teachers may have had more positive beliefs in terms of mathematics teaching self-efficacy beliefs. Studies also enlightened those pre-service and in-service teachers' understanding and beliefs regarding training may be changed, their self-efficacy towards mathematics increases, they are more motivated to use innovative approaches for mathematics lessons and their anxiety about teaching mathematics decreases when effectively designed educational content is provided (Ginsburg & Uscianowski, 2017; Jao, 2018; Jett, 2018; Lane & Ríordáin, 2020; Rogers et al., 2015). From this point of view, these kinds of training may be suggested for teacher education to integrate mathematics and children's literature.

The last variable examined within the scope of the study was the mathematical literacy self-efficacy scale. The findings showed that the pre-service teachers' mathematics literacy self-efficacy belief scores were in favor of the post-test and that the training had a medium effect on beliefs. Besides, the difference scores did not differ across branches as in the mathematics teaching self-efficacy scale. The pre-service teachers may be close to each other in terms of the knowledge they gained after the training. The reasons for the absence of the differences across the beliefs about integrating mathematics teaching and children's literature in terms of branches can be explained by the fact that the pre-service teachers had different knowledge and experience.

When the pre-service teachers' views are examined, it can be seen very easily that pre-service teachers have positive opinions about integration. However, they still have some hesitations about this integration's limitations even though they have gone so far in the competences about selecting proper and high-quality books, making effective integrated lesson plans, and overcoming the limitations of children's literature and mathematics integration. This finding is critical for implications and future studies. Even teacher educators take necessary measurements into account, and try to change

teachers' beliefs, so their intentions for performing expected behaviors are not enough. So, in the future, classroom observations and a long period of training may be provided.

The most important implication of this study is that the pre-service teachers had similar beliefs in terms of positive pedagogical effects of integration and practitioner competencies facilitating the integration process. Their beliefs differed in terms of the role of the resources in integration and the practitioner competencies complicating the integration process and social norms. These findings are positive in a way because the pre-service teachers are aware of the benefits of integrating children's literature in mathematics teaching. This can be considered a sign that they are open to professional development in this regard, in conjunction with the studies (Edelman, 2017; Prendergast et al., 2019). Just like the pre-service teachers, in-service teachers also believed that the two biggest barriers to the integration process were their awareness/competence of integration and access to appropriate books (Livy et al., 2021; Prendergast et al., 2019; Trakulphadetkrai, 2017). In this online training, pre-service teachers gained knowledge about the importance of mathematics and children's literature integration, and this allowed them to make connections between theory and practice. They worked on different types of children's books by means of mathematical context. They prepared lesson plans using all kind of these books, examined peers' lesson plans, and found at least one solution to limited and inappropriate book problems by writing their own mathematical digital stories. They all provide some clues to researchers and educators about how to focus on education aiming at changing competencies and beliefs/intentions about mathematics teaching and children's literature implementation.

Implications

There is a growing literature that emphasizes the integration of children's literature and mathematics education and disciplinary/content area reading practices on this topic but very little of these studies are experimental and it's not clear how to prepare teachers for these discipline specific practices (Edelman et al., 2019; Kushner & Phillips, 2020). Pre-service teachers' gains through the training cannot be thought of without the collaboration of researchers from different fields. As noted in the relevant literature (such as Kushner & Phillips, 2020) it may be suggested that teacher educators should consider this situation because without collaboration, this research findings would be different. From this point of view, the study is valuable with some limitations. This training was limited to a very short time and carried out online in the present study. Therefore, it is of utmost significance to examine the changes in the pre-service teachers' beliefs by means of intentions about integration and their behaviors of ensuring integration in their classrooms by longer term and face-to-face. Face-to-face training was impossible due to the pandemic, so this method was used in this study. Yet, this situation, which is a disadvantage, strengthened the project by providing the diversity of participants and trainers. In addition, the study was conducted with the pre-service teachers who were unaware of how the structure and content of mathematics lessons changed during the transition between education levels and who would work at different education levels to get an idea of what mathematical skills and competencies are expected from their students at higher levels. It may be advisable to carry out further studies for specific grade levels or groups. In a nutshell, it is critical for pre-service teachers to carry out studies to understand and develop their beliefs/intentions by

bearing in mind that their practices towards integrating are an indicator of their beliefs and pedagogical content knowledge, and to use innovative approaches for their classrooms to cope with the barriers they may encounter in the integration process such as national exams and curriculum density (Qhobela & Moru, 2014; Rott, 2020; Xie & Cai, 2021).

Conflicts of Interest

There are no conflicts of interest in this study.

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In-service Teachers' Opinions about the Use of Video-based Self-Reflective Thinking for Pedagogical Development

Hizmet İçi Öğretmenlerin Pedagojik Gelişim İçin Video-Temelli Öz-Yansıtıcı Düşünmeye İlişkin Düşünceleri

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ABSTRACT: Classrooms are a learning environment for teachers as well as students. Teachers can improve their teaching practices by monitoring and reviewing their practices. An important tool of this development is the reflective thinking of teachers. For teachers, reflection is an opportunity to look into the classroom from the outside, to examine the learning process, and to make inferences for pedagogical development. Video recordings of teachers' lessons can be used to stimulate self-reflection by capturing the details of the teaching process and by examining the classroom atmosphere. This study aims to investigate teachers' opinions about using video-based self-reflection for their pedagogical development. Seven teachers participated in the research. Data were collected through a Pre-interview Protocol, Teachers' Reflection Reports written for twelve weeks about one recorded lesson per week, and a Post-interview Protocol after the 12-week video-based self-reflection period. The main findings show that the teachers' video-based self-reflections constitute nine categories and two weeks video-based self-reflection process resulted in changes in teachers' opinions in terms of reflection on video recording, professional development and teaching and learning process.

Keywords: Case-study, in-service teachers, pedagogical development, video-based self-reflective thinking.

ÖZ: Sınıflar öğrenciler için olduğu kadar öğretmenler için de birer öğrenme ortamıdır. Öğretmenler uygulamalarını izleyerek ve gözden geçirerek öğretim pratiklerinde gelişim sağlayabilir. Bu gelişimin önemli bir aracı öğretmenlerin yansıtıcı düşünmesidir. Öğretmenler için yansıtıcı düşünme, sınıfa dışarıdan bakmak, öğrenme sürecini incelemek ve pedagojik gelişim için çıkarımlarda bulunmak için bir fırsattır. Öğretmenlerin kendi derslerine yönelik video kayıtları, öğretim sürecinin ayrıntılarını yakalayarak ve sınıf atmosferini inceleyerek öz yansıtmayı teşvik etmek için kullanılabilir. Bu çalışma, öğretmenlerin pedagojik gelişimleri için video temelli öz yansıtma kullanımına ilişkin görüşlerini araştırmayı amaçlamaktadır. Araştırmaya yedi öğretmen katılmıştır. Veriler, Ön Mülakat Protokolü, haftada bir kayıtlı ders hakkında on iki hafta boyunca yazılan Öğretmenlerin Düşünce Raporları ve 12 haftalık video temelli öz-yansıtma döneminden sonra Mülakat Sonrası Protokol aracılığıyla toplanmıştır. Temel bulgular, öğretmenlerin video temelli öz-yansıtmalarının dokuz kategori oluşturduğunu ve iki haftalık video temelli öz yansıtma sürecinin öğretmenlerin video temelli öz yansıtma kullanımına ilişkin görüşlerinde yoğunluk ve içerik açısından değişikliklere yol açtığını göstermektedir.

Anahtar kelimeler: Durum çalışması, hizmet içi öğretmenler, pedagojik gelişim, video temelli öz-yansıtıcı düşünme.

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The classroom is a learning and development area for teachers as well as students. Teachers make many educational decisions, apply them, evaluate the validity of their choices, and make inferences about subsequent learning practices while preparing, using, and assessing the teaching and learning process. In doing this, reflective thinking plays a crucial role in providing and developing different perspectives.

Reflective thinking is thinking about the teaching process for teachers. A range of teaching activities requires teachers to look at these processes from an outside perspective from pre-planning analysis to evaluation. According to Dewey (1933), reflective thought is 'active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends' (Dewey, 1933, p. 118). Schon (1983) approaches reflective practice to consider one's own experiences in applying learning to practice. Jaworski (1998) claims that past experiences turn into plans by reflective practices. As Jao and colleagues (2020) described, it is "not a passive, cursory look at one's practice, but rather an active, ongoing consideration of pedagogical decision making and all of the factors that influence the making of those decisions" (p. 50). Thus, in a broad sense, teacher reflection can be defined as "a self-critical, investigative process wherein teachers consider the effect of their pedagogical decisions on their situated practice to improve those practices" (Tripp & Rich, 2012, p. 678).

Effective teaching is related to reflective practice which is defined by Zwozdiak-Myers (2012) as "a disposition to enquiry incorporating the process through which students, early career and experienced teachers' structure or restructure actions, beliefs, knowledge, and theories that inform teaching for the purpose of professional development" (p. 5). When teachers reflect on their lessons, they are more willing to try new approaches (Nagro et al., 2017). Through reflective thinking activities, teachers have the habit of looking at their teaching process as an observer. Besides, they have the opportunity to use the information they have acquired from the outside to organize new teaching activities. Reflective ability is a skill like other teaching skills (deBettencourt & Nagro, 2019), and it is strongly related to instruction. Teachers who regularly monitor their teaching and reflect on it improve their teaching understanding (Aslan et al., 2022). In this context, it is underlined in the literature that reflective thinking is handled in cycles that include a process rather than a once-applied activity. Thus, it is essential to consider the development process for reflective teaching practices as systematic and orderly. However, it is challenging for teachers to have reflective thinking activities, especially at the beginning.

Reflective thinking can be developed by guiding frameworks and the help of well-informed people (Shanahan & Tochelli, 2014). Without guidance, teachers would have difficulty in reflective practice (Nagro et al., 2017). Asking them to record videos without providing any support or guidance is not seen as a practice that serves the development of teachers (Chen & Chan, 2022). The need-based training of teachers between cycles may yield different results (Aslan et al., 2022). Besides, although teachers sometimes have problems spending time on reflective thinking on a busy school day, it may be suggested to address this as a whole, emphasizing the importance of improving the teaching process. However, teachers need to be encouraged to improve their teaching practices and think reflectively (Pow & Lai, 2021). Thus, incorporating

professional development into the school day is vital in maximizing success (van Veen et al., 2012). Despite the benefits of reflective thinking practices, research reveals that some teachers have concerns about using reflection in their classroom practices (e.g., Farrell, 2020). Based on teachers' opinions after a reflective experience, determining the factors which retain teachers from using this method can contribute to the in-service teachers' widespread use of it by eliminating their concerns.

Reflection requires looking at the classroom from outside, examining the learning process thoroughly, making inferences about this process, and continuing the teaching process. Many events occur in the learning environment, and it is difficult for the teacher to notice all of them during teaching. The use of video helps teachers to analyze the lesson despite the compelling effects arising regarding the multiplicity of the lessons, the combination of many events at the same time during lesson and the complex structure of it (Gaudin & Chaliés, 2015). Besides, teachers may not remember the entire process or details from different aspects after completing the lesson. For teachers, it is difficult to remember what they did in the classroom; there is a need to provide a retrospective data record (Farrell, 2020). Recent studies indicate that there is a tendency towards observations using digital technologies compared to observations made with traditional methods (e.g., Liang, 2015). At this point, video recordings can be used to capture the details in the course process and examine the classroom atmosphere thoroughly. There are findings in literature that reflection is made more deeply when video is added to the self-reflection process in the field of education (e.g., Danielowich & McCarthy, 2013; Kane et al., 2016). Using video allows teachers to watch the conducted lesson more than once. Video supports teachers' specific teaching practices as well as contributing to their professional development (Körkkö et al., 2019; Nagro et al., 2020). Besides, it provides an opportunity to look from a different perspective in viewing (Coffey, 2014; Sherin & van Es, 2005). Thus, video-assisted reflection is beneficial for pedagogical growth, student engagement and classroom management (e.g., Gibbons & Farley, 2021; Sydnor, 2016).

Teachers' self-reflection on their videos is a powerful technique for improving their educational performance. The use of video seems to be effective for improving teachers' reflective thinking potential and noticing skill (Marsh & Mitchell, 2014). In addition, video use can support the development of more specialized skills (McCoy & Lynam, 2021). As underlined in the literature, teachers' reflection on their teaching practices increases their potential to make changes in them (e.g., Harlin, 2014). External evaluation carries the risk of "control-oriented routines" (Towndrow & Tan, 2009, p. 285) perception and may result in denial rather than a support for professional development. On the contrary, encouraging teachers to be evaluators of their own performance (Cheung, 2009; Cranton, 2001) is preferable. Besides, video-based flood-reflection is both time-efficient and effective in supporting practitioners' active participation in the process (Gibbons & Farley, 2021). Self-reflection through video recording provides insight and information about the needs, progress level of the teacher who administers the technique and motivates them to continue with their professional development (Ross & Bruce, 2007). Besides, analyzing the lessons of teachers is seen as one of the effective practices in providing their professional development (e.g., Chen, 2020). In this respect, it is evident that recording and analyzing videos while applying the teacher's self-reflection is critical (Sablić et al., 2020). However, more in-depth

research is needed into how reflective thinking is in real transformation into the analysis (Ruffinelli et al., 2020).

Video recordings of teachers' teaching practices and self-reflections on these recordings are defined as an effective process in their development (e.g., Calandra et al., 2014; Kourieos, 2016). In this study, it was planned that teachers would create video recordings of their lessons for a semester and make video analysis on these recordings. In the literature, it is underlined that reflective thinking is handled in cycles that include a process rather than a once-applied activity (e.g., Aslan et al., 2022). In addition to this, studies in which the entire lesson was videotaped (e.g., Santagata & Angelici, 2010) have findings indicating that this contributes to professional development. Besides these, it is important for teachers to receive guidance in the reflection process (Straková & Cimermanová, 2018). To enhance the sustainability of systematic self-reflection process interviews and trainings that guide teachers at the beginning of the process, throughout the process and at the end of the process can be included in the practice. Thus, this study aims to investigate teachers' opinions about using video-based self-reflection for their pedagogical development. As the way systematic self-reflection process is handled in the study, it has a potential to provide a model for individualized professional development (Gibbons & Farley, 2021) for teachers. Thus, the research question of this study is "What are the teachers' opinions about video-based self-reflection on their lessons for their pedagogical development?" This research question is investigated under three sub-questions regarding the process of the research as their opinions before, during and after the process:

1. What are the teachers' opinions about video-based self-reflection on their lessons for their pedagogical development *before* the video-based self-reflective thinking process?

2. What are the teachers' opinions about video-based self-reflection on their lessons for their pedagogical development *during* the video-based self-reflective thinking process?

3. What are the teachers' opinions about video-based self-reflection on their lessons for their pedagogical development *after* the video-based self-reflective thinking process?

Method

Research Design

The research employs a qualitative approach using the case study method (Merriam & Tisdell, 2016). The data obtained from the Pre-interview before the process, Teachers' Reflection Reports during the process, and post-interview at the end were analyzed by using thematic analysis. Thematic analysis organizes the patterns in a data set and defines themes to interpret the aspects of the research topic (Braun & Clarke, 2006). In this analysis, direct quotations are often made to reflect the views of the individuals interviewed or observed (Yıldırım & Şimşek, 2016). The data obtained in the research are arranged by the researchers and interpreted concerning the themes.

Participants

The participants are seven in-service teachers pursuing their careers in three different subject areas: early childhood education, elementary education, and elementary mathematics education. Among 7 participants from different schools in Ankara, 2 of them are preschool teachers, 3 of them are elementary school teachers, and the last 2 are mathematics teachers at the elementary level. Their teaching experience ranges from 6 to 25 years. All of the participants were female. The selection of the participants was based on volunteerism and not having experience in the systematic reflective teaching process. In the selection of the participants, the questions were sent to all the teachers who could be reached, and opinions were received from 94 teachers for 4 questions. Seven of these teachers, who are willing to watch their lessons for 12 weeks and to reflect on them, were included in the long-term data collection process of the study. In this study, the focus was on teachers' opinions about their pedagogical development. Therefore, having different subject areas and having different years of experience for teachers were considered sources of rich data for commonality of opinions.

Data Collection

Data Collection Instruments

In this study, three data collection tools are used to provide an opportunity to triangulate the data (Yıldırım & Şimşek, 2016).

Pre-Interview Protocol. According to the research question to reveal the teachers' opinions towards video-based self-reflection, three questions are prepared. The questions asked the opinion of teachers about the effect of (1) video recording, (2) self-reflection only, and (3) self-reflection on video recording of their lessons on pedagogical development. The questions were; "What is your opinion on recording videos of your lessons?", "What is your opinion on self-reflective thinking on your lessons?", and "What is your opinion on self-reflective thinking by watching videos of your lessons?"

The questions were prepared by the researchers. The main purpose of preparing the questions is to determine the teachers' opinions on these concepts before the study. To ensure the appropriateness of the questions (Merriam, 1995), after preparation, 4 teachers who were not included in the study were asked for their opinions on the clarity of the questions. In addition, opinions about the appropriateness of the questions were taken from three experts working in the field of teacher education. Before the 12-week systematic data collection process, the questions are sent to several teachers to understand general opinions regarding video-based self-reflective thinking. The data collected from 94 teachers from various subject areas showed that the questions were understandable and that they could be used in the same way without any change.

Teachers' Reflection Reports. In Teachers' Reflection Report, there are three questions to reveal teachers' opinions about the video-based reflection are prepared. These same experts investigated the questions and finalized them as follows: (1) Please write your evaluations about the lesson you have completed (2) If you could do this lesson again, what changes would you make? Why? (3) Indicate other points you want

to evaluate about this process. Besides, the teachers were presented with a checklist of quality teaching items. This list is designed only to make the participants write their reflections quickly, as a supplementary and it is not put into the evaluation. Therefore, using the list statements is optional. In fact, the researchers are just the collector of the reflection reports and they do not interfere to the process. Sample items in the list are as follows: "Providing effective feedback", "Answering students' questions", and "Transition between activities".

Post-interview Protocol. At the end of the research, post-interview is organized in a focus group meeting format, and the process is discussed with the teachers. This time the researchers were the conductors of the semi structured interview. They asked questions and noted the given answers. The same questions used in the Pre-interview Protocol were asked during post-interview. Since this interview was in semi-structured format, the researchers put additional questions in order to enrich and expand the discussion for a deeper understanding of teachers' opinions. In addition to three main data collection tools discussed above, every three weeks of the data collection process (on 3rd, 6th, 9th weeks), the researchers organized 3 face to face brief interviews with unstructured questions with teachers for technical and procedural issues.

Data Collection Procedure

The ethical approval document and permission from the Ministry of National Education (MoNE) was presented to all subjects. Then, the volunteer teachers were informed about the aim and the procedure of the project and consent was obtained from all subjects before the study.

The researchers gave a face-to-face seminar regarding the techniques of using a video recorder, saving recorded sessions and writing reflections utilizing the data collection instrument designed by the researchers. The seminar included the sessions of informing the teachers about the purpose of the study, introducing the document (forms) to be used in the study process, and the technical use of the camera. In addition to this, a sample lesson video was watched, the teachers' thoughts were asked, and then they were asked to reflect on this lesson. 2 hours are allocated for all these activities. Expectations related to the research processes were presented and the teachers were guided to reflect on a sample lesson watched on the video by using the Teachers' Reflection Report. The teachers were guided about the placement of the video in the classroom in such a way that the faces of the students would not be visible. Besides, they were suggested to start using the video before the actual data collection process in order to help them get used to the camera in the classroom and act in a way that does not disrupt the natural process. Teachers were expected to explain to the students that it was within the scope of progress for their teaching. For obtaining permission, the teachers received written consent forms from their students and parents, which were submitted as an attachment to the ethics committee form.

After the seminar, a 12-week video-based reflection process was started. During the first lesson recordings of the teachers, the researchers were at the school to be accessible for support. The teachers recorded themselves for about one class hour, at least once a week for 12 weeks. The recordings were confidential and were not shared with the researchers. The teachers watched their teaching sessions on their recordings.

They wrote video-based reflections using a Teachers' Reflection Report. Teachers shared their reports via e-mail sent to the researchers. Every three weeks, the researchers conducted brief interviews to sustain the progress of the process. After the video recording and reflecting on lessons were over, researchers arranged a post-interview which lasted for an hour with the teachers. The summary of the research design is presented in Table 1.

Table 1

Summary of the Research Design

Process item	Instrument	Period	Schedule
Pre-interview	Pre-interview Protocol	Once	At the beginning
Video-based reflection process	Teachers' Reflection Reports	12 weeks	During
Brief interviews	-	Every 3 weeks	During
Post-interview	Post-interview Protocol	Once	At the end

Data Analysis

The data collected via the Pre-interview Protocol, Teachers' Reflection Report and the Post-interview Protocol are analyzed using descriptive analysis. As a first step, the data collected via the interview protocols, and reports were saved digitally on a computer without any alteration or correction. The participant teachers were indexed as P1, P2, … to P7 for the confidentiality of personal information so that the names remained anonymous. Then the answers to the open-ended questions were coded to identify topics, issues, similarities, and differences revealed through the teachers' narratives (Braun & Clarke, 2006; Yıldırım & Şimşek, 2016).

The data from the seven Pre-interview Protocols, 84 Teachers' Reflection Reports, and one Post-interview Protocol were analyzed in total. The researchers applied an independent coding process for the data gathered from interviews and each of the reports gathered from teachers. Evidence is provided from some quotes in the collected data. After discussing emerged meanings to agree on overemphasized or underemphasized themes (Shenton, 2004), another colleague is also consulted for his inner vision into the emerging codes to decrease or avoid any potential bias. Moreover, for inter-rater agreement, the formula of "[the number of agreement / (the number of agreement + the number of disagreement)] x 100" (Miles & Huberman, 1994, p. 64) was used. The interrater agreement in the initial case was 86.2%. For the thematic analysis of the data, MAXQDA qualitative data analysis software was used. The coding process is considered in three titles: Pre-interview, Teachers' Reflection Reports, and Post-interview. Pre-interview and Post-interview processes generated three categories: 'Teaching and learning process, 'reflection on video recording' and 'professional development'. For the coding of Teachers' Reflection Reports, the themes of teachers' answers fell into two categories: ''positive' and 'open for improvement'. If the teachers

in their video-based reflection of their lessons reflected on one of the subcategories in a positive way, it is considered under "Positive" category.

Ethical Procedures

The ethical approval for this study was obtained from the Human Research Ethical Committee of TED University with the document number 2019/04 on 28.02.2019.

Findings

Findings of the study were presented to provide answers to the research question as teachers' opinions about the effects of video-based self-reflection on their lessons for their pedagogical development "before the process", "during the process" and "after the process".

Teachers' Opinions before the Process

As part of the Pre-interview Protocol, the teachers were asked their opinions about video self-recording during teaching and reflecting on them. The teachers' answers in the pre-interview sessions were categorized drawn on the coding process, as shown in Table 2 below.

Table 2

Categories and Subcategories on the Coding of the Pre-Interview

Category	Subcategory	f	%
Reflection on video recording		12	52.2
	Benefit	7	
	Privacy	5	
Professional development		7	30.4
	Criticism of the lesson	4	
	Noticing mistakes	2	
	Enabling recall	1	
Teaching and learning process		4	17.4
	Approach in compliance with level of the student	2	
	Materials and examples used	1	
	Students' understanding and explanations	1	

As seen in Table 2, the findings of the pre-interview answers fall under three categories and eight subcategories. During this pre-interview session it was seen that what the teachers emphasize the most was reflecting on video recordings of their lessons. 'Reflection on video-recording', is the most powerful theme (f=12) comprising two sub-categories as 'benefit', and 'privacy'. These subcategories suggest that teachers foresee the potential benefits of reflecting on their video recordings of their lessons and at the same time they have concerns about the privacy of their lessons. Related to the

'benefit' subcategory, teacher P6 puts it as: *"Because what I live flies away, it is more effective for me if there is a video recording that I can access later."* P7 has concerns about being recorded regarding privacy issue but still agrees that there may be a beneficial use of it with the words as follows:

Classroom is a private place. Therefore, I do not find it accurate to have cameras and images in the classroom. ... I do not approve of sharing it with everyone, but if I am going to plug in a camera and watch it myself, then it might make sense.

'Professional development' (*f*=7) was another theme that emerged from the pre-interview session with three subcategories as 'criticism of the lesson', 'noticing mistake' and 'enabling recall'. The teachers seem to realize the contribution of the reflection process on their professional development. For example, teacher P5 expressed this as follows:

"... the teacher experiences something in the classroom, sometimes watching it again and seeing a mistake, seeing where and what went wrong means personal criticism, and it makes sense.". P4 puts it as: "Just watching it again may be compensating for the mistakes I made, but I always question this in my mind without recording a video, though; maybe the video recording can make it easier."

The weakest density belongs to the 'teaching and learning process' theme with a frequency of three. For the 'Teaching and Learning Process' category, subcategories were: 'approach in compliance with level of the student ', 'materials and examples used', 'explanation for student understanding'. The subcategories evince that the participant teachers can benefit from the reflection on self-video recording process in different ways in terms of teaching methods that they can use in the classroom. For instance, teacher P6 finds the clue about the student's level to adjust her approach accordingly and expressed it as follows:

I can predict what the student does not understand after explaining the subject without putting it in words, I can see where there is a question mark. It may be useful in that respect.

P6 also eliminated about the materials and examples she used in her lesson and put it as follows:

It can be useful to keep in my mind the materials I have made and the examples I have given.

Teachers' Opinions during the Process

The teachers' opinions in the Teachers' Reflection Reports were categorized drawn on the coding process, as shown in Figure 1 below.

Figure 1

The Density of the Categories in Teachers' Reflection Reports
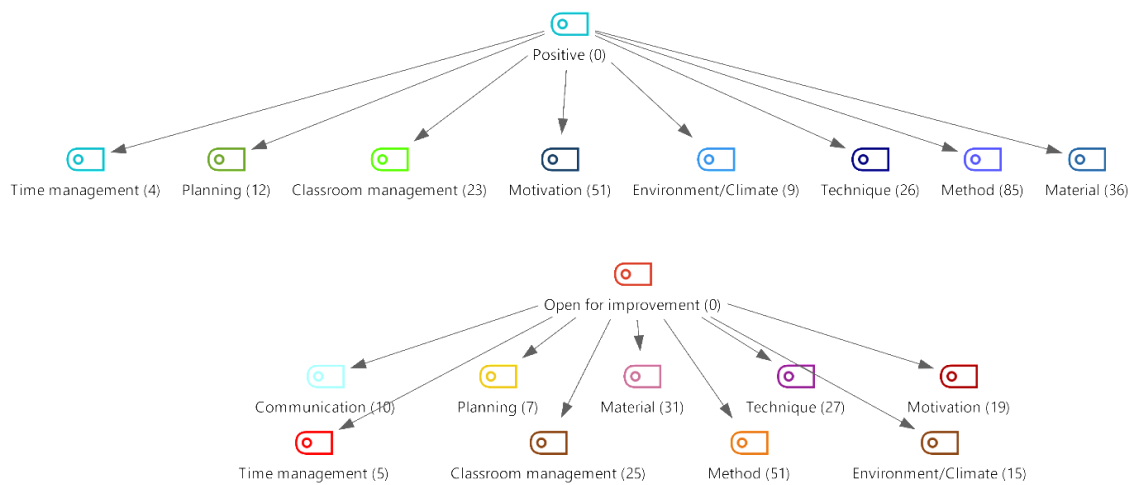
As seen in Figure 1, data from Teachers' Reflection Reports revealed two categories as 'positive aspects' and 'aspects open for improvement' with nine subcategories comprising time management, planning, classroom management, material, technique, method, environment/climate, motivation, communication. In the reflections on their self-video recordings, the teachers reported about the methods, techniques and materials they used in their lessons, the environment of the classroom and the climate they created during the lessons, their time and classroom management skills, the motivation and the communication in their lessons, and their planning for the lessons. The density of the categories and subcategories listed above is presented in Table 3.

Table 3

Frequency Table for the Categories Drawn on the Coding of Teachers' Reflection Reports

Category	Positive Aspects		Aspects open for improvement	
Subcategory	*f*	%	*f*	%
Method	85	19.5	51	11.7
Motivation	51	11.7	19	4.4
Material	36	8.3	31	7.1
Technique	26	6.0	27	6.2
Classroom management	23	5.3	25	5.7
Planning	12	2.8	7	1.6
Environment/Climate	9	2.1	15	3.4
Time management	4	0.9	5	1.1
Communication	-	-	10	2.3

As seen in Table 3, among the nine subcategories, the 'Method' subcategory is the strongest, and it can be stated that it is referred to in most of the teacher reflections. For example, P1 mentioned outdoor lessons as a method for her students to benefit from her lesson more, and she expressed this as: *"Soil and seeds were very dispersed in the classroom environment. It would be better to do it outside of the classroom."* This reflection was categorized under 'Open for improvement'. For example, P6 shared how it worked well to start the lesson by answering the homework questions and using the revision method as follows: *"The lesson started with the solution of the homework. The assignment about the place value of decimal notation has been done, the subject was repeated."*

Although the same subcategories emerged in 'Positive aspects' and 'Aspects open for improvement' categories, the order of their density varied. For example, for the 'Positive aspects' category, the second subcategory that follows 'method' is 'motivation,' while it is 'material' subcategory for the 'Aspects open for improvement' category. P7 reflected on her motivation sources during the lesson and put it as follows: *"An introduction to the lesson was made by arousing students' interest and motivation throughout the lesson. Rewarding is a method I use very rarely in my lessons."* The same subcategory is referred to under the 'Aspects open for improvement' category by the same teacher (P7) in her ninth-week reflections as follows:

I try to explain the lesson in a clear and understandable language, but some of the students give up because of their negative prejudices against the new generation question types that require interpretative power. Unfortunately, I cannot attract the attention of some students with such questions.

P2 in both categories referred to the 'material' subcategory. In her seventh week, she reflected on how she should improve about using materials with the words: *"I have to diversify the materials to provide more interest and motivation."* while she refers in her ninth week under the 'Positive aspects' category with the words:

The materials I will use in the activity (metal, wood, plastic, fabric, wool) were prepared separately for each child, and it helped get their attention in the introduction and keeping the interest in the activity.

About the 'Classroom management' subcategory under the 'Positive aspects' category, participant P3 declared that she was successful in classroom management and expressed this as follows: *"Since it is a text that attracts the attention of children that they love, there was no problem in classroom management ..."* P3 continued: *"The course meets the criteria for classroom management."* About the same subcategory under the 'Open for improvement' category, the same participant thought that she failed to manage the classroom in that lesson and reported as follows: *"When I watched the video, I saw that this lesson, I focused on a few students. I should have been careful with that."*

Some reflections of the teachers address more than one theme at a time. In her second-week reflection, P3 put it as *"Reflecting the text on the board in the teaching-learning process took our time so that it could have been prepared in advance."* With these words, she points out room for improvement in time management, and at the same time, she mentions the necessity for planning before the lesson, both of which are categorized under the 'Open for improvement' category. An example for the same

subcategory under the 'Positive' category from the same teacher (P3) is recorded as follows:

From so many videos, I understand that the better preparation the teacher makes before the lesson, the easier and more enjoyable it is for children to learn. The participation of the children in the lesson shows that the interest and desire of the children were at the expected level, due to the preparation made in advance.

She reflected on preparing before the lesson, and following the plan during the lesson contributed to her lesson. On the other hand, P7 found last week's lesson satisfying in terms of time management and reflected as follows: *"The planning and time of the lesson were ideal."* There were some specific techniques that some participants emphasized the beneficial use. P5 used the experiment technique reported it as "*... It was observed that the course was properly introduced, techniques were used appropriately, necessary warnings were made, and active participation was achieved.*" in her sixth-week report. Besides, *"An experiment was made on the states of matter."* in her seventh-week report while she determined the need for the use of different techniques in the lesson with his words: *"... I would organize a drama activity; get the attention, and then move on to the learning and teaching process."*

One of the themes drawn from the participants' reflection reports was the environment and the climate of the classroom. It was referred to in both the categories as to be improved and the successful implementations of it. For example, P4 expressed this as follows; *"I think that motivation is impaired from time to time in the lesson, and this is because the physical environment is not arranged according to the requirements of the lesson. Next time I will consider physical arrangement beforehand."* On the other hand, P7 shared in her report that she starts the lesson after arranging the physical environment: *"After preparing the physical environment of the classroom for the lesson ..."*

The last theme only under the 'Aspects open for improvement' category is the 'communication' subcategory. P7 shares her efforts for a healthy communication in her classroom and describes her attempt as follows: *"I try to communicate with the students by using my voice and body language effectively (in the teaching process). I listen to them with interest and try to make each one feel valuable."*

Teachers' Opinions after the Process

After the 12-week implementation session, a post-interview with teachers was arranged. This post-interview data was analyzed, and the teachers' answers to the post-interview questions were categorized drawn on the coding process, as shown in Figure 2 and Table 4 below.

Figure 2

The Density of the Categories for the Post-Interview
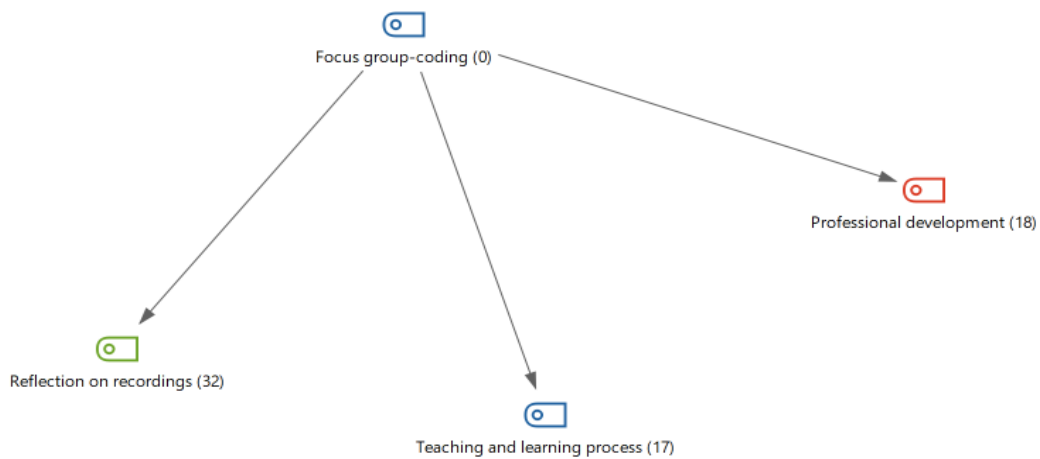
As seen in Figure 2, the coding for the post-interview falls under three categories and 14 subcategories:

Table 4

Themes and Their Density Are Drawn on the Coding of Post-Interview

Category	Subcategory	f	%
Reflection on video recording		32	47.7
	Contribution	11	
	Keeping written record	8	
	Watching video recordings	8	
	Missing information	5	
Professional development		18	26.9
	Hesitation	6	
	Self-evaluation and improvement	7	
	Learning by doing	3	
	Adjustment to environment	1	
	Pre-service teacher training	1	
Teaching and learning process		17	25.4
	Diversity	6	
	Pre-planning	4	
	Material	3	
	Introduction	2	
	Equity	2	

As seen in Table 4, 'reflections on video recordings', with a frequency of 32, is the most powerful theme. It is followed by 'professional development' with a frequency of 18. The weakest density belongs to the 'teaching and learning process' with a frequency of 17. Comparing to pre-interview results, it is seen that the post interview subcategory densities have increased. The reason for this is that the participant teachers emphasized some themes repeatedly. This gives a rise to the argument that the participants were highly influenced by the experience they had, and they used repetitive emphases to express this.

In the 'Reflection on video recording' category, subcategories are emerged as 'contribution', 'keeping written record', 'missing information', and 'watching video-recordings'. The teachers agreed on the contribution of recordings to their reflection on video recording. For example, P2 puts it as: *"There could be things we forgot. I know what I will write according to the criteria, but watching it helped me a lot. If we had written our reflections without watching the video recordings, there would be a lot more missing."* P1 shared the same idea and reflected as: *"We would have forgotten if there was no watching by that time."* and P6 declared that she agreed by saying *"Yes, same"* and continued, *"It is essential to watch."*

'Professional development' category revealed subcategories as 'hesitation', 'self-evaluation and self-improvement', 'self-improvement,' 'learning by doing', 'adjusting to the environment, pre-service teacher training', and 'life-long development'. For example, about the 'Professional development' theme, P2 mentioned her hesitation at the beginning of the process and how she ended up with the sense of self evaluation and self-improvement. P6 reflected on this as follows:

I thought maybe I would hesitate, but I think it contributed a lot to evaluate myself…. Even if I am not going to shoot it, I always have it in my mind, and I think I am improving myself. Rest of her words demonstrated her experience of learning by doing and adjusting to the environment. She voiced it as*: It contributed a lot to me. …. In other words, we learned by doing in professional life. It took a long time that we kept adjusting to the environment.* She also suggested the same study to be conducted with preservice teachers as follows: *I think a study of this kind will contribute a lot to the students as well,* and P5 contributed as: *"I can really express it as I grew up, and developed further."*

For the 'Teaching and Learning Process' category, subcategories risen as; 'diversity', 'pre-planning', 'material', 'introduction' and 'equity'. For example, P2 shared about the diversity in her teaching process using different methods and materials, and her pre-planning for the lessons:

For example, I realized that I diversified the methods and materials I used in my lessons after this project started. You know, there are differences in the children's learning how can I say… now that I believe there should be diversity, I started to teach the lesson by preparing myself according to student differences. P6 articulated that she started preparing an introduction to each subject and paying attention to be fair to the students during her lessons as *"So it makes sense to consider how I introduce a subject effectively or do I give equal opportunities to each child, or switch on that subject after a few students understand."*

Conclusion and Discussion

The results of the pre-interview and post-interview process revealed that the teachers' opinions on their pedagogical development changed after the 12-week video-based self-reflection practice and the findings of the video-based self-reflection reports provide insight about how these changes occur. It is thought that teachers' reflection in a systematic way for a long time instead of once is effective in this change, as suggested in previous studies (e.g., Aslan et al., 2022).

The teachers' major concern in the video-recording process was the privacy of their classroom. It is in line with the literature that when the video is watched by other people it can be perceived as a violation of privacy (Kleinknecht & Schneider, 2013). As a solution, teachers were told that they would be the only ones to watch the videos they recorded. Thus, knowing that others would not watch reduced teachers' anxiety and contributed to their being authentic (Nagro, 2019).

Teachers stated that knowing about reflection in the early stages of their profession would contribute a lot to their pedagogical development. They further suggested that pre-service teachers may benefit from the reflective process in undergraduate education before starting a profession as a teacher yet. These views of the teachers coincide with the findings of the Toker (2016) and Güngör (2016) studies. The suggestions of participant teachers seem to align with the literature as it is asserted that reflection is an ability that should be taught with other teaching abilities (deBettencourt & Nagro, 2019).

Teachers have difficulties reflecting that they spend time recording videos, watching videos, and reflecting during the busy school day due to their high workload for teaching. Thus, video-based reflection might be a part of the corporate culture of the school. Beyond that, the reflection would benefit from being a school policy in the scope of stimulating teachers to develop their teaching practices and self-reflection (Pow & Lai, 2021). Action steps such as scheduling reflection times like teaching time for teachers at school can enable teachers to reflect since incorporating such professional development maximizes sustainability and achievement (van Veen et al., 2012).

Within the study's scope, researchers provided flexibility for teachers in recording videos whenever they wanted, in the course and the type of lesson. Providing teachers with the flexibility to analyze their videos at a time that is convenient for them, a process did not require immediate response (Weber et al., 2018). This may have enabled them to adapt to the process more easily.

Data from the Teachers' Reflection Reports revealed that each teacher focused more on certain items in line with their own developmental needs, such as issues related to teaching methods. From this point of view, it can be predicted that reflection, which is oriented on needs, can benefit teachers (Ross & Bruce, 2007). In addition, this finding overlaps with previous literature findings (e.g., Chen, 2020) that it is beneficial for teachers to analyze their lessons in terms of improving their teaching practices. In the context of the study, teachers had a chance to include reflection elements to identify more situations at first, but as the process progresses, they seek solutions to the elements they reflect, and even start to reflect on them by applying these solutions in their lessons. This finding supports the previous finding that when video evidence is used

successively, teachers' emphasis shifts from personal issues such as feelings to decisions based on data related to their instruction (Nagro et al., 2020).

It was seen that the teachers used the list consisting of items about quality teaching for more than one purpose, such as using in lesson planning. In other words, they were able to pre-reflect not based on previous teaching experiences but only based on elements in this list. Thus, it became a robust professional development practice (Körkkö et al., 2019; Nagro et al., 2020) for teachers.

Teachers' reflections show that this process encouraged them to plan and implement more student-centered lessons. From this point of view, although this cannot be said for every teacher, it can be said that the video-based reflection process, as in this study, contains some factors that may lead to some skill and attitude changes in teachers' teaching and development. Teachers' reflections on student learning and engagement may have triggered their practice to review and improve in this direction.

Development takes time and may be related to different factors; the same level of change and development is inevitably not observed in every teacher. Thus, video-based reflection can provide improvement opportunities for teaching practices (Gibbons & Farley, 2021; Sydnor, 2016; Tripp & Rich, 2012).

Previous studies have shown that teachers' videos for their lessons facilitate them to recognize the elements they did not notice before since they have a chance to watch their videos more than once (Sherin & van Es, 2005). As seen in the reflections of teachers, it enables them to notice (Marsh & Mitchell, 2014) to make refinements in their lessons and their teaching and learning process.

The literature suggests that guiding frameworks and knowledgeable people can promote the reflection process (Shanahan & Tochelli, 2014). In this study, participating in a systematic reflection provided a framework to reflect at a particular time. This framework provided an opportunity to rank what they should focus on to improve their teaching. Teachers have facilitated this guidance which is important in their reflection process (Straková & Cimermanová, 2018).

The teachers stated that they would continue to reflect on their teaching, although it is not mandatory, because they have seen the benefit of this development process. Teachers who are volunteer to experience new approaches to meeting their students' needs have a positive approach to use reflection (Nagro et al., 2017). The students continuously change, but teachers remain the same, and if they reflect, they can keep up with this change and development.

Implications

In this study, although the teachers shared their reflections with the researchers, the sharing among them was limited to the focus group. In future studies, planning can be made to increase teacher sharing to enhance collaborative reflection since it is beneficial for teachers to engage in practices that will encourage their communication and reflective thinking with their peers (Nami, 2022). Besides, although a framework for reflection is presented in the study, it is for pedagogical development in general. In future studies, the contribution of focused reflections to the pedagogical development of teachers can be studied.

Teachers in this study were expected to make their reflections in writing, and to create a sound recording if they wanted to. Different digital resources and tools such as video annotation tool (e.g., Shek et al., 2021) or coding software can be used for teachers to make their reflections. In this way, teachers can use their time effectively.

The interviews were made face-to-face in this study. In future studies, online interviews and supervision processes can be added to the study. Besides, in this study, the teachers analyzed the videos holistically and made their reflections accordingly. In other studies, it is possible to take cuts from the videos and focus on them according to the development areas and needs of the teachers. In addition, teachers made reflections by watching their own videos in the study. Besides, watching other people's videos can be included in the process.

In light of all of the above, it can be concluded that for teachers, a video-based self-reflection process has been defined as seeing themselves through the student's eyes and seeing themselves in the mirror. As stated by the teachers, video-based reflection can be used as a tool to evaluate the teaching process from the students' perspective. The data were obtained through teachers' opinions on video-based reflection to support their pedagogical development. In future studies, research can be conducted to examine how teachers put their opinions into practice in teaching to ensure their pedagogical development. Since this study focuses on pedagogical development, it is important to include teachers from different branches. In other research studies, researchers can also work with teachers from a single field that focuses on pedagogical content development. It was observed that each of the teachers with different experience periods benefited from this process. Studies can be conducted on how reflection contributes to teachers of different experience levels based on this.

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Statement of Responsibility

Assoc. Prof. Dr. Sühendan Er provided supervision, project administration and funding acquisition for this project. Besides, she conducted validation and formal analysis with other researchers. Asst. Prof. Dr. Zerrin Toker conducted resource investigation and data curation process. Besides, conceptualization of the framework was done in collaboration with other researchers. Asst. Prof. Dr. Seçil Yücelyiğit provided methodology part and conducted software use process for data analysis and interpretation. Writing the original draft and editing are all conducted within collaborative work process of all authors.

Conflicts of Interest

There is no conflict of interest in this study.

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Investigating Pre-service Teachers' Origami-based Mathematics Lesson Plans

Öğretmen Adaylarının Origami Temelli Matematik Ders Planlarının İncelenmesi

Okan ARSLAN*

ABSTRACT: Origami became an increasingly used instructional tool in mathematics education and its successful use depends on developing adequate origami-based mathematics lesson plans. Therefore, this study investigated origami-based mathematics lesson plans developed by pre-service teachers who were trained for the effective use of origami in mathematics education in two courses in their teacher education program. In this quantitative study, survey research was combined with causal-comparative research, and there were 88 pre-service teachers who have been enrolling in the Elementary Mathematics Education program as participants. Pre-service teachers in one of these courses received origami-based mathematics education training for four weeks, whereas pre-service teachers in the other course received training for twelve weeks. Descriptive analyses revealed that pre-service teachers were able to develop adequate origami-based lesson plans after receiving training in these courses. Furthermore, it was revealed that they preferred to develop lesson plans mostly in the geometry and measurement content area. To test whether the adequacy level of lesson plans differs based on the training length of pre-service teachers, one-way ANCOVA was performed. Analysis results indicated that pre-service teachers who received longer training developed significantly are better at origami-based mathematics lesson plans. All the findings were discussed, and some implications based on these findings were explained.

Keywords: Lesson plan, mathematics, origami, pre-service teachers.

ÖZ: Origami matematik eğitiminde giderek artan şekilde kullanılan bir öğretim aracı haline gelmiştir ve origaminin başarılı bir şekilde kullanımında uygun bir ders planı hazırlamanın önemli bir rolü bulunmaktadır. Bu nedenle, bu çalışmada öğretmen adayları tarafından geliştirilen origami temelli matematik ders planları incelenmiştir. Bu nicel çalışmada, betimsel araştırma deseni ilişkisel araştırma deseni ile desteklenmiştir ve çalışmaya İlköğretim Matematik Öğretmenliği programında öğrenim gören 88 öğretmen adayı katılım göstermiştir. Çalışmaya katılan öğretmen adaylarından bir grup dört hafta süresince origami temelli matematik eğitimi hakkında bir eğitim alırken, diğer grup oniki haftalık bir eğitim almışlardır. Betimsel analiz sonuçları her iki gruptaki öğretmen adaylarının uygun origami temelli matematik ders planı geliştirebildiklerini göstermiştir. Ayrıca, ders planlarının içeriği incelendiğinde çoğunlukla geometri ve ölçme öğrenme alanına yönelik ders planlarının geliştirildiği görülmüştür. Eğitim süresi ile ders planının uygunluk seviyesi arasındaki ilişkiyi test etmek üzere tek yönlü ANCOVA analizi gerçekleştirilmiştir. Analiz sonuçları daha uzun süre eğitim alan öğretmen adaylarının istatistiksel olarak daha iyi ders planı geliştirdiklerini göstermiştir. Çalışma kapsamında elde edilen tüm bulgular tartışılmış ve bulgular ışığında çeşitli önerilerde bulunulmuştur.

Anahtar kelimeler: Ders planı, matematik, origami, öğretmen adayları.

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Enabling active participation of students during the paper folding process, providing opportunities for mathematical discussions, and making abstract mathematical concepts concrete made origami a valuable mathematics instruction tool appropriate for contemporary learning theories (Boakes, 2009; Kandil & Işıksal-Bostan, 2019; Sze, 2005; Wares & Elstak, 2017). Therefore, origami is increasingly used as an instructional tool in mathematics education literature.

In the existing literature, origami was used for various mathematical purposes and ages of students. At the pre-school level, Yuzawa and Bart (2002) explored that origami activities improved 5 and 6-year-old children's size comparison strategies. In another study, Mastin (2007) stressed that combining origami with storytelling, which was called storigami, improved her pre-school students' geometry knowledge and the use of mathematical language. At the elementary school level, Golan and Jackson (2010) exemplified how origami can be used to cover all geometry concepts in the elementary school curriculum and emphasized their positive experiences related to origami-based geometry instruction conducted in more than 70 Israeli schools. Supporting their claim, it was revealed that origami-based mathematics activities improved elementary students' geometry knowledge (Golan, 2011) and spatial skills (Çakmak et al., 2014). At the middle school level, origami-based mathematics activities were found to improve students' geometry knowledge (Georgeson, 2011; Kandil & Işıksal-Bostan, 2019), spatial visualization skills (Boakes, 2008), algebraic thinking (Georgeson, 2011; Higginson & Colgan, 2001), and understanding of ratio relationships (Boz, 2015; DeYoung, 2009; Hartzler, 2003). At the high school level, Budinski et al. (2018) exemplified how origami activities can be used by combining with GeoGebra to teach Platonic solids. In another study conducted with high school students, it was revealed that origami activities helped them conceptualize the properties of two- and three-dimensional geometrical shapes (Canadas et al., 2010). At the higher education level, it was revealed that using origami activities improved college students' spatial visualization skills (Boakes, 2008), Van Hiele's geometric thinking levels (Çaylan et al., 2017), and provided opportunities to explore some trigonometry and calculus concepts (Wares, 2019; Wares & Valori, 2020). In addition to the above-mentioned cognitive benefits of origami, it is also mentioned that origami activities helped students to gain self-efficacy in mathematics (Kandil & Işıksal-Bostan, 2019), be aware of the connection between arts and mathematics (Boz, 2015; Wares & Elstak, 2017; Wares & Valori, 2020), enjoy mathematics lessons (Boakes, 2009; Georgeson, 2011; Golan & Jackson, 2010; Higginson & Colgan, 2001), and develop knowledge about different cultures (Tuğrul & Kavici, 2002; Wares & Elstak, 2017).

As exemplified above, research studies related to origami-based mathematics education focused on the learner side either by investigating the effects of origami-based mathematics activities or sharing the experiences in such activities. Research studies with in-service or pre-service teachers seem to be less. These limited studies investigated views and beliefs of pre-service regarding the use of origami in mathematics education. The findings revealed that pre-service teachers consider origami as a beneficial instructional tool to be used in mathematics lessons, and they plan to benefit from origami activities in their teaching career (Arslan & Işıksal-Bostan, 2016; Fiol et al., 2011; Masal et al., 2018).

Origami can be an effective instructional tool in mathematics if only the teacher makes the appropriate connections between origami folding steps and mathematical concepts, and making this connection is not an easy task for teachers (Cipoletti & Wilson, 2004; Georgeson, 2011; Golan & Jackson, 2010; Sze, 2005). When the teacher could not make this connection, origami-based mathematics lessons do not differ from traditional teacher-centered mathematics instruction (e.g., Uygun, 2019). Therefore, various training (e.g., courses, workshops, or professional development programs) opportunities were offered to pre-service (Çaylan et al., 2017; Fiol et al., 2011; Masal et al., 2018; Mastin, 2007) and in-service teachers (Cipoletti & Wilson, 2004; Golan & Jackson, 2010; Mastin, 2007) to support the effective use of origami in mathematics lessons. However, no research study in the accessible literature investigated how effective pre-service or in-service teachers plan and apply origami-based mathematics lessons after receiving such training. Therefore, this study focused on the origami-based mathematics lesson plans developed by pre-service middle school mathematics teachers who were trained to effectively use origami in mathematics education through two courses in their teacher education program.

A Prerequisite for Successful Lessons: An Adequate Lesson Plan

A lesson plan is defined as "a teacher's detailed descriptions of the course of instruction for an individual lesson" (Mishra, 2009, p. 2). Lesson plans are described as road maps for teachers guiding their teaching practices (Haynes, 2010; Milkova, 2012), thus, effective lesson plans are considered essential for successful lessons (Li et al., 2009). Supporting this claim, special emphasis is given to lesson planning in countries such as China, Japan, and Finland, which show top performances in PISA and TIMMS studies (e.g., Hemmi et al., 2017; Li et al., 2013; Melville & Corey, 2021; Shimizu, 2008; Yang & Ricks, 2013). Investigating lesson plans reveals a teacher's professional competence (Blömeke et al., 2008). Therefore, various studies in the mathematics education literature focused on the lesson plans developed by pre-service or in-service teachers (e.g., Backfish et al., 2020; Li et al., 2009; Shimizu, 2008).

Adequate lesson plans are also vital for origami-based mathematics lessons. There are several factors to be considered to develop adequate origami-based mathematics lesson plans. The first factor is the decision about the origami model to be folded. The origami model should be appropriate for students' age level and psycho-motor abilities to avoid problems during the folding steps (Boakes, 2008; Golan & Jackson, 2010). Furthermore, the folding steps of the selected origami model should provide opportunities to ask questions in line with the mathematical objective(s) of the lesson (Boakes, 2008; Cipoletti & Wilson, 2004; Golan & Jackson, 2010). After deciding on the origami model, a diagram clearly explaining the folding steps of the origami model should be developed (Boakes, 2008; Sze, 2005). Different than the regular origami diagrams, folding steps should be explained by using mathematical language in the diagrams (Baicker, 2004; Cipoletti & Wilson, 2004; Robichaux & Rodrigue, 2003). For instance, rather than saying "fold in half," it should be said, "fold along the diagonal symmetry line." One of the most critical parts of origami-based mathematics lessons is to ask appropriate mathematical questions in line with the mathematical learning objective(s) of the lesson during the folding steps (Georgeson, 2011; Serra, 1994). Furthermore, there should be additional questions enabling one to

remember previously learned mathematical concepts (Baicker, 2004; Serra, 1994). Folding steps of origami models provide opportunities to support learners' higher order-thinking levels (Canadas et al., 2010; Sze, 2005). Therefore, instructors can pose challenging questions in origami-based mathematics activities to improve learners' problem-solving abilities (Georgeson, 2011; Higginson & Colgan, 2001; Wares, 2019). Origami-based mathematics activities also provide opportunities to relate mathematics to art and science (Higginson & Colgan, 2001). By making this relation, instructors can "inspire artistic-minded individuals to think mathematically" (Wares & Valori, 2020, p. 2). Similar to the regular mathematics lessons, origami-based mathematics lessons should be ended with assessment questions to test whether the mathematical learning objectives are achieved (Cipoletti & Wilson, 2004; Serra, 1994).

In brief, an adequate lesson plan could be accepted as a prerequisite for successful lessons and instructors should consider several aspects in the development of origami-based mathematics lesson plans.

Research Purpose and Questions

The successful use of origami in mathematics education depends on developing adequate lesson plans. Therefore, the first research question of this study is to investigate the adequacy of origami-based mathematics lesson plans developed by a group of pre-service teachers who were trained on the use of origami in mathematics education: (1) What is the adequacy level of origami-based mathematics lesson plans developed by pre-service teachers?

As exemplified above, origami can be used for several mathematical purposes in the literature. Investigating lesson plans not only reveals teachers' competence but might also serve as a window to reveal their teaching-related views and intentions (Shimizu, 2008). Therefore, it was aimed to explore which mathematical topics were preferred by pre-service teachers in their origami-based mathematics lesson plans: (2) Which mathematical topics were addressed in pre-service teachers' origami-based mathematics lesson plans?

Although it is acknowledged in the literature that training is essential for pre-service and in-service teachers to support the effective use of origami in mathematics education, there is no research conducted on the content or the length of such training. Therefore, this study aimed to contribute to the existing literature by investigating whether the adequacy of origami-based mathematics lesson plans differs based on the training length (shorter training length–4 weeks; longer training length–12 weeks) of pre-service teachers: (3) Is there a significant difference on the adequacy level of origami-based mathematics lesson plans by considering origami-based mathematics education training length of pre-service teachers?

Method

Research Design

This quantitative research study focused on pre-service teachers' origami-based mathematics lesson plans. It was aimed to answer how adequate the lesson plans were, which mathematical concepts were addressed in those lesson plans, and whether the adequacy level of lesson plans differed based on the pre-service teachers' training

length on origami-based mathematics instruction. In line with these research aims, survey research was combined with causal-comparative research, which is a commonly used research design in quantitative research studies (Fraenkel & Wallen, 2006). Specifically, survey research design principles were applied in the first and second research questions, and causal-comparative research design principles were applied in the third research question.

Participants and Context

The participants of this study were pre-service teachers who have been enrolling in the Elementary Mathematics Education program in one of the public universities in Turkey. The program lasts for four years, and graduates become eligible to work as middle school (grades 5 to 8) mathematics teachers. The program has some core (such as Teaching Geometry and Measurement, Teaching Numbers, Connections in Mathematics, and Misconceptions in Mathematics) and elective (such as Informal Learning Environments in Mathematics Teaching, Ethnomathematics, and Teaching Mathematics to Gifted Students) courses related to mathematics education. The Approaches in Learning and Teaching Mathematics course is one of the core courses which is offered to sophomore pre-service teachers. As a part of the course, pre-service teachers were trained for four weeks to use origami as a learning and teaching approach in mathematics lessons. During the four weeks of training, pre-service teachers were firstly trained on basic origami skills (basic origami folds, different types of origami, reading an origami diagram, and folding simple origami models), and then on the methods of using origami in mathematics lessons as a teaching approach (developing an origami diagram appropriate for mathematics lessons, origami model selection criteria for origami-based mathematics lessons, exemplary origami-based mathematics activities, and developing origami-based mathematics lesson plans). The content of the other course, Origami, was similar—training on the basic origami skills first, and then on the methods of using origami as an instructional tool in mathematics lessons. However, this training lasted 12 weeks since the course was solely on origami. Therefore, even though both participant groups received similar training in content, the ones in the Origami course received more detailed training.

There was a total of 91 pre-service teachers in these two courses, and 89 of them provided written consent forms for using their origami-based mathematics lesson plans in the current study. Because of some missing data, one lesson plan was excluded from the data set, thus, there were 88 final participants (72 females and 16 males) in this study. Among the participants, 58 of them received shorter training (4 weeks in the Approaches in Learning and Teaching Mathematics course), whereas 30 of them received longer training (12 weeks in the Origami course).

Ethical Procedures

All the ethical permissions to conduct this study were obtained from the researcher's institution (Burdur Mehmet Akif Ersoy University Non-Interventional Clinical Research Ethics Committee, Ethics assessment document number: GO 2021/22). All the participants informed about the study, and they signed informed consent form.

Data Collection and Analysis

As a part of their training in the above-mentioned courses, pre-service teachers were required to develop origami-based mathematics lesson plans, which constituted the data of this study. There were no restrictions about the grade level (as long as it is at the middle school level) and the topic that would be addressed in the lesson plans. The adequacy level of origami-based mathematics lesson plans was assessed by an analytic rubric: Origami-Based Mathematics Lesson Plan Evaluation Rubric. The rubric consists of eleven items with three levels (poor, average, and good). The rubric items were first developed after a detailed literature review and revised based on the views of three experts: one from the measurement and assessment department, and the other two from the mathematics education department who have academic research studies and fieldwork experience related to origami-based mathematics instruction. Sample items of the rubric are given in Table 1.

Table 1

Sample Items of the Rubric

Item Number	Poor (0)	Average (1)	Good (2)
2	The chosen origami model is not appropriate for mathematical objective	The chosen origami model is partially appropriate for mathematical objective	The chosen origami model is appropriate for mathematical objective
5	Most/all of the folding steps given in the diagram are not clear	Some of the folding steps given in the diagram are not clear	All the folding steps given in the diagram are clear
7	Appropriate questions for the mathematical objective were rarely/never asked during the folding steps of the origami model	Appropriate questions for the mathematical objective were sometimes asked during the folding steps of the origami model	Appropriate questions for the mathematical objective were often/always asked during the folding steps of the origami model

To ensure the validity and reliability of the rubric, exploratory factor analysis and some reliability tests (Cronbach's Alpha, Pearson Correlation, and Cohen's Kappa) were performed. Analysis results indicated that the rubric had one dimension, which explained 42.5% of the total variance. All the items in the rubric were appropriate for the rubric: item factor loadings were higher than .30, and item communality values were higher than .10. Furthermore, it was revealed that data obtained through the application of the rubric had high internal consistency: Cronbach's Alpha was calculated as .83. Moreover, the use of rubric provided highly consistent results when two researchers graded the same origami-based mathematics lesson plans independently: Pearson Correlation Coefficients ranged between .75 and 1.00, and Cohen's Kappa Coefficients ranged between .63 and 1.00 for the rubric items.

In brief, the detailed item development process and satisfactory exploratory factor analysis results indicated that the rubric is a valid instrument for evaluating origami-based mathematics lesson plans (Moskal & Leydens, 2001; Pallant, 2007). Moreover, data obtained through the application of rubric had high internal consistency

and assured interrater reliability criteria (Cohen, 1960, 1988; Moskal & Leydens, 2001). The details of the rubric development process, validity, and reliability evidence were given in Arslan (2022).

In the data analysis process, descriptive statistics were used to answer the first two research questions, and one-way between groups Analysis of Covariance (ANCOVA) was used to answer the third research question of the study. Before performing ANCOVA, all the assumptions (such as normality, linearity, homogeneity of variances, and homogeneity of regression slopes) were checked and all but one assumption were assured. Data set failed to assure normality assumption, however, ANCOVA was still performed since this analysis was found to be robust for the violation of normality assumption (Olejnik & Algina, 1984). In the analysis, pre-service teachers' Cumulative Grade Point Average (CPGA) was used as the covariate since their overall success in the Elementary Mathematics Education program might affect the adequacy level of their origami-based mathematics lesson plans. The analysis supported this claim and showed that there was a significant relationship between pre-service teachers' CPGA and their score obtained for the adequacy level of origami-based mathematics lesson plan (F(1, 85)=27.187, p=.000), thus, CPGA remained as the covariate in the analysis for the third research question.

Results

In this part of the study, descriptive and inferential statistics were presented to answer the study questions.

Pre-service Teachers' Origami-based Mathematics Lesson Plans

Descriptive analyses revealed that the mean score of pre-service teachers' origami-based mathematics lesson plans was 18.24. The minimum score that could be obtained from the Origami-Based Mathematics Lesson Plan Evaluation Rubric was 0, whereas the maximum score was 22. Therefore, pre-service teachers' origami-based mathematics lesson plans were above the average and could be interpreted as adequate lesson plans in general. Details about the calculated mean score are given in Table 2.

Table 2

Descriptive Statistics for Origami-based Mathematics Lesson Plans

	N	Minimum	Maximum	Mean	Std. Deviation
Total Score	88	4	22	18.24	3.45

When the lesson plans were interpreted in more detail, it was revealed that pre-service teachers' lesson plans received the highest mean score in choosing the appropriate origami model in accordance with the mathematical purpose of the lesson (*M*=1.93 out of 2) and the lowest mean score in making the connections between origami and non-mathematical fields such as science, art, and engineering (*M*=.99 out of 2). Descriptive findings for all rubric items were presented in Table 3.

Table 3

Detailed Descriptive Statistics of Origami-based Mathematics Lesson Plans

Rubric item is about…	Minimum	Maximum	Mean	Std. Deviation
Choosing the appropriate origami model in accordance with students' age and psycho-motor abilities	0	2	1.88	.36
Choosing the appropriate origami model in accordance with the mathematical objective of the lesson	0	2	1.93	.29
Setting the length of the lesson appropriately by considering the chosen origami model	0	2	1.80	.48
Motivating the students to the origami-based mathematics lesson	0	2	1.73	.47
Clarity of the origami folding diagram	1	2	1.75	.43
Using the appropriate mathematical vocabulary in folding steps	1	2	1.92	.27
Asking appropriate mathematical questions during the folding steps in accordance with the primary mathematical purpose of the lesson	0	2	1.82	.42
Asking mathematical questions in addition to the primary mathematical learning objective	0	2	1.71	.48
Asking appropriate questions to support students' higher-order thinking	0	2	1.13	.71
Making the connections between origami and non-mathematical fields	0	2	.99	.85
Choosing the appropriate assessment methods in accordance with the mathematical purpose of the lesson	0	2	1.57	.54

As can be seen in more detail in Table 3, pre-service teachers' lesson plans were quite successful in choosing the appropriate origami model and relating it to the mathematical content through the questions during the folding steps. There were only two rubric items in which the mean score was close (slightly above or below) to the average score: making connections to the non-mathematical fields and asking questions that support students' higher-order thinking.

Pre-service mathematics teachers' origami-based lesson plans were also analyzed based on the mathematical content and the grade level to be used. It was seen that origami-based mathematics lesson plans were varied by the grade level and mathematical content area (see Table 4).

Table 4

Origami-based Mathematics Lesson Plans Based on the Grade Level and Mathematical Content Area

Grade Level	Content Area			
	Numbers & Operations	Algebra	Geometry & Measurement	Total
5	4	0	25	29
6	9	0	4	13
7	0	0	9	9
8	1	2	34	37
Total	14	2	72	88

As can be seen in Table 4, pre-service teachers preferred to develop lesson plans in 5th ($n=29$) and 8th ($n=37$) grade levels, and in the geometry and measurement content area ($n=72$). The primary purposes of geometry and measurement topics in the origami-based mathematics lesson plans were: distinguishing acute, right and obtuse angles, constructing triangle segments (altitude, median, and angle bisector), determining the sum of the measures of the interior angles of triangles and quadrilaterals, calculating the perimeters of triangles and quadrilaterals, determining the basic elements of rectangle, parallelogram, rhombus and trapezoid, classifying triangles by sides or angles; calculating areas of polygons and solving related problems, determining the properties of complementary and supplementary angles, understanding the side and angle properties of regular polygons, determining side and angle relations of congruent and similar triangles, determining the similarity ratio of similar polygons, drawing two dimensional representation of three dimensional geometrical objects from different directions, examining their properties by determining congruent, reverse, interior reverse and exterior reverse angles, drawing translation and reflection images of points, line segments, and other shapes, recognizing the rectangular prism and determining its basic elements, recognizing the right cone and the right pyramid and determining its basic elements.

The origami-based mathematics lesson plans in the numbers and operations content area were about: establishing the rule of a number or shape pattern, adding and subtracting fractions, modeling the division of fractions, determining equivalent fractions by using simplification and expansion, ordering fractions with the same numerator or denominator, calculating and modeling percentages, determining the ratio of two values, understanding the basic rules of exponentials. There were only two origami-based mathematics lesson plans in the algebra content area. Both lesson plans were about multiplying algebraic expressions.

Influence of the Length of Origami-based Mathematics Education Training on the Effectiveness of Lesson Plans

One group of pre-service teachers was trained for 12 weeks on the effective use of origami in mathematics education, whereas the other group was trained for four weeks. Mean scores obtained from origami-based mathematics lesson plans indicated that pre-service teachers who had trained for a longer period had higher mean scores,

and higher adjusted mean scores when pre-service teachers' CGPA scores were used as the covariate for their origami-based mathematics lesson plans (see Table 5).

Table 5

Results of Descriptive Statistics for Pre-service Teachers' Origami-based Mathematics Lesson Plans by Considering the Length of Their Training

	N	Mean	Std. Deviation	Adjusted Mean	Std. Error
12 weeks training	30	19.17	3.64	19.43	.53
4 weeks training	58	17.79	3.31	17.66	.38

ANCOVA results indicated that there was a statistically significant mean difference in pre-service teachers' origami-based mathematics lesson plans when their CGPA scores were controlled ($F(1, 85)=7.43$, $p=.008$). The eta squared was calculated as .08, which indicated a medium effect size (Pallant, 2007). The details of the analysis results are given in Table 6.

Table 6

ANCOVA Results

	Sum of squares	*df*	Mean square	*F*	Sig.	Partial eta squared
Corrected model	342.35	2	171.17	20.71	.000	.328
Intercept	5.36	1	5.36	.65	.423	.008
CPGA	305.04	1	305.04	36.90	.000	.303
Training Length	61.42	1	61.42	7.43	.008	.080
Error	702.64	85	8.27			
Total	30391.00	88				
Corrected Total	1044.99	87				

Discussion and Conclusion

Research studies regarding the use of origami in mathematics education have hitherto mainly focused on the benefits of using origami in mathematics education. However, it is unlikely to benefit from origami in mathematics education without an adequate lesson plan. Therefore, central to this study was origami-based mathematics lesson plans developed by pre-service teachers. Analysis results revealed that pre-service teachers, who had training, were able to develop adequate, above the average and quite close to the maximum level, origami-based mathematics lesson plans. Pre-service teachers were specifically successful in selecting appropriate origami models, developing clear diagrams by using mathematical language, asking questions in relating the origami model to the mathematical learning objective(s), and preparing appropriate assessment questions. However, they were less successful in making the connection

between origami and non-mathematical fields and asking questions supporting higher order thinking levels of students. It is emphasized that connecting origami to fields such as art and science helps to attract students' attention more (Higginson & Colgan, 2001). Therefore, pre-service or in-service teachers should be encouraged to make such connections more in their origami-based mathematics lessons. Even though origami provides a context to ask questions supporting higher order thinking levels of students, participant pre-service teachers were not very successful in doing so. This result might be expected since developing such questions is not an easy task, specifically for pre-service teachers. To support the use of such challenging questions, there should be origami-based mathematics resources in which the use of such questions was exemplified. Such resources are restricted to a few articles (e.g., Georgeson, 2011; Wares, 2019; Wares & Valori, 2020) and books (e.g., Serra, 1994). Enriching these resources might help pre-service and in-service teachers to develop more challenging questions in their origami-based mathematics lessons.

In the origami-based mathematics lesson plans, geometry concepts were addressed most. These lesson plans included all the geometry concepts at the middle school level (such as angles, area, volume, properties of geometrical shapes and objects, symmetry, and reflection). This result supports the claim that origami might be a powerful source to teach various geometry concepts in different grade levels (Boakes, 2009; Golan & Jackson, 2010). Apart from geometry topics, pre-service teachers mostly used origami to teach fractions and ratio concepts. Even though origami-based mathematics activities for all content areas at the middle school level (geometry and measurement, numbers and operations, algebra, and data analysis) were exemplified in pre-service teachers' courses, they mostly preferred to develop lesson plans in the geometry and measurement content area. The findings of this study were limited to shedding light on the underlying reasons for pre-service teachers' origami-based mathematics lesson plan preferences. However, it might be interpreted as pre-service teachers feeling more competent to use origami to teach geometry concepts compared with other content areas, or they might interpret that origami in mathematics education is more appropriate for geometry topics. To support the use of origami in different content areas in mathematics, instructors might emphasize the examples out of geometry topics in training.

Pre-service teachers in this study were able to develop adequate lesson plans regardless of their origami-based mathematics education training length. This might be interpreted as the content of the courses being appropriate to gain knowledge and efficiency in origami-based mathematics education. However, pre-service teachers who received longer training developed significantly more adequate lesson plans when compared with the ones who received shorter training. This result might be expected since developing adequate lesson plans requires training (Li et al., 2009); thus, longer training period might lead to better lesson plans. Yet, this result showed that longer training (e.g., individual course) should be preferred in developing competence for origami-based mathematics lessons when applicable. This study investigated the adequacy of origami-based mathematics lesson plans by considering pre-service teachers' training length. However, there might be further studies that compare pre-service and in-service teachers' origami-based mathematics lesson plans, and there

might also be cross-cultural studies that might explore the potential influence of culture in origami-based mathematics lesson plans.

The findings of the current study might contribute to the existing limited origami-related mathematics education by focusing on the lesson plans developed by pre-service teachers. However, there is a need for further studies conducted with pre-service and in-service teachers to develop knowledge in supporting the use of origami in mathematics education to a maximum extent.

Conflicts of Interest

There is no conflict of interest in this study.

Author Bio

Okan Arslan completed his master's and doctoral studies in the field of Mathematics Education at Middle East Technical University. Currently, he is working as a research assistant at Burdur Mehmet Akif Ersoy University. His research concentrates on using origami in mathematics education, mathematics teacher identity development, and affective factors in the teaching and learning of mathematics.

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Examining the Relationship between Meaningful Work and Job Engagement

Anlamlı İş ve İşle Bütünleşme İlişkisinin İncelenmesi

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ABSTRACT: Ensuring teachers' job engagement is critical in achieving educational goals. This study examined the relationship between meaningful work and job engagement using the data collected from 452 teachers in Turkey. The data collected by using Meaningful Work Scale and Job Engagement Scale Turkish Form were analyzed by descriptive statistics, confirmatory factor analysis, multivariate regression analysis, and moderation analyses. We found a positive, moderate, and significant relationship between meaningful work and job engagement. We tested the predictive effects of meaningful work and demographic variables (gender, seniority, and educational status). Meaningful work explained 47% of the variance in teachers' job engagement in the first model. All subdimensions of meaningful work except for the search for meaning at work and work relations were found to be significant predictors of job engagement. With the inclusion of demographic variables, the second model again explained 47% of the variance in teachers' job engagement. Furthermore, we found that seniority was a significant and positive predictor of job engagement. Moderation analyses indicated gender and educational status did not have a moderator role in the relationship between meaningful work and job engagement. We found that seniority had a moderator effect on the relationship between work relationships and job engagement. This study contributes to meaningful work and job engagement literature in the context of teachers.

Keywords: Meaningful work, job engagement, positive psychology, teacher, motivation.

ÖZ: Eğitimsel amaçların başarılmasında öğretmenlerin işle bütünleşmelerinin sağlanması kritiktir. Bu çalışmada Türkiye'deki 452 öğretmenden toplanan verileri kullanarak anlamlı iş ve işle bütünleşme arasındaki ilişki incelenmiştir. Anlamlı İş Ölçeği ve İşle Bütünleşme Ölçeği Türkçe Formu kullanılarak toplanan veriler, betimsel istatistikler, doğrulayıcı faktör analizi, çok değişkenli regresyon analizi ve moderasyon analizleri ile çözümlenmiştir. Anlamlı iş ile işle bütünleşme arasında pozitif yönlü, orta düzeyde ve anlamlı bir ilişki tespit ettik. Anlamlı işin ve demografik değişkenlerin (cinsiyet, kıdem ve eğitim durumu) yordayıcı etkisini test ettik. Birinci modelde anlamlı iş, öğretmenlerin işle bütünleşmelerindeki varyansın %47'sini açıklamıştır. Anlamlı işin, işte anlam arayışı ve iş ilişkileri dışındaki tüm alt boyutları, işle bütünleşmenin anlamlı yordayıcıları olarak bulunmuştur. Demografik değişkenlerin dahil edilmesi ile ikinci model, öğretmenlerin işle bütünleşmelerindeki varyansın tekrar %47'sini açıklamıştır. Ayrıca kıdemin, işle bütünleşmenin anlamlı ve pozitif bir yordayıcısı olduğunu tespit ettik. Moderasyon analizleri, cinsiyet ve eğitim durumunun anlamlı iş ile işle bütünleşme arasındaki ilişkide düzenleyici role sahip olmadığını göstermiştir. İş ilişkileri ile işle bütünleşme arasındaki ilişkide kıdem değişkeninin düzenleyici etkiye sahip olduğunu belirledik. Bu çalışma, öğretmenler bağlamında anlamlı iş ve işle bütünleşme literatürüne katkı sunmaktadır.

Anahtar kelimeler: Anlamlı iş, işle bütünleşme, pozitif psikoloji, öğretmen, motivasyon.

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Teachers are principal actors in unlocking and improving the potential of each student in schools. In this context, teachers have vital responsibilities in achieving educational goals and raising future generations (OECD, 2005). In meeting social expectations regarding education, teachers are expected to keep their motivation alive and dedicate themselves to their work (İlğan & Ceviz, 2019; Somech & Ron, 2007). When teachers develop positive attitudes towards their profession, they can transfer all their energies to their work (Granziera & Perera, 2019). In this context, job engagement, which requires transferring physical, mental, and emotional energy to the work roles (Kahn, 1990), comes to the fore for teachers.

Job engagement leads to several psychological and organizational outcomes for teachers (Bakker et al., 2007; Salanova et al., 2006). Teachers with a high level of job engagement experience positive psychological consequences for their inner world (Bakker & Bal, 2010; Hakanen et al., 2006). Job engagement affects teachers' job satisfaction (Granziera & Perera, 2019; Klassen et al., 2012; Salanova et al., 2011; Viseu et al., 2015) and well-being positively (Kang & Yoo, 2019; Klassen et al., 2012; Rusu & Colomeischi, 2020). Job engagement matters in making teachers feel happy, energetic, enthusiastic, and motivated about their work (Bakker & Bal, 2010; Burić & Macuka, 2018; Klassen et al., 2012). Moreover, job engagement reduces negative situations such as weariness, burnout, and related health problems in teachers (Hakanen et al., 2006; Hoigaard et al., 2012; Klassen et al., 2012).

Job engagement improves teachers' job performance from an organizational perspective (Bakker & Bal, 2010; Hakanen et al., 2006; Öncel, 2007). Job engagement plays a role in increasing teachers' organizational commitment (Hakanen et al., 2006; Han et al., 2016), reducing their burnout (Hakanen et al., 2006), and intention to leave (Hoigaard et al., 2012; Öncel, 2007). Teachers engaged in their profession are more likely to achieve educational goals than their peers who experience burnout (Guglielmi & Tatrow, 1998; Rudow, 1999). Job engagement is critical for teachers' potential to influence student achievement (Sethi & Scales, 2020; Valenta, 2010). Teachers who experience job engagement get positive results in improving student achievement (Gordon, 2006; Roth et al., 2007) and are effective in activating curiosity, excitement, energy, and interest among students (Bakker, 2005; Patrick et al., 2000). Thus, teachers' job engagement levels contribute to school effectiveness (Klassen et al., 2012; Koçak & Nartgün, 2020; Parker & Martin, 2009).

Individual and organizational variables contribute to teachers' job engagement (Klusmann et al., 2008). Teacher self-efficacy (Burić & Macuka, 2018; Kavgacı, 2014; Salanova et al., 2006; Simbula et al., 2011; Skaalvik & Skaalvik, 2014), teacher autonomy (Kavgacı, 2014; Victor & Patil, 2016), teacher leadership (İnanır, 2020), and positive psychological capital (Coleman, 2016; Eser, 2018; Price, 2017; Tösten et al., 2019) are among the individual factors that lead to job engagement. The organizational factors that affect teachers' job engagement are school culture (Khan, 2016; Louis & Smith, 1991), school climate (Bakker et al., 2007; Hakanen et al., 2006; İnanır, 2020; Song et al., 2014), organizational justice (Akdeniz & Ottekin Demirbolat, 2019; Köse & Uzun, 2018; Viseu et al., 2015), organizational citizenship (Runhaar et al., 2013), school principal support (Bakker & Demerouti, 2007; Klusmann et al., 2008), and the leadership displayed in the school (Bird et al., 2012; Breevaart & Bakker, 2018; Leonetti, 2019). Furthermore, job resources such as administrative support, social

environment at school, information sharing, innovative atmosphere, and job control increase teachers' job engagement (Hakanen et al., 2006). One of the possible factors that lead to teachers' job engagement can be considered *meaningful work*.

Perceiving one's work as meaningful leads to several potentially positive outcomes, both individually and organizationally (Chaolertseree & Taephant, 2020; Hu & Hirsh, 2017). The implications of meaningful work experience also apply to teachers (Lavy & Bocker, 2018; Steger & Dik, 2010). In terms of individual outcomes, meaningful work affects teachers' motivation, job satisfaction, and well-being (Fouché et al., 2017; Lavy & Bocker, 2018). Meaningful work is essential for making teachers happier, more productive, and more responsible (Fourie & Deacon, 2015). According to Kun and Gadanecz (2019), the factors that make teachers happy in schools are social relationships, finding meaning in work, achieving goals, and receiving feedback. Meaningful work supports teachers' self-perceived health and improves their well-being by enabling them to cope better with stressful working conditions (Minkkinen et al., 2020). In organizations that create a meaningful work environment, productivity, creativity, and sense of achievement increase, while stress and absenteeism decrease (Chalofsky, 2010; Lips-Wiersma & Morris, 2018). Meaningful work helps teachers display organizational citizenship behavior (Selamat et al., 2017) and cope with the stress created by a demanding work environment in schools (Månsson & Persson, 2005).

As understood from the literature review, there are various studies on the causes and consequences of teachers' job engagement. While stress, burnout, and intention to leave the job decrease in teachers who feel job engagement, positive psychological feelings such as excitement, happiness, intrinsic motivation, and job satisfaction increase (Bakker & Bal, 2010; Hakanen et al., 2006; Hoigaard et al., 2012). Job engagement is critical in enhancing teachers' work performance and maintaining school effectiveness (Bakker & Bal, 2010; Klassen et al., 2012). Additionally, meaningful work has significant implications for teachers and schools (Fouché et al., 2017; Kun & Gadanecz, 2019; Lavy & Bocker, 2018).

Several studies in the literature focus on the link between job engagement and school culture (Khan, 2016; Louis & Smith, 1991), school climate (Bakker et al., 2007; Hakanen et al., 2006; İnanır, 2020; Song et al., 2014), organizational commitment (Özkeskin, 2019), emotional labor (Çarıkcı, 2020), managerial support, transformational leadership (Hakanen et al., 2006; Hoigaard et al., 2012), job satisfaction (Blatný et al., 2018; Granziera & Perera, 2019; Klassen et al., 2012; Salanova et al., 2011; Viseu et al., 2015), personality traits (Blatný et al., 2018), intention to leave (Hoigaard et al., 2012; Öncel, 2007) in educational organizations. On the other hand, some studies examined teachers' level of meaningful work (Akar, 2020; Toptaş, 2018) and how they make sense of the work (Demirkasımoğlu, 2015; Fourie & Deacon, 2015; Koşar, 2019; Willey, 2016). Moreover, studies were conducted on the association between meaningful work and teacher motivation (Fourie & Deacon, 2015), intention to leave (Janik & Rothmann, 2015), work behaviors (Willemse & Deacon, 2015), job satisfaction, and well-being (Fouché et al., 2017; Lavy & Bocker, 2018; Minkkinen et al., 2020). Akar (2020) and Toptaş (2018) found that teachers find their work highly meaningful. In another study by Kavgacı (2014), teachers' job engagement levels were found high. However, studies focusing on the links between meaningful work and job

engagement in educational organizations are limited in literature (Fouché et al., 2017; Van Wingerden & Poell, 2019). The present study is expected to contribute to practice and theory in this context.

Conceptual Framework

Job Engagement

The concept of engagement emerged in business and was first included in Gallup studies in the 1990s (Schaufeli, 2012). The necessity of fostering employee engagement for organizational effectiveness was stressed in related studies (Ferguson & Carstairs, 2005). "Employee engagement," which has a broader scope, is mainly preferred in business, while "job engagement" is more common in academia (Rich et al., 2010; Schaufeli & Salanova, 2011). Kahn first conceptualized engagement at work and defined personal engagement as "the harnessing of organization members' selves to their work roles" (1990, p. 694). Based on this definition, Rich et al. (2010, p. 619) defined job engagement as "a multidimensional motivational concept reflecting the simultaneous investment of an individual's physical, cognitive, and emotional energy in active, full work performance."

Kahn (1990) defined engagement as individuals adjusting their selves according to the requirements of their roles. Job engagement is the individual's experience of a psychological existence at work. Schaufeli and Bakker (2010) emphasize that employees who are engaged in a job put a lot of effort into their work as they identify with the job. Kahn (1990) laid the theoretical foundations of job engagement based on Goffman's (1972) study on role performance. According to Goffman (1972), where there is action, there is interaction, and people can only participate in an interaction if they have a role to play. Within the scope of the job, people adopt the role expected from them in the organization, or they detach themselves from the role performances (Goffman, 1972). In this context, Kahn (1990) based his definition of engagement on Goffman's (1972) idea of role distance, which states there are differences in an individual's levels of attachments and detachments in role performances. When individuals achieve engagement, they cognitively, emotionally, and physically involve themselves in the work role performance. Thus, individuals fully engaged in their roles display their true selves. Conversely, individuals separate themselves from their work roles when they fail to engage in the job (Kahn, 1990).

Job engagement means "a positive, fulfilling, work-related state of mind characterized by vigor, dedication, and absorption" (Schaufeli et al., 2002, p. 74). *Vigor* is defined by a high energy level, work resilience, perseverance when faced with challenges, and a willingness to put effort into one's work. *Dedication* means a sense of inspiration, pride, importance, passion, and coping with challenges at work. *Absorption* refers to being happy, concentrating fully, and immersing oneself in one's work by having difficulty disconnecting from work (Schaufeli et al., 2006; Schaufeli et al., 2002).

Kahn (1990) reports that participation in one's role depends on three psychological conditions: meaningfulness, safety, and availability. Individuals' perception of being rewarded for their labor in their role performances at work is defined as *psychological meaningfulness* (Kahn, 1990). The value individuals attach to

the purpose of work according to their ideals or standards constitutes the state of psychological meaningfulness (Hackman & Oldham, 1980; May et al., 2004). *Psychological safety* is defined as the individual's sense of dedication and self-disclosure without fear of negative effects on one's self-esteem, position, or career (Kahn, 1990, p. 708). Individuals can reveal their true selves when they feel an atmosphere of trust at work (May et al., 2004). *Psychological availability*, on the other hand, is expressed as the feeling of having the physical, emotional, and psychological resources required for individuals to devote themselves to role performance (Kahn, 1990).

Physical, emotional, and cognitive engagement are the three components of job engagement (Kahn, 1990; Rich et al., 2010). *Physical engagement* refers to the physical energy people spend to accomplish their duties. The individuals' determination and hard work while doing their jobs is possible with physical engagement (Kahn, 1990; Rich, 2006). In this context, Kahn's (1990) physical engagement dimension is consistent with Schaufeli et al.'s (2002) vigor dimension. *Emotional engagement* is related to how employees feel about the organization, its leaders, working circumstances, and their favorable or negative emotions about the organization and its leaders (Kahn, 1990). Emotional engagement shows parallelism with Schaufeli et al.'s (2002) dedication dimension. *Cognitive engagement*, on the other hand, is the state of focusing on one's work and giving full attention to it (Kahn, 1990). This dimension is also associated with the absorption dimension in Schaufeli et al.'s (2002) job engagement model (Schaufeli & Bakker, 2010).

Meaningful Work

Individuals seek to find meaning in their working life (Frankl, 1992). Meaningfulness, which expresses an inclusive state of existence, contributes significantly to individuals' sense of reaching their life goals. In this context, meaningfulness is essential for individuals' mental health, organizational health, and high performance (Chalofsky, 2003). It is striking that there is no complete agreement among scholars on the definition of meaningful work (Michaelson, 2021). Meaningful work means the work done has specific importance and positive meaning for individuals (Lysova et al., 2019; Rosso et al., 2010). Individuals find work meaningful when their expectations, values, beliefs, and behaviors are coordinated with the features and responsibilities of the job (Pratt & Ashforth, 2003). Scroggins (2008) defines meaningful work as work that allows people to adapt to their surroundings, experience success, and realize themselves. Work-life balance (May et al., 2004), meeting internal needs, and achieving goals all contribute to the sense of meaningful work (Ashmos & Duchon, 2000; Miller, 2008).

Meaningful work is about more than simply the significance of one's paid work; it is also about how one lives life. The harmonization of values, relationships, purpose, and activities pursued in life creates meaningful work (Chalofsky, 2003, p. 58). Individuals who have a sense of meaningful work are happier, more productive, and more responsible. Moreover, while productivity, creativity, and sense of achievement increase in organizations creating meaningful work, employee stress and absenteeism decrease (Chalofsky, 2010; Lips-Wiersma & Morris, 2018). Employees' feeling of

meaningful work is critical to ensuring organizational effectiveness (Christian et al., 2011).

In Hackman and Oldham's (1976) job characteristics model, experiencing meaningfulness at work is considered one of the critical psychological states. According to this model, meaningfulness at work is a key determinant in developing positive outcomes, such as job satisfaction, high-quality work performance, high internal work motivation, low absenteeism, and turnover. Since the 1990s, meaningful work has been at the forefront of organizational behavior, particularly in terms of human resource development (Bailey et al., 2019).

Chalofsky (2003, 2010) introduced the *integrated wholeness meaningful work model*, consisting of three components: *sense of self, the work itself,* and *sense of balance.* Miller (2008) added "*sense of contribution*" to this model. *The sense of self* is related to individuals' ability to devote themselves to their work with their whole being (mind, body, emotion, spirit), to harmonize their goals in life with their work, and to be aware of their potential. *The work itself* is associated with individuals' ability to master their performance, demonstrate creativity at work, experience continuous improvement and learning, and realize their purpose through work. It also includes a sense of autonomy, empowerment, and control over one's environment at work. *The sense of balance* is related to the ability of individuals to establish a balance between work and life in general (Chalofsky, 2003, 2010; Miller, 2008). *The sense of contribution* refers to the ability of individuals to use their skills, strengths, and abilities to serve others, make a difference, strive to make the world a better place, to feel part of something bigger. This model is based on Maslow's theory of motivation. The individual's effort to be an integrated whole and thus providing intrinsic motivation is a fundamental building block of the self-actualization process (Miller, 2008).

According to Göçen and Terzi (2019), meaningful work consists of six subdimensions (*meaning at work, search for meaning at work, work relationships, transcendence at work, humility at work, and meaning leadership at work*). *Meaning at work* is explained by the fact that the work done serves higher purposes for the individual, provides spiritual pleasure, and contributes to the individual's self-knowledge and personal development. *The search for meaning at work* refers to individuals' questioning the purpose of working life and their search for meaning at work. *The work relationships* express the positive communication climate, unity, trust, support, and solidarity that individuals establish with their colleagues in the workplace. *Transcendence at work* is defined as the love of work, inner peace, and spiritual pleasure of individuals in working life. The harmony between individual and organizational goals promotes a sense of transcendence at work. *Humility at work* means that individuals do not expect personal benefits, compliments, and rewards in the face of what they do by acting with the motivation of serving society. *Meaning leadership at work* is defined as the leader's power of influence and helping colleagues discover and realize their life goals and build meaning at work.

The Relation between Meaningful Work and Job Engagement

In recent decades, especially with the rise of positive psychology, meaningful work and job engagement issues have increased (Albrecht, 2013; Fairlie, 2011; Hoole & Bonnema, 2015). Meaningful work is closely related to positive psychology and job

engagement (Albrecht, 2013). Seligman (2002), the pioneer of positive psychology, defines "meaningful life" as the state of the highest happiness. According to Seligman, the source of a meaningful life is expressed as the search and experience of doing things people believe and value. Meaning in the workplace is a crucial aspect of a meaningful life (Cohen-Meitar et al., 2009). Meaningful work is a necessary prerequisite for experiencing job engagement (Kahn, 1990). Many studies conducted on organizations other than educational organizations emphasized that meaningful work leads to job engagement (Albrecht, 2013; Fairlie, 2011; May et al., 2004; Van Wingerden & Van der Stoep, 2018). Studies conducted on educational organizations (Fouché et al., 2017; Van Wingerden & Poell, 2019) indicated a positive and significant relationship between meaningful work and job engagement. Moreover, relevant studies suggest that meaningful work leads to job engagement.

Purpose of the Study

The purpose of the current study was to examine the relationship between meaningful work and job engagement based on teacher opinions. Accordingly, answers to the following research questions were sought:

1. Is there a relationship between meaningful work and job engagement according to teachers' opinions?

2. Do gender, educational status, and seniority play a moderator role in the relationship between meaningful work and job engagement?

Method

Participants

The research population comprises 2374 teachers working in preschool, primary, secondary, and high school institutions in Kırıkkale province in the 2020-2021 academic years. Using a sample size table, we concluded that including at least 322-333 teachers was sufficient to ensure representativeness (Cohen et al., 2007, p. 104). We adopted stratified sampling method. Each school level (preschool, primary school, secondary school, high school) was considered a stratum to ensure the sample could best represent the population. In this context, we determined that 21 teachers from kindergarten, 81 teachers from primary school, 110 teachers from secondary school, and 119 teachers from high school could represent the population.

Data Collection Tools

Meaningful Work Scale (MWS)

We used MWS developed by Göçen and Terzi (2019) to examine the meaningful work level of teachers. The MWS consists of 21 items and six subscales. The subscales include *meaning at work* (5 items)*, search for meaning at work* (3 items)*, work relationships* (4 items)*, transcendence at work* (3 items)*, humility at work* (3 items)*,* and *meaning leadership at work* (3 items)*.* The MWS is a 5-point Likert-type scale ranging from "absolutely disagree" to "absolutely agree." (Sample Items: "*My work serves a great purpose"* and "*I feel my colleagues value me*"). Factor loading values of the items for sub-dimensions of the scale are as follows: *meaning at work* (between .61 and .80), *search for meaning at work* (between .80 and .87), *work*

relations (between .71 and .82), *transcendence at work* (between .66 and .82), *humility at work* (between .75 and .78), and *meaning leadership at work* (between .61 and .84). Cronbach Alpha (α) reliability value of the MWS was .84 (Göçen & Terzi, 2019, p.1500). We re-examined the validity and reliability analyses of the MWS in this study. Confirmatory factor analysis (CFA) was applied in the Lisrel 8.80 program to test the validity and the six-dimensional structure was examined. The results of CFA [$\chi2$=384.93; *df*=183; *χ2/df*=2.10; AGFI=.91; GFI=.92; NFI=.95; CFI=.97; RMSEA=.05] showed that the scale had construct validity. Within the scope of this research, we calculated the Cronbach Alpha value (α) of the MWS as .83. Cronbach Alpha values for sub-scales were found as .71 for meaning at work, .85 for search for meaning at work, .89 for work relationships, .71 for transcendence at work, .64 for humility at work, .81 for meaning leadership at work.

Job Engagement Scale (JES)

To examine the level of teachers' job engagement, we used the JES developed by Rich (2006) and adapted into Turkish as JES-TR by Öngöre (2013). Based on Kahn's (1990) study on engagement, the JES-TR consists of 18 items and three subscales *(physical engagement, emotional engagement, and cognitive engagement).* Each subscale has six items. The JES-TR is a 5-point Likert-type scale ranging from "strongly disagree" to "strongly agree." (Sample Items: "*I exert a lot of energy on my job.*" and "*I feel positive about my job.*"). The item load values of the JES-TR ranged from .52 to .70 in the physical engagement factor, between .62 and .73 in the emotional engagement factor, and between .70 and .79 in the cognitive engagement factor. Cronbach Alpha reliability value of the JES-TR was .95 (Öngöre, 2013). Within the current study, we retested the validity and reliability of the JES-TR. For the scale validity, CFA was performed in the Lisrel 8.80 program. JES-TR was found to have construct validity based on the results obtained with the five modifications made in the CFA process [$\chi2$=371.51; *df*=127; *χ2/df*=2.92; AGFI=.89; GFI=.92; NFI=.98; CFI=.99; RMSEA=.06]. In this study, we calculated the Cronbach's Alpha value of the scale (α) as .95.

Procedures and Data Analysis

Research data were collected online from volunteer participants via Google forms. Due to Covid-19 pandemic circumstances throughout the study dates, we preferred the online data collection method. It took an average of ten minutes to complete the scales for participants. During the data collection, we distributed 500 scale forms to the participants to prevent potential data loss and reached 459 teachers.

After data collection, we transferred the data set to the SPSS 23 program and R Studio. As a result of the extreme value analysis, 452 (98%) scale forms were found suitable for the analysis. We examined correlation coefficients, variance inflation factors (VIF), and tolerance values to test whether there was a multicollinearity problem. We found that the correlation values between the independent variables were below .80. If the VIF value is less than ten and the tolerance values are equal to or greater than .10, it indicates no multicollinearity problem (Cohen et al., 2003, p. 423). In this study, we found the VIF value of the variables was between 1.01 and 1.67, and the tolerance values were between .598 and .983 acceptance range.

The correlation range of 0 to .30 was regarded as "low," the range of .31 to .70 as "moderate," and the range of .71 to 1.0 as "high" (Büyüköztürk, 2020, p. 32). We employed arithmetic mean, standard deviation, frequency, Pearson correlation coefficient, and regression analysis to analyze the data. Additionally, we ran moderation analyses to examine whether the variables of gender, educational status, and seniority played a moderator role between meaningful work and job engagement.

Ethical Procedures

Before the data collection, we obtained permission from the owners of the data collection tools via e-mail. We also got approval from the Social and Humanities Studies Ethics Committee of Kırıkkale University (July 18, 2020, session number: 07, decision no: 09) and legal permission from the Kırıkkale Provincial Directorate of National Education to apply the scales in relevant public schools. We informed participants that their personal information was kept confidential. Participation in the study was carried out voluntarily with a consent form.

Findings

Table 1

Descriptive Statistics for Variables

Variable	Mean	*SD*	Min.	Max.	Skew	Kurtosis
MWS	4.14	.44	2.14	5	-.51	.33
Meaning at Work	4.57	.45	2.80	5	-1.27	1.60
Search for Meaning	2.88	1.22	1	5	.08	-1.01
Work Relationships	4.13	.85	1	5	-.92	.41
Transcendence	4.40	.64	1.33	5	-1.18	1.55
Humility at Work	4.42	.65	1.67	5	-1.29	1.64
Meaning Leadership	4.19	.77	1	5	-.98	.87
JES-TR	4.57	.46	2.50	5	-1.31	1.43

Note. N=452. Gender: 1=Female (56%) and 2=Male (44%). Seniority: 1=1–5 years (8%), 2=6–10 years (19%), 3=11–15 years (19%), 4=16–20 years (17%), and 5=21 years and above (38%). Educational Status: 1=Associate Degree (4%), 2=Bachelor's Degree (76%), and 3=Postgraduate Degree (20%).

We observed that the majority of the participants were women (56%), had seniority of 11 years and above (74%), and had bachelor's degrees (76%). Skewness and kurtosis values were within |2| the acceptable range, which did not pose a threat to further analyses (See Table 1). We found that teachers had high levels of meaningful work ($\bar{X}$=4.14, *Sd*=.44) and job engagement ($\bar{X}$=4.57, *Sd*=.46). The results of the correlation analysis regarding the MWS and the JES-TR are presented in Table 2.

Table 2

Correlation Analysis Results

Variable	1.	2.	3.	4.	5.	6.	7.	8.
1. MWS	1							
2. Meaning at Work	.67**	1						
3. Search for Meaning	.43**	-.03	1					
4. Work Relationships	.71**	.43**	.04	1				
5. Transcendence	.66**	.56**	.04	.40**	1			
6. Humility at Work	.43**	.24**	-.00	.10*	.22**	1		
7. Meaning Leadership	.73**	.46**	.01	.47**	.44**	.34**	1	
8. JES-TR	.58**	.61**	-.00	.37**	.56**	.32**	.46**	1

N=452; **p<.01; *p<.05

The results of correlation analysis indicated a positive, moderate, and significant relationship between meaningful work and job engagement (*r*=.58, *p*<.01). Except for *the search for meaning at work* dimension, positive and significant relationships were found in the meaningful work sub-dimensions and job engagement. The results of multiple regression analysis are presented in Table 3.

Table 3

Multiple Regression Results

Variable	Model 1: MW				Model 2: MW + Demographics			
	Est. (SE)	*t*	*β*	*η²*	Est. (SE)	*t*	*β*	*η²*
Intercept	1.28(.18)***	7.05	0	0	1.41(.21)***	6.72	0	0
Meaning at Work	.36(.45)***	7.93	.35	.37	.35(.05)***	7.75	.34	.32
Search for Meaning	-.01(.01)	-.57	-.02	<.01	-.01(.01)	-.59	-.02	0
Work Relationships	.02(.02)	1.09	.05	.01	.01(.02)	.51	.02	0
Transcendence	.19(.03)***	6.16	.27	.06	.19(.03)***	6.14	.27	.06
Humility at Work	.09(.03)***	3.56	.13	.02	.09(.03)***	3.44	.13	.02
Meaning Leadership	.07(.03)**	2.64	.11	0	.07(.03)**	2.65	.11	0
Gender					-.04(.03)	-1.16	-.04	0
Seniority					.03(.01)*	2.15	.08	.06
Educational Status					-.03(.04)	-.82	-.03	0
	Adj. *R²*=.467				Adj. *R²*=.472			
	F(6,445)= 67.08***				*F*(9,442)= 45.85***			

Note. *p<.05; **p<.01; ***p<.001. SE=standard error (in parenthesis). $η2$= eta-squared that represents the proportion of variance in the dependent variable explained by the independent variables. The dependent variable is job engagement.

Firstly, we employed regression analysis with the sub-dimensions of MW in Model 1 using R statistical computing environment (RStudio Team, 2022). Meaningful work explained 47% of the variance in job engagement (see Table 3). We found that *meaning at work* (*β*=.35, *p*<.001), *transcendence* (*β*=.27, *p*<.001), *humility at work* (*β*=.13, *p*<.001), and *meaning leadership* (*β*=.11, *p*<.01) were significant and positive predictors of job engagement, respectively. We found that *search for meaning at work* and *work relations* were not significant predictors of teachers' job engagement. When demographic factors (gender, seniority and educational status) were added in Model 2, the model still explained 47% of the variance in teachers' job engagement. The effects of MW subscales on JE were robust to model specifications when covariates were added. *Meaning at work* (*β*=.34, *p*<.001), *transcendence* (*β*=.27, *p*<.001), *humility at work* (*β*=.13, *p*<.001), and *meaning leadership* (*β*=.11, *p*<.01) were still significant and positive predictors of job engagement, respectively. Model 2 revealed that seniority was significant and positive predictor of job engagement (*β*=.08, *p*<.05). We ran moderation analyses to test whether gender, educational status, and seniority play a moderator role in the relationship between meaningful work and job engagement. The results of moderation analyses are presented in Table 4.

Moderation analyses indicated that the effects of MW subscales on JES-TR did not change mostly across moderator levels. Gender and educational status did not moderate the relationship between meaningful work and job engagement (see Table 4). Seniority moderated the relationship between work relationships and job engagement (*β*=.12, *p*<.05). This finding means that work relationships in conjunction with seniority results in job engagement.

Table 4

Moderation Analyses Results

Variable	Moderator: Gender				Moderator: Educational Status				Moderator: Seniority			
	Est. (SE)	*t*	*β*	*η²*	Est. (SE)	*t*	*β*	*η²*	Est. (SE)	*t*	*β*	*η²*
Intercept	4.58(.02)***	281.57	0	0	4.58(.02)***	280.96	0	0	4.57(.02)***	272.87	0	0
Meaning at Work	.16(.02)***	7.46	.34	.37	.16(.02)***	7.48	.34	.37	.16(.02)***	7.29	.33	.37
Search for Meaning	-.01(.02)	-.62	-.02	0	-.01(.02)	-.68	-.02	0	-.01(.02)	-.68	-.02	0
Work Relationships	.00(.02)	.16	.01	.01	.01(.02)	.67	.03	.01	.02(.02)	.99	.04	.01
Transcendence	.13(.02)***	6.17	.27	.06	.12(.02)***	5.85	.26	.06	.12(.02)***	5.58	.25	.06
Humility at Work	.06(.02)***	3.35	.13	.02	.06(.02)***	3.60	.14	.02	.06(.02)**	3.10	.12	.02
Meaning Leadership	.06(.02)**	2.92	.13	0	.06(.02)*	2.60	.11	0	.06(.02)**	2.69	.12	0
Gender	-.02(.02)	-1.17	-.04	0	-.02(.02)	-1.26	-.05	0	-.02(.02)	-1.25	-.05	0
Seniority	.04(.02)*	2.18	.08	0	.04(.02)*	2.05	.07	0	.04(.02)*	2.20	.08	0
Educational Status	-.02(.02)	-1.08	-.04	0	-.01(.02)	-.60	-.02	0	-.01(.02)	-.63	-.02	0
Moderator x Meaning at Work	.01(.02)	.57	.03	0	.01(.02)	.61	.03	0	-.03(.02)	-1.52	-.07	0
Moderator x Search for Meaning	.02(.02)	1.09	.04	0	-.00(.02)	-.24	-.01	0	.00(.02)	.08	0	0
Moderator x Work Relationships	-.03(.02)	-1.65	-.07	0	-.01(.02)	-.54	-.02	0	.05(.02)*	2.58	.12	0
Moderator x Transcendence	.03(.02)	1.32	.01	0	.02(.02)	.91	.04	0	-.04(.02)	-1.74	-.08	0
Moderator x Humility at Work	.00(.02)	.15	.01	0	.02(.02)	.84	.03	0	-.00(.02)	-.03	0	0
Moderator x Meaning Leadership	.02(.02)	.75	.03	0	-.03(.02)	-1.53	-.12	0	-.00(.02)	-.18	-.01	0
	Adj. *R²*=.47				Adj. *R²*=.47				Adj. *R²*=.48			

$F(15,436)=28.07***$ $F(15,436)=27.69***$ $F(15,436)=28.72***$

Note. *$p<.05$; **$p<.01$; ***$p<.001$. SE=standard error (in parenthesis). $\eta2$=eta-squared represents the proportion of variance in the outcome explained by the corresponding predictor variable. The dependent variable is job engagement.

Discussion and Conclusion

We examined the relationship between meaningful work and job engagement in this study. The findings revealed the meaningful work level of teachers was high. This finding is in line with the findings of studies on teachers (e.g., Akar, 2020; Fouché et al., 2017; Toptaş, 2018). Willey (2016) reported that teachers working in international schools found their work meaningful in a qualitative study. Månsson and Persson (2005) reported that teachers found their work meaningful despite major challenges in the workplace, particularly at the psychosocial level. Furthermore, in another study, it was concluded academicians found their work highly meaningful (Balcı et al., 2019). The critical value of the teaching profession in raising qualified human resources can explain why teachers have such a high level of meaningful work. Kahraman and Çelik (2020) reported that teachers' perceptions regarding the prestige of the teaching profession were positive. The spiritual (intrinsic) satisfaction felt while performing the profession and the academic success of the pupils in return for their efforts are two aspects that motivate teachers (Karabağ-Köse et al., 2018). The teaching profession contributes to social progress in terms of raising future generations. In this respect, teachers' high level of meaningful work may be related to the fact that the teaching profession requires dedication and calling (Wrzesniewski et al., 1997).

Teachers often lose motivation due to excessive workload, stress, burnout, low wages, and society's lack of appreciation for the teaching profession (European Commission/EACEA/Eurydice, 2015; Karabağ-Köse et al., 2018). However, being a teacher means touching the lives of students, being versatile, being open to improvement, presenting fresh viewpoints, guiding, and struggling with challenges (Koşar, 2019). Teachers experience meaningful work through integrating personal and professional values, making a difference in students' lives, finding joy from creativity, developing via work, building meaningful connections, and feeling empowered by professional autonomy (Willey, 2016). Working closely with students, monitoring their progress, shaping the future, and thus assuming meaningful social responsibility can contribute to teachers' sense of meaningful work (Demirkasımoğlu, 2015). Moreover, teachers' contribution to students' learning and success by dedicating themselves to their work can provide them with intrinsic motivation and meaningful work experience.

The present study found that teachers have a high level of job engagement. Some studies in the literature concluded that teachers' job engagement emerge at high level (e.g., Basikin, 2007; Çarıkcı, 2020; Çelik, 2019; Ceviz, 2017; Fouché et al., 2017; Gün, 2017; Gürler, 2018; İnanır, 2020; Kavgacı, 2014; Özkeskin, 2019) and moderate level (e.g., Akdeniz & Ottekin Demirbolat, 2019; Coleman, 2016). In the present study, high intrinsic work motivation, positive psychological capital, work dedication, and perseverance in the face of difficulties may be effective in the high level of teachers' job engagement (Coleman, 2016; Eser, 2018; Price, 2017; Tösten et al., 2019). Individual psychological characteristics such as self-efficacy, optimism, resilience, and high levels of hope are effective in teachers' job engagement (Coleman, 2016).

This study showed a positive, moderate, and significant relationship between meaningful work and job engagement. This finding is consistent with the findings of studies on teachers (e.g., Fouché et al., 2017; Van Wingerden & Poell, 2019). Perceiving work as meaningful can increase teachers' sense of responsibility, well-being, and happiness. This context may play a role in teachers' putting more effort into their work and ensuring job engagement (Fouché et al., 2017; Fourie & Deacon, 2015; Lavy & Bocker, 2018). As a result of the role performance of the teaching profession, teachers' feeling of being rewarded for their efforts shows a state of meaningfulness, one of the psychological states stated by Kahn (1990). Except for *the search for meaning at work* dimension, positive and significant relationships were found in the meaningful work sub-dimensions and job engagement. To be human is to be in search of meaning throughout life. Teachers' opinions on seeking meaning at work may have changed due to the pandemic.

As a result of the research, we found that meaningful work was a significant predictor of teachers' job engagement. 47% of the variability in teachers' job engagement scores was explained by the six dimensions of the meaningful work scale. This finding is supported by the findings of studies conducted on teachers (e.g., Fouché et al., 2017; Van Wingerden & Poell, 2019). The variables explaining teachers' job engagement are listed in order of importance as meaning at work, transcendence at work, humility at work, meaning leadership at work, work relations, and search for meaning at work. The results showed that the dimensions of meaning at work, transcendence at work, humility at work, and meaning leadership were significant predictors of job engagement. Teachers who feel they are doing meaningful work while performing the teaching profession are aware that they are working for a purpose. This, in turn, can enable teachers to adapt their selves to their work roles and to feel engaged in their professions (Kahn & Heaphy, 2014).

In the present study, we found the search for meaning at work and work relations dimensions were not significant predictors of teachers' job engagement. This finding contradicts the findings of the studies in the literature that work relations ensure job engagement (e.g., Fouché et al., 2017; Kahn & Heaphy, 2014). Teachers' working conditions may change over time in unpredictable ways, such as during the Covid-19 pandemic (Harris & Jones, 2020). In such an environment of undeniable crisis and chaos, the adaptation process of teachers to the changes may take time. Hargreaves and Fullan (2020) reported that teacher cooperation, teacher-student relations, and teachers' work relations have weakened during the pandemic process. In another study by Ballová-Mikušková and Verešová (2020), it was found that teachers' negative emotions increased while their positive emotions decreased during the pandemic period. In the pandemic conditions covering the period in which this study was conducted, distance education was conducted in Turkey, as in many other countries of the world. In this period, teachers mostly established work relationships in the online environment. Therefore, the change in teachers' opinions of seeking meaning at work and work relations during the pandemic period may not have contributed positively to their level of job engagement.

The present study found that seniority was a significant and positive predictor of job engagement, while gender and educational status did not predict job engagement. The moderation analyses showed that gender and educational status did not moderate

the relationship between meaningful work and job engagement. These findings support studies that have found no significant difference in teachers' level of job engagement in terms of gender (e.g., Basikin, 2007; Çelik, 2019; Ceviz, 2017; Eser, 2018; Gün, 2017; Gürler, 2018; İnanır, 2020; Kavgacı, 2014; Özkeskin, 2019) and educational status (e.g., Akdeniz, 2018; Ceviz, 2007; Gün, 2017; İnanır, 2020; Özkeskin, 2019). However, some studies found male teachers had higher levels of job engagement than females (e.g., Akdeniz, 2018; Çağrı-San & Tok, 2017). Furthermore, some studies have concluded that teachers' job engagement levels decrease as their level of education increases (e.g., Çelik, 2019; Gürler, 2018; Jackson, 2004; Kavgacı, 2014). We found that seniority had a moderator effect on the relationship between work relationships and job engagement. Contrary to this result, some studies concluded that seniority did not make a significant difference in teachers' job engagement (e.g., Akdeniz, 2018; Ceviz, 2007; Çağrı-San & Tok, 2017; Gürler, 2018; İnanır, 2020).

The effects of meaningful work sub-dimensions on job engagement were robust to model specifications when covariates were added, and their effect did not change mostly across moderator levels. This indicates that interventions such as professional development that aim to improve teachers' job engagement should focus on 'meaningful work' in their program. Furthermore, these professional development programs should be structured to promote "work relationships" based on seniority status rather than gender or education level.

Experiencing teaching as meaningful work and ensuring job engagement can yield positive outcomes in terms of teacher motivation. In this context, important responsibilities fall on policymakers and education administrators to encourage teachers to feel meaningful work in their profession. Practices and policies such as supporting teacher autonomy, creating an environment of trust and positive communication, and making teachers feel valued can be implemented (Fouché et al., 2017). Thus, it can be ensured teachers transfer their energies to work and feel engaged in their jobs. Additionally, researchers can examine the relationship between meaningful work and job engagement in larger samples, including public and private schools. Studies on the relationship between the variables of meaningful work and job engagement with different variables can be conducted in educational organizations.

Statement of Responsibility

The study was conducted and reported with the equal collaboration of the researchers.

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The Mediating Role of Leader-Member Exchange in the Relationship between Motivational Language and Loyalty to Supervisor in Schools

Okullarda Motivasyonel Dil ile Yöneticiye Sadakat İlişkisinde Lider-Üye Etkileşiminin Aracılık Rolü

Mevlüt KARA*   Sedat ALEV**

ABSTRACT: The present study aimed to examine the mediating role of leader-member exchange in the relationship between motivational language and loyalty to supervisor. The population of this correlational study consisted of primary, secondary, and high schools in Gaziantep, during the 2020-2021 academic year. The research sample included randomly determined 511 teachers through unequal cluster sampling technique. Data were collected through "Motivational Language Scale", "Loyalty to Supervisor Scale" and "Leader-Member Exchange Scale". In data analysis, descriptive statistics and correlation coefficients were estimated. Then, the model, which was based on the theoretical framework, was tested through structural equation modelling. According to research results, teachers' perceptions of motivational language, loyalty to supervisor, and leader-member exchange were found to be relatively high. There were positive and high-level relationships between motivational language, loyalty to supervisor, and leader-member exchange. The results of structural equation modelling analysis indicated that the leader-member exchange partially mediated the relationship between motivational language and loyalty to supervisor. The research results revealed that the motivational language of school administrators was a significant determinant of teachers' perception of leader-member exchange and their loyalty to supervisor. Thus, it seemed necessary to establish high-quality communication, appreciate their efforts, and support teachers to increase their loyalty to the administrator.

Keywords: Motivational language, leader-member exchange, loyalty to supervisor, teacher.

ÖZ: Araştırmada, motivasyonel dil ile yöneticiye sadakat ilişkisinde lider-üye etkileşiminin aracılık rolünün incelenmesi amaçlanmıştır. İlişkisel modelde yürütülen araştırmanın evrenini, 2020-2021 eğitim-öğretim yılında Gaziantep ilinde bulunan ilkokul, ortaokul ve liseler oluşturmaktadır. Örneklem ise, bu okullarda görev yapan ve oransız küme örnekleme yöntemiyle tesadüfi olarak belirlenen 511 öğretmenden oluşmaktadır. Veriler, "Motivasyonel Dil Ölçeği", "Yöneticiye Sadakat Ölçeği" ve "Lider-Üye Etkileşimi Ölçeği" aracılığı ile toplanmıştır. Analiz aşamasında betimsel istatistikler ve korelasyon katsayıları hesaplanmıştır. Daha sonra kuramsal çerçeveye dayalı olarak öne sürülen model, yapısal eşitlik modeli ile test edilmiştir. Betimsel analiz sonuçlarına göre, öğretmenlerin motivasyonel dil, yöneticiye sadakat ve lider-üye etkileşimine yönelik algı düzeyleri görece yüksektir. Motivasyonel dil, yöneticiye sadakat ve lider-üye etkileşimi değişkenleri arasında pozitif yönde ve yüksek düzeyde bir ilişki bulunmaktadır. Yapısal eşitlik modeli analizi sonucunda, lider-üye etkileşiminin; motivasyonel dil ile yöneticiye sadakat arasındaki ilişkide kısmi aracılık rolü olduğu tespit edilmiştir. Araştırma sonuçları, okul yöneticilerin kullandıkları motivasyonel dilin, öğretmenlerin lider-üye etkileşimi algı düzeyleri ve yöneticiye sadakatleri üzerinde önemli bir belirleyici olduğunu ortaya koymuştur. Buradan hareketle öğretmenlerin yöneticiye sadakatlerini artırmak için, nitelikli iletişim kurulması, yaptıkları çalışmalara değer atfedilmesi ve desteklenmesi önemli görülmektedir.

Anahtar kelimeler: Motivasyonel dil, lider-üye etkileşimi, yöneticiye sadakat, öğretmen.

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Various individual and organizational variables affect the performance of employees in organizations. Loyalty, which is accepted to be a vital factor for quality and productivity (Mohsan et al., 2011), indirectly affects organizational performance by increasing the performance of employees (Chen, 2001). Loyal employees show commitment to the organization, identify with the values and goals of the organization, and behave accordingly (Ali et al., 1997). In the schools, it is asserted that the high level of loyalty of teachers to their administrators is one of the factors facilitating the realization of the school goals of (Akman, 2017). Loyalty is associated with teachers' performance and motivation in interpersonal relationships. Interactions with school administrators, colleagues and students play a prominent role in the development of teachers' feelings of loyalty (Akman & Özdemir, 2019). School administrators' fair practices among teachers by considering their differences and providing opportunities for them to improve themselves are examples of practices that will improve teachers' feelings of loyalty (Akman, 2017). Dewhurst et al. (2010) determined that offering praise, courtesy, and leadership roles to employees positively affects loyalty. Therefore, it can be argued that motivational expressions and high-quality interactions of school administrators during interpersonal relations will improve teachers' loyalty. Furthermore, Ülker (2015) noted that the feeling of loyalty would develop, and teachers' commitment to the school and the administrator will boost administrator-teacher relationships with a high level of emotional interaction, which refers to the relationship between loyalty to supervisor and the leader-member exchange.

Studies have concluded that the use of motivational language increases teachers' job satisfaction (Haider et al., 2018) and is an effective factor in establishing relationships based on trust, respect and loyalty (Sivik, 2018). Besides, motivational language positively affects the sense of trust in principals (Holmes & Parker, 2018) and school climate (Alqahtani, 2015; Sabir & Bhutta, 2018). Principals must be aware that their personal behavior has an impact on both teachers and school outcomes (Anderson, 2008). Therefore, it is vital for positive school climate that school principals use their leadership skills in an effective way through motivational language (Alqahtani & Alajmi, 2010).

Consequently, motivational language contributes to establishing relationships based on trust, respect, and loyalty by deepening the quality of communication with teachers (Gemalmaz, 2014). Thus, leader-member exchange may enhance depending on motivational language (Brannon, 2011; Karaaslan, 2010). However, relevant studies have not considered the mediating role of leader-member exchange in the association between motivational language and loyalty to supervisor. Therefore, the role of leader-member exchange in the association between motivational language and loyalty to supervisor needs to be clarified through future studies in light of the results of the previous studies in the literature to focus more on the relationships between the variables in question.

Conceptual Framework

Loyalty to Supervisor

The concept of loyalty to supervisor, which is closely associated with organizational commitment, has been the subject of numerous research in recent years

(Bozkurt & Sincar, 2019; Çelebi & Korumaz, 2016; Wang et al., 2017). Loyalty is the sincere support that an employee shows for his/her supervisor. This support is explained as sacrificing the personal interests of the employees and devoting themselves to the supervisor (Chen et al., 2002). Loyalty to supervisor is the employee's support of his/her manager, dedication to his/her goals, placing his/her interests before one's own (Ceylan & Doğanyılmaz, 2007; Schaufeli et al., 2002) and accepting the manager's values as a part of their own (Janssen, 2004). The quality of communication with employees, supporting employees, and solving their problems increase the loyalty of employees to the supervisor (Chang et al., 2010). Similarly, the managers' fair behaviors are suggested to be crucial in heightening the loyalty of the employees to the supervisor (Uğurlu & Üstüner, 2011).

Chen et al. (2002) discussed that loyalty to supervisor is composed of five sub-dimensions. *Dedication to the supervisor* includes behaviors such as supporting the manager, making sacrifices, putting the manager's interests before their own. *Making an extra effort for the supervisor* refers to the employee's complete fulfillment of his/her responsibilities and making an extra effort to do his/her job in the best way even when the manager is not there. *Attachment to the supervisor* is the state of being happy to work in the same institution and willing to continue working with the manager even if better alternatives may emerge. *Identification with the supervisor* is about the employee's feeling attached to the manager, being proud of working together and attributing the triumphs or failures of the manager to oneself. Internalizing the values of the supervisor is perceiving the values of the manager as one's own. In other words, it is the similarity of the value fit between the manager and the employee.

Loyalty to the supervisor is seen as the unconditional commitment of teachers to the wishes of the administrators, working self-sacrificingly to fulfill their duties successfully, and offering sincere support to the administrator (Akman & Özdemir, 2019). Loyalty to the supervisor, which is also considered to be commitment to the administrator in the context of education, has been the subject of numerous research (Arlı, 2011; Bozkurt, 2018; Çelebi & Korumaz, 2016; Duman, 2018). In these studies, it was found that school administrators' creation of a trust-oriented school climate increase teachers' commitment (Bozkurt, 2018; Çelebi & Korumaz, 2016); administrators have to exert effort to improve teachers' confidence, loyalty and commitment to their supervisors (Arlı, 2011), and loyalty is a factor that strengthens teachers' affective and normative commitment to school (Duman, 2018). Therefore, it can be argued that the attitudes and behaviors of school administrators are important in shaping loyalty to the administrator.

Motivational Language

Motivation is the power that moves an individual to achieve a specific goal (Ryan & Deci, 2000). Leaders must exhibit attitudes and behaviors that will improve the motivation of employees for the realization of organizational goals (Hoy & Miskel, 2010). Most of the leadership studies conducted recently have emphasized the influence of communication. The use of motivational language by the managers is shown to be effective in positive organizational outcomes (Brown et al., 2018; Karaaslan, 2010; Özen, 2013). Motivational language is defined as a verbal communication strategy used by leaders that produce positive outcomes such as higher job performance, increased job

satisfaction, and lesser absenteeism of employees (Mayfield et al., 1995). Sullivan (1988) developed the Motivational Language Theory based on the assumption that leaders' communication skills are influential in increasing employee performance. Accordingly, the leader-subordinate relationship is based on three basic speech acts. *Direction-giving language* means explaining and guiding the employees about their duties (Madlock & Sexton, 2015), *empathetic language* is reinforcing the positive behaviors of the employees and encouraging them to express their thoughts comfortably (Brannon, 2011), and *meaning-creating language* refers to conveying the structure, values, and norms of organizational culture to employees by making use of literary arts, metaphors, and stories (Özen, 2013).

The motivational language studies conducted suggested that the use of motivational language by school administrators increases the job satisfaction of teachers (Haider et al., 2018), positively affects the sense of trust for the administrators (Holmes & Parker, 2018), improves organizational citizenship behaviors as a result of extra-role efforts for the development of the school (Özen, 2014). Additionally, it was yielded that motivational language contributes to establishing relationships based on trust, respect, and loyalty by deepening the quality of communication with teachers (Gemalmaz, 2014) and to the professional dedication of teachers (Sivik, 2018). Based on this information, it is possible to allege that motivational language will have positive reflections on teachers' behaviors.

Leader-Member Exchange

The Leader-Member Exchange Theory (Cropanzano & Mitchell, 2005), which is used to explain the manager-employee relationship and developed based on Blau's (1964) Social Exchange Theory, suggested that the leader does not interact with all the members in the organization in a similar way, but develops personal relations each of them with different qualities contrarily (Northouse, 2013). Leader-member exchange is explained as a relation based on trust, respect, and loyalty (Yu & Liang, 2004). Employees have to interact with the leader constantly to receive the necessary support during the process of realizing individual and organizational goals. The approach and behaviors of the leaders may direct the attitudes and behaviors of the members. Therefore, the leader's manner of approaching is regarded as an influential factor in the performance of the employees (Agarwal et al., 2012).

The present study was based on the classification of Liden and Maslyn (1998), examining leader-member exchange under four sub-dimensions. While *affect* includes the perceptions of the leader and the member's sympathy for each other, their exhibiting sincere behaviors and mutual interactions; *contribution* includes perceptions about the amount, quality, and direction of direct or indirect actions for the common purpose during the leader-member exchange process (Lee, 2005). *Loyalty* plays a vital role in developing and continuing the leader-member exchange and includes the approval, respect, support, and advocating of the decision taken either by the leader or the member (Göksel & Aydıntan, 2012). *Professional respect* relates to perceptions of the mutual competence of the leader and member in work-related matters. These perceptions are based on past experiences, impressions of other individuals, and rewards received (Baş et al., 2010).

The studies on leader-member exchange in educational settings concluded that it reduces the bad effects of organizational cynicism (Alev, 2020) and burnout (Alev & Taş, 2020), positively affects teachers' performance (Cerit, 2012), and school climate (Alqahtani, 2015; Alqahtani & Alajmi, 2010; Sabir & Bhutta, 2018), positively affects the sense of trust for the principals (Holmes & Parker, 2018) and improves organizational citizenship behaviors (Runhaar et al., 2013). In addition, they offered suggestions on how to build a high-quality relationship between school administrators and teachers (Power, 2013) by emphasizing that the quality of administrator-teacher interaction is vital in terms of teachers' adapting to the school, their devoted work, and feeling like a part of the school (Gül, 2019).

The Present Study

The motivational language used by the leader has an important place in yielding positive attitudes and behaviors, such as employee commitment in the organizational milieu (Mayfield & Mayfield, 2002; Murray, 2016; Sabir & Bhutta, 2018). The sincere and motivational language use among individuals in educational organizations contributes to the strengthening the bond between the administrators, teachers, and students (Sivik, 2018). Moreover, administrator-teacher relationships with a high level of emotional interaction enable the enhancement of a sense of loyalty, and thus teachers' commitment to both the school and the administrator boosts (Ülker, 2015). In a similar vein, Duman (2018) concluded that administrators who want to receive the support of teachers, strengthen their relations with them, and encourage teachers to strive beyond their job requirements should attempt to win teachers' loyalty. Furthermore, it is specified that motivational language is an essential communicating power for administrators, and thus the quality of communication with teachers will increase and it will have positive reflections on the school climate (Gemalmaz, 2014). In light of these, the following hypotheses have been developed:

Hypothesis 1. There is a significant and positive relationship between motivational language and loyalty to supervisor.

Hypothesis 2. There is a significant and positive relationship between motivational language and leader-member exchange.

Hypothesis 3. There is a significant and positive relationship between leader-member exchange and loyalty to supervisor.

Hypothesis 4. Leader-member exchange has a mediating role in the relationship between motivational language and loyalty to supervisor.

The conceptual model of the present study was created based on the above hypotheses and was presented in Figure 1.

Figure 1

The Conceptual Model
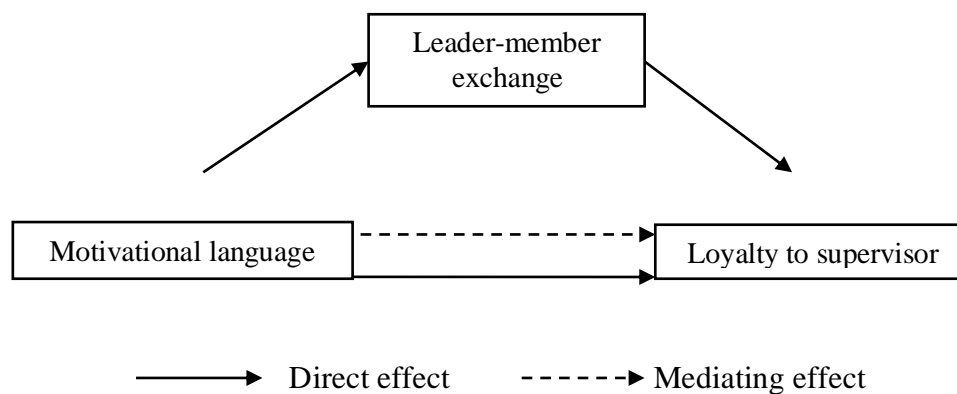
Method

Research Design

The correlational survey design, one of the quantitative research methodologies, was employed to examine the relationship between motivational language, loyalty to supervisor, and leader-member exchange.

Population and Sample

The population of the study consisted of primary, secondary, and high schools in Gaziantep in the 2020-2021 academic year. The research sample consists of randomly determined teachers through the unequal cluster sampling technique. The scales were delivered to approximately 650 teachers, and 36 surveys were excluded due to being filled in incorrectly or incompletely among the total of 547 files. Data analyses were conducted on 511 scales. Of the participating teachers, 276 (54.0%) were female, and 235 (46.0%) were male. While 270 teachers (52.8%) were between 21-30 years old, 185 of them (36.2%) were between 31-40, and 56 of them (11.0%) were 41 and over. In terms of professional seniority, 255 (49.9%) had been working between 1-5 years, 127 (24.9%) had between 6-10 years, 68 (13.3%) had between 11-15 years, 61 (11.9%) had 16 years and over. Based on the types of schools, 210 (41.1%) of the participating teachers worked at primary school, 220 (43.1%) of them were in secondary school, and 81 (15.9%) of them were high school teachers.

Instruments

Motivational Language Scale

This scale was developed by Mayfield et al. (1995) and adapted into Turkish by Özen (2013). The scale consisted of 24 items and three sub-dimensions. It has a 5-point Likert type grading by I completely agree (5) … I do not agree at all (1). In the CFA, which was conducted to test the construct validity of the scale, theoretically supported modifications were made to improve the model fit by adding covariance between the error terms of the items ML1 and ML2, ML7, and ML8, ML14 and ML15, and ML21 and ML22. The items ML9, ML18, and ML19 that caused the increase in the chi-square values were deleted, respectively. As a result of the analysis, goodness of fit indices were estimated as; χ^2=720.49, *df*=182, χ^2/df=2.95, RMSEA=.07, RMR=.05, NFI=.91,

IFI=.93, TLI=.92 and CFI=.93. It was determined that χ^2/df and RMSEA had an acceptable fit while the others had the perfect fit. (Hu & Bentler, 1999; Kline, 2011). For the original scale, the Cronbach's Alpha reliability coefficient was estimated as .94 for *direction-giving language*, .93 for *empathic language*, .88 for *meaning-making language*, while the present study's Cronbach's Alpha reliability coefficient was computed as .93 for *direction-giving language*, .88 for *empathic language*, .86 for *meaning-making language*, and .95 for the overall scale.

Loyalty to Supervisor Scale

This scale was developed by Chen et al. (2002) and adapted into Turkish by Ceylan and Doğanyılmaz (2007). It consisted of 17 items and five sub-dimensions. It has a 5-point Likert type grading by I completely agree (5) … I do not agree at all (1). In the CFA, the LS4 item with a low factor load was excluded from the data set. As a result the analysis, goodness of fit indices were estimated as; χ^2=322.89, df=94, χ^2/df=3.44, RMSEA=.07, RMR=.05, NFI=.93, IFI=.95, TLI=.94 and CFI=.95. It was determined that χ^2/df and RMSEA had an acceptable fit while the others had the perfect fit. (Hu & Bentler, 1999; Kline, 2011). For the original scale, the Cronbach's Alpha reliability coefficient was estimated as .67 for *dedication to the manager,* .81 for *making an extra effort for the manager,* .82 for *being attached to the manager,* .81 for *identification with the manager,* .73 for *internalizing the manager's values* while the present study's Cronbach's Alpha reliability coefficient was computed as .78 for *dedication to the manager,* .80 for *making an extra effort for the manager,* .85 for *being attached to the manager,* .87 for *identification with the manager,* .85 for *internalizing the manager's values*, and .91 for the overall scale.

Leader-Member Exchange Scale

This scale was developed by Liden and Maslyn (1998) and adapted into Turkish by Öztürk (2015), thanks to the validity and reliability studies. It consisted of a total of 12 items and four sub-dimensions. It has a 5-point Likert type grading by I completely agree (5) … I do not agree at all (1). As a result of the CFA, goodness of fit indices were estimated as; χ^2=128.07, df=48, χ^2/df=2.67, RMSEA=.05, RMR=.03, NFI=.97, IFI=.98, TLI=.97 and CFI=.98. For the original scale, the Cronbach's Alpha reliability coefficient was estimated as .89 for the sub-dimension of *affect,* .89 for the sub-dimension of *loyalty,* .84 for the sub-dimension of *contribution,* .94 for the sub-dimension of *professional respect*, and .96 for the overall scale while the present study's Cronbach's Alpha reliability coefficient was computed as .87 for the sub-dimension of *affect,* .86 for the sub-dimension of *loyalty,* .80 for the sub-dimension of *contribution,* .86 for the sub-dimension of *professional respect*, and .92 for the overall scale.

Data Analysis

Data was analyzed with SPSS 22.0 and AMOS 23.0 software. Skewness and kurtosis were estimated following the removal of the outliers, and it was determined that they ranged between -1.5 to +1.5. It indicated that the research data was normally distributed (Tabachnick & Fidell, 2013). For the model fit, certain indices were reported in the CFA. Studies mainly were found to report χ^2, χ^2/df, RMSEA, RMR, NFI, IFI, TLI, and CFI indices (Meydan & Şeşen, 2015). Therefore, it was deemed appropriate to report these values in the present study. A χ^2/df ratio less than or equal to 5 means an

acceptable fit. RMSEA and RMR less than or equal to .08 (Kline, 2011), and NFI, IFI, TLI and CFI indices .90 and over (Hu & Bentler, 1999) indicate that the model has the perfect fit. The reliability coefficients of the scales were computed using Cronbach's Alpha (α). Path analysis was conducted using structural equation modeling (SEM) to determine the role of leader-member exchange in the relationship between motivational language and loyalty to supervisor. The level of significance for the mediation effect was tested using the Bootstrap method. The bootstrap method makes it possible to resample by producing very large data sets from the existing data set (Sacchi, 1998). Thus, more accurate results can be obtained with analyses conducted on larger data sets obtained by resampling.

Ethical Procedures

Necessary permissions were obtained from the institutions where the research was conducted before the research. Participants whose opinions were sought in the study were selected on a voluntary basis. The identity information of the participants was not included anywhere in the study. Ethical approval for this study was obtained from Gaziantep University Ethics Committee dated 1st June 2021 and numbered 49278. The research scales included the Motivational Language Scale, the Loyalty to Supervisor Scale, and the Leader-Member Exchange Scale, as well as the personal information of the participants.

Findings

The descriptive statistics are given in Table 1 below.

Table 1

Descriptive Statistics for the Variables and Correlation Coefficients

Variables	Mean	*SD*	*SE*	1	2	3
1. Motivational Language	4.01	.62	.03	1		
2. Loyalty to Supervisor	3.85	.61	.03	.72**	1	
3. Leader-Member Exchange	3.96	.64	.03	.64**	.70**	1

According to Table 1, teachers' perceptions of motivational language (*M*=4.01, *SD*=.62), loyalty to supervisor (*M*=3.85, *SD*=.61), and leader-member exchange (*M*=3.96, *SD*=.64) were partially high. The examination of correlation coefficients yielded that the three variables were related. Both motivational language (*r*=.72, *p*<.01) and leader-member exchange (*r*=.70, *p*<.01) were positively and highly correlated with loyalty to supervisor. In addition, there was a positive and a high level of relationship between motivational language and leader-member exchange (*r*=.64, *p*<.01).
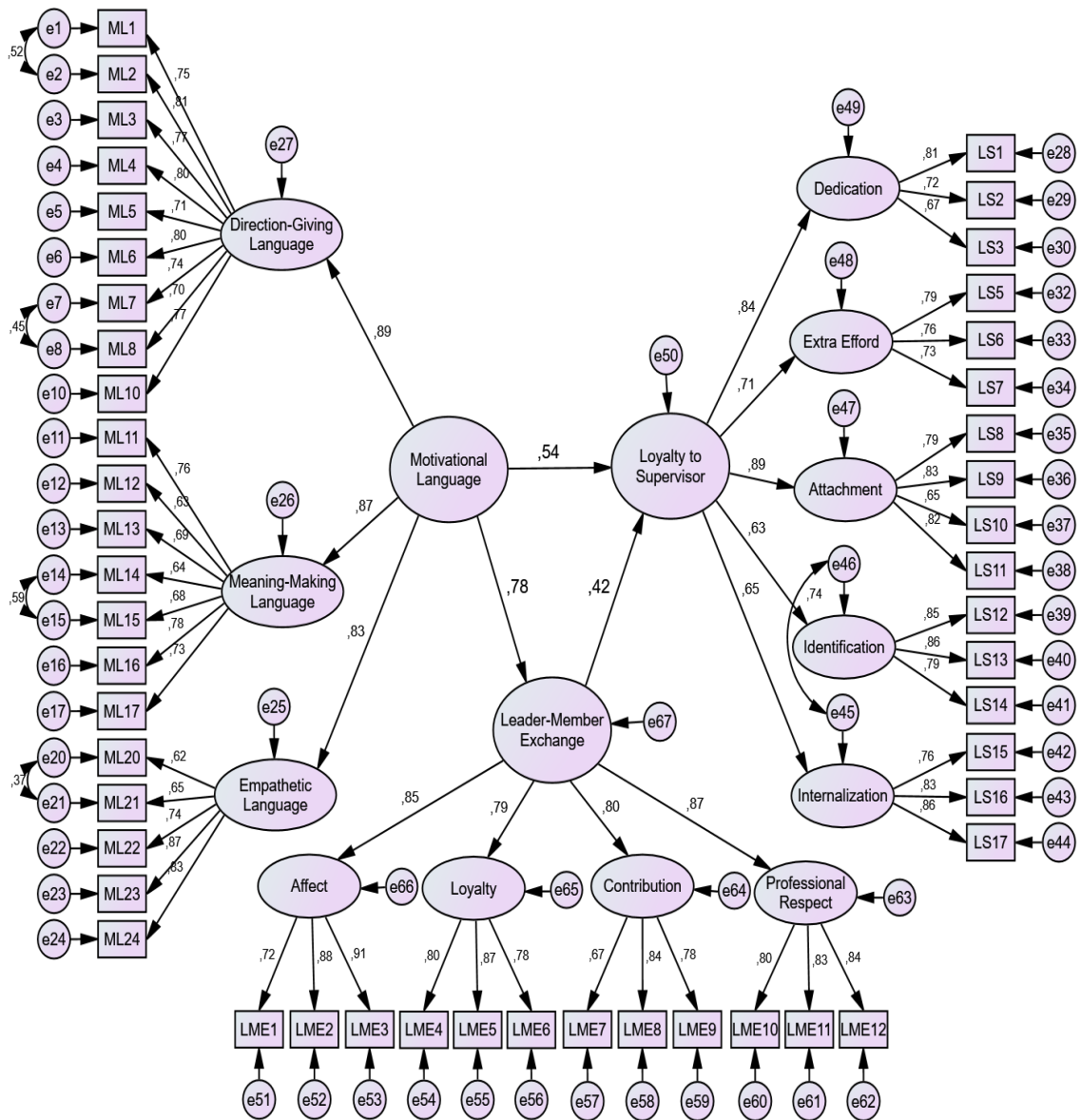
The Mediation Test

The mediation test included the results for the mediating role of leader-member exchange on the motivational language's predicting loyalty to supervisor. It was determined that motivational language predicted leader-member exchange (*β*=.78, *p*<.001) and loyalty to supervisor (*β*=.54, *p*<.001) positively and statistically significant.

Then, it was concluded that the direct effect of leader-member exchange on loyalty to supervisor was positive and statistically significant (β=.42, p<.001), and the leader-member exchange (mediator variable) was also found to predict loyalty to supervisor (dependent variable) without motivational language (independent variable). The obtained results implied that the mediation test would be appropriate for the model. Therefore, the mediating role of leader-member exchange in the relationship between motivational language and loyalty to supervisor was finally tested, and the findings were submitted in Figure 2.

Figure 2

The Mediating Role of Leader-Member Exchange

As seen in Figure 2, the paths added to the model in the mediation analysis contributed significantly to the model's goodness of fit. The goodness of fit indices were respectively estimated as; $\chi^2/df_{(2687/1107)}$= 2.43; RMSEA=.05, RMR=.05, NFI=.85, IFI=0.91, TLI=.90 and CFI=.91. The obtained scores as a result of the path analysis are given in Table 2.

Table 2

Path Analysis Results

Hypothesis	Paths	B	β	SE	t	p	Result
H1	ML ---> LS	.48	.54	.08	13.100	***	Accept
H2	ML ---> LMX	.83	.78	.07	13.474	***	Accept
H3	LMX ---> LS	.36	.42	.08	6.280	***	Accept
H4	ML ---> LMX ---> LS	.30	.33	.06	7.521	***	Accept

*** $p<.001$, (Note: ML: Motivational language, LS: Loyalty to supervisor, LMX: Leader-member exchange)

The examination of Table 2 indicated that the H1 hypothesis was accepted as motivational language positively predicted loyalty to supervisor ($β=.54$, $p<.001$), the H2 hypothesis was confirmed that motivational language positively predicted leader-member exchange ($β=.78$, $p<.001$), and the H3 hypothesis was approved as the leader-member exchange positively predicted loyalty to supervisor ($β=.42$, $p<.001$). Though it was still statistically significant, the $β$ coefficient between motivational language and loyalty to supervisor decreased with the addition of leader-member exchange to the model ($β=.33$, $p<.001$). In other words, the motivational language's predicting loyalty to supervisor both directly and indirectly through leader-member exchange suggested that leader-member exchange had a partial mediating role. Therefore, the H4 hypothesis was also confirmed and accepted.

After determining the partial mediating role of the leader-member exchange, the significance of the mediating effect was tested through the bootstrap method. The coefficients and confidence intervals of the direct and indirect effects are presented in Table 3.

Table 3

Direct and Indirect Effects on the Mediating Role of Leader-Member Interaction

Paths	Bootstrap coefficients		95 % Bootstrap CI		p
	β	SE	Lower	Upper	
Direct effect					
ML ⟶ LMX	.78***	.03	.74	.83	***
LMX ⟶ LS	.42***	.09	.28	.56	***
Indirect effect					
ML ⟶ LMX ⟶ LS	.33***	.07	.22	.45	***

Notes. 2,000 bootstrap samples. CI = confidence interval. ML: Motivational language, LS: Loyalty to supervisor, LMX: Leader-member exchange. ***$p<.001$

The examination of the bootstrap coefficients and confidence intervals in Table 3 yielded that the direct paths between motivational language and leader-member exchange ($β=.78$; SE=.03; 95% Bootstrap CI=[.74, .83]; $p<.001$), and leader-member exchange and loyalty to supervisor ($β=.42$; SE=.09; 95% Bootstrap CI=[.28, .56] were

significant. Moreover, motivational language significantly affected loyalty to supervisor (β=.33; SE=.07; 95% Bootstrap CI=[.22, .45]; p<.001).

Discussion and Conclusion

The current study aimed to examine the mediating role of leader-member exchange in the relationship between motivational language and loyalty to supervisor. According to the descriptive research results, teachers' perceptions of motivational language, loyalty to supervisor, and leader-member exchange were relatively high. This can be regarded as an indication that school administrators use a motivating language for the staff, teachers were loyal to school administrators, and there was a high level of communication between them. As a result of the correlation analysis to determine the direction and level of the relationship between the variables, it was found that the variables had a positive and high level of relationship with each other. In other words, while teachers' high levels of perception of the motivational language used by school administrators affect their levels of loyalty to the administrator and leader-member exchange perceptions positively, their perception levels of loyalty to the administrator and leader-member exchange decrease in cases where motivational language perception levels were low. This was an anticipated finding as the results of the previous studies demonstrated that the motivational language used by school administrators positively affected teachers' commitment to the administrator (Çelebi & Korumaz, 2016; Sabir & Bhutta, 2018; Sivik, 2018) and that the school administrator's explaining and guiding teachers about their duties within the scope of motivational language, reinforcing their exhibiting positive behaviors and meeting their expectations were necessary for increasing loyalty depending on the trust placed in the administrator (Holmes & Parker, 2018). Moreover, the leader-member exchange had a positive effect on teachers' loyalty to the administrator. High-quality teacher-administrator interaction was an essential factor for teachers to adopt the school, work devotedly, and see themselves as a part of the school (Gül, 2019).

As a result of the study, it was determined that motivational language affected loyalty to the administrator both directly and indirectly through leader-member exchange. This is in line with the results of previous research (Akman & Özdemir, 2019; Holmes & Parker, 2018; Murray, 2016; Ülker, 2015). Motivational language (Chen et al., 2002; Mayfield & Mayfield, 2002) and the quality of the interaction with the leader (Brown et al., 2018) affect employees' feelings of loyalty and commitment to the manager Moreover, Bejer (2019) concluded that the use of motivational language in the working environment contributes to the interactions of administrators. Motivational language has various positive outcomes for educational settings. While motivational language enables teachers to develop positive feelings towards their profession (Haider et al., 2018), it provides them with confidence in their administrators (Holmes & Parker, 2018) and makes them exert extra efforts for the school development beyond their role behaviors (Özen, 2014). Therefore, the use of motivational language by school administrators not only increases the loyalty of teachers, which includes working selflessly to successfully fulfill their duties and providing sincere support to their administrator (Akman & Özdemir, 2019) but also has positive reflections on the school climate by increasing the quality of communication between the administrator and the teacher (Gemalmaz, 2014).

Although this study provides a deeper understanding of the relationships among motivational language, loyalty to supervisor, and leader-member exchange, several limitations should be noted. The findings of the study have some limitations regarding the research design and the method used. First of all, the findings are not representative of all schools in Turkey, as the data were not collected from a sample that would represent the whole country. Future researchers can compare the findings of this study with those they will conduct in different settlements as private schools. Various factors can play a role in motivational language, loyalty to the principal, and leader-member exchange, both at the school level and at the individual level. Thus, it should be determined which variables are influential at the school or teacher level by performing multi-level analyses. However, we could not perform these as the collected data were not suitable for multi-level analyses.

The evaluation of the overall results implied that the motivational language used by the school administrators was an important determinant in establishing a high-quality communication between the administrators and teachers and, accordingly, in the formation of the teachers' perception of loyalty to the administrator. If teachers are required to work selflessly and support their administrators sincerely to fulfill their duties successfully, it is necessary to create a school climate based on love and respect, allowing them to enjoy their work, and appreciate and support their work. School principals' using motivational language, guiding them in their work, encouraging them, and creating a sense of belonging and commitment to the school will positively affect the loyalty to the administrator. Moreover, the increase in teachers' loyalty to the administrator will contribute to the effective realization of educational goals by enabling them to be productive and deliver higher performance. Future research can be designed with variables such as trust in the administrator, perceived organizational support, organizational justice, school culture, etc., which are believed to be the antecedents of loyalty to the administrator.

Statement of Responsibility

Mevlüt Kara; determination of problem situation, determination of sample group, selection and application of data collection tools, planning and implementation of activities, literature review, methodology, reviewing and inspection, writing-original draft and resources, editing. Sedat Alev; literature review, methodology, validation, writing-original draft, arrangement, writing review, analysis, visualization and supervision.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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Book Review: A Vocabulary Proposal Aligned with the Common European Framework of Reference for Languages towards Turkish A1 and A2 Levels

Kitap İncelemesi: Türkçe A1 ve A2 Düzeylerine Yönelik Diller İçin Avrupa Ortak Öneriler Çerçevesi ile Uyumlanmış Bir Söz Varlığı Önerisi

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ABSTRACT: This study aims to introduce Prof. Nihal Çalışkan's study entitled A Vocabulary Proposal Aligned with the Common European Framework of Reference for Languages towards Turkish A1 and A2 Levels. The teaching of Turkish that has made a rapid improvement in recent years draws a great deal of attention as a foreign/ second language. Nonetheless, the lack of word/ vocabulary lists stands out in this field. This study that is based on corpus linguistics, Çalışkan's field of study, and her own language learning experiences has been built on the idea that vocabulary is important in the acquisition of language skills, yet that a certain part of it should be taught as a priority in the face of the broad volume of the elements of vocabulary. In this study, which was meticulously carried out in line with the principle of transparency by examining current textbooks, the word was considered as an orthographic unit. This study was conducted in three phases and reached 1152 words at the A1 level and 1653 words at the A2 level. In the list prepared, the vocabulary elements were basically divided into two groups "words" and "units that exceed the limits of word". The units that exceed the limits of word were further subdivided into four categories: "morpheme units", "lexical units", "syntactic units" and "discourse units". The words determined based on prevalence criteria were aligned with the Common European Framework of Reference for Languages (CEFR). All units are exemplified by sentences generated by the author herself.

Keywords: Teaching Turkish to foreigners, book introduction, vocabulary.

ÖZ: Bu çalışmada Prof. Dr. Nihal Çalışkan'ın Türkçe A1 ve A2 Düzeylerine Yönelik Diller İçin Avrupa Ortak Öneriler Çerçevesi ile Uyumlanmış Bir Söz Varlığı başlıklı çalışmasının tanıtımı amaçlanmıştır. Son yıllarda hızlı bir ilerleme kaydeden Türkçenin yabancı/ikinci dil olarak öğretimi oldukça büyük bir ilgi görmektedir. Görülen bu ilgiye karşın alanda sözcük/söz varlığı listelerinin eksikliği hissedilmektedir. Çalışkan'ın çalışma alanı olan derlem bilim ve kendi dil öğrenme tecrübelerinden beslenen çalışmanın çıkış noktası, dil becerilerinin ediniminde söz varlığının önemli olduğu ancak söz varlığı ögelerinin geniş hacmi karşısında belli bir kısmının öncelikli olarak öğretilmesi gerektiği görüşüdür. Mevcut ders kitapları taranarak titizlikle ve şeffaflık ilkesi doğrultusunda hazırlanan bu çalışmada sözcük ortografik bir birim olarak ele alınmıştır. Çalışma üç aşamalı olarak gerçekleştirilmiş olup A1 düzeyinde 1152 ve A2 düzeyinde 1653 sözcüğe ulaşılmıştır. Hazırlanan listede söz varlığı ögeleri "sözcükler" ve "sözcük sınırlarını aşan birimler" olarak temelde iki gruba ayrılmıştır. Sözcük sınırlarını aşan birimler de "biçim birimsel birimler, sözcüksel birimler, söz dizimsel birimler ve söylem birimleri" olarak dört başlıkta gruplandırılmıştır. Yaygınlık kriterine göre belirlenen sözcükler DAOÖÇ ile uyumlu hâle getirilmiştir. Tüm birimler, yazarın kendisi tarafından üretilen cümlelerle örneklenmiştir.

Anahtar kelimeler: Yabancılara Türkçe öğretimi, kitap tanıtımı, söz varlığı.

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Teaching Turkish as a foreign/ second language is a field that has recorded rapid improvement in recent years. The considerable demand for learning Turkish has enabled the studies to develop systemically and become more qualified in this field. Despite all the developments, one of the main points lacking in this field is that the word/ vocabulary list prepared based on language levels is inadequate. Çalışkan's study entitled *A Vocabulary Proposal Aligned with the Common European Framework of Reference for Languages towards Turkish A1 and A2 Levels* provides a basis for this subject as well as being the source of further studies. The list that has been generated is of greater importance rather than a word list, yet in terms of a vocabulary list.

The *Introduction* part of the study is organized into two headings: Word Lists intended from Foreign Languages and Turkish Word Lists. In the *Method* part, however, the study is explained in detail under the headings of Creating the List, Evaluating the List, Aligning the Vocabulary with CEFR and Reaching the Units that Exceed the Limits of the Word based on the Final List; in addition, the process was elaborated. The *Findings and Interpretation* part covers the headings of the Inclusion Process, the Elimination Process and Notes on Certain Words (Adjectives, Verbs, Adverbs, Function Words). Following the *Result* and *Discussion* part, at the initial part of the *Sample List* is a short description written by the author for users both in Turkish and English. This section is an instruction manual on the nature of the list and how to benefit from it. In addition to Turkish, English explanation also addresses the target audience of the study. The Appendix section, which follows Sample List, contains numeric data about the units touched upon and the explanations of the preferences of inclusion and elimination throughout the study. This section, as emphasized by the author several times, is noteworthy in demonstrating the transparency of the inclusion and elimination processes performed in accordance with subjective criteria at certain points.

This study has been built on the idea that vocabulary is important in the acquisition of language skills, yet that a certain part of it should be taught as a priority in the face of the broad volume of the elements of vocabulary. However, previous studies indicated a positive correlation between vocabulary and language skills. The language learner develops basic comprehension and expression skills through vocabulary in the first place. Nevertheless, contrary to grammar that consists of a certain number of rules, it is unlikely to limit the vocabulary. This raises the question of how to identify vocabulary elements that are a priority for a language learner and increases the importance of word lists to be prepared accordingly. Çalışkan highlights the need to teach words based on a specific system. In this regard, she presents a vocabulary proposal aligned with the Common European Framework of Reference for Languages towards Turkish A1 and A2 levels. In the study, the word was regarded as an orthographic unit whereas such expressions that exceed the limits of word were also included. Çalışkan predicated the generation vocabulary on the prevalence criteria. The fact that she made inclusion and elimination in the word lists obtained from textbooks and gravitated towards the units that exceed the limits of word based on orthographic units made the study more comprehensive, taking it beyond a word list and making it a vocabulary.

Çalışkan carried out this study in three phases. In the first phase, A1 and A2 level textbooks (Gazi, İstanbul, Yedi İklim ve Yeni Hitit) used in the teaching of

Turkish as a foreign/ second language were scanned and transferred into digital environment. Through the data obtained, the Turkish Textbooks Corpus was generated. Correspondingly, at the A1 level, 57.674 input words and 10.328 different words; at the A2 level, 69.670 input words and 15.288 different words were identified. In the second phase, 4765 orthographic words were obtained by dissociating the words in the corpus. In the final phase of the study, however, the word list was aligned with CEFR and a draft consisting of 2027 words was formed. As a result of certain inclusions and eliminations made to the list, 1152 words at the A1 level and 1653 words at the A2 level were finally achieved. The author states that the inclusion and elimination process constitutes the subjective aspect of the study. On the contrary, the weaknesses that may result from the subjectivity were attempted to be eliminated by listing the criteria that are the basis of evaluation.

In her list, Çalışkan basically classified vocabulary elements under two categories "words" and "units that exceed the limits of word." Under the "word" heading, word was considered as an orthographic unit; however, "the units that exceed the limits of word" was further subdivided into four categories: "morpheme units," "lexical units," "syntactic units," and "discourse units." The vocabulary elements may be exemplified as follows: Words: tavşan (rabbit), kalem (pencil), anne (mother) etc. (words written separately from the words that come before and after itself); Morpheme Units: arkadaki (in the back), birbirimiz (each other), hepimiz (all of us) etc. (units that are formed as a result of the combination of independent and dependent morhemes); Lexical Units: sabaha karşı (towards the morning), yavaş yavaş (slowly), ağrı kesici (painkilller) etc. (compound words, reduplications, embedded collocations); Syntactic Units: X^{noun} + A zararlı (harmful) (sağlığa zararlı) (harmful for the health), $X^{adjective}$ + gözlü (eyes) kahverengi gözlü (brown eyes), $X^{günü\ (day)}$ Pazartesi günü (on Monday) etc. (productive units in which words appear within certain grammatical structures); Discourse Units: iyi ki (fortunately), bunun için (therefore), görüşürüz (see you) etc. (expressions that ensure the coherency and consistency of the text, that reveal the attitude of speaking and govern mutual communication). It is also worth noting that presenting the syntactic units included in the units that exceed the limits of word to students by formulating provides an effective framework for the students.

To ensure that words and additionals are noticed throughout the list, the additional has been shown by hyphens as in the examples "Ders- ten sonra park- ta tenis oyna- dı-k. (We played tennis after the lesson). Doktor randevu<s>u var (S/he has an appointment at the doctor's)." In case of an elision or phoneme evaluation, the relevant sound has been underlined, as seen in the example "Doğru seçeneğ-i işaretle<y>in (Mark the correct option)." The author formed sample sentences following its context in the corpus instead of being selected from the corpus generated for the study. This is due to the likelihood that the relevant word was not used in coherence based on the dictionary item as well as the possibility that other words in the context were not included in the list. Thus, all sentences presented for the A1 level were intended to be generated through the words at the A1 level.

One of the purposes of the study is to eliminate uncertainties resulting from homophony, homogram, and parts of speech. To this end, parts of speech were classified and listed; the words having multiple meanings were presented together with sample sentences in order to reveal their meanings at relevant language levels. In

addition to words, morpheme and lexical units were also identified. The first column shows examples of homophones as (I) and (II). Here, it is worth noting that certain words that are not labeled as homophones in the Turkish Dictionary are listed in Çalışkan's list as (I) and (II) in line with the representation of homophones. For instance, the word "sıra" (queue) used in such sentences as "Sıraya girin" (Get in the queue) or "Kitaplar sıranın üzerinde" (The books are on the desk) is given as an example for these words. In our opinion, the main point here is that the words have lost their transparency so that their interlexical sense relations are lost for those who learn Turkish as a foreign/ second language. This situation, however, triggers the debates on whether there should be a difference between dictionaries to be prepared for foreigners and for general purposes in terms of the item presentation.

Certain criteria that the author puts emphasis on while developing the list are remarkable. First of all, the CEFR text was taken as guidance. The vocabulary that was formed was aligned with the CEFR. In this process, the author determined key expressions related to the vocabulary in the statements of acquisition at A1 and A2 levels and evaluated each word in terms of their compatibility with the framework suggested by these key expressions. The second criterion is transparency. The list was made as transparent as possible, allowing the word to be included or eliminated when necessary. The author, who attaches importance to transparency, included the inclusions and eliminations made during the research process in the *Appendix* section at the end of the book. This may enable researchers to use the current list by forming it based on their purposes. When preparing the list in the study, in addition to focusing upon frequently and widely used words, it is ensured that the words were in compliance. This may contribute to language learners producing text. The third criterion of the author is up-to-dateness. In the finalization of the word list, the selection of words that students can use in their daily lives was considered.

While preparing the list, Çalışkan examined the national and international literature and evaluated relevant studies. The most important part of Çalışkan's list that distinguishes it from other lists is that the criterion of prevalence was based on rather than frequency. The second crucial point is that the list was aligned with CEFR. At this point, the keyword elimination method may guide the subsequent adaptation efforts. Finally, the fact that a series of subjective criteria were included in the study and, in this regard, additions were made from other lists also increases the content validity of the list.

The current study may also guide the further studies to be conducted in terms of the determination of units that exceed the limits of word. Moreover, it may allow students to control their learning by themselves in addition to Turkish as foreign/second language teachers. When preparing the word list, the relationships between the words and grammatical structures were also intended to be revealed. The association between the meaning of a word and grammar was especially emphasized. In this regard, the current study also guides teachers and those who develop teaching materials. Based on the above-mentioned properties, this vocabulary proposal which was distinguished from previous studies and prepared by carrying out comprehensive and rigorous studies to address the need in the relevant field is thought to establish a precedent for field researchers and be a new starting point.

Çalışkan conducted the present study on the basis of the most-used textbooks in teaching Turkish to foreigners. Nevertheless, the number of textbooks used in this field is rapidly increasing. In case the current study is updated or new vocabulary lists are prepared for B1, B2, and C1 language levels, using all current teaching sets may increase the content validity and a clearer view of the field is presented. As emphasized in the title of the study by the author, it is intended for a "proposal" rather than offering a peremptory vocabulary list. Moreover, evaluating all existing textbooks may reinforce this proposal.

Conflicts of Interest

There is no conflict of interest.

Author Bio

She was born in 1978 in Karabük. She completed her primary and secondary education in Çankırı/Çerkeş. She graduated from Gazi University, Faculty of Literature and Sciences, Department of Turkish Language and Literature in 1998; She received her master's degree from Gazi University, Institute of Social Sciences, Department of Turkish Language in 2001; She completed her doctorate in Gazi University, Institute of Educational Sciences, Department of Turkish Language and Literature Education with her thesis titled "The Place of Institutions Training Turkish/Literature Teachers in Turkish Education History (1923-1950)" in 2012. She worked as a lecturer in Kastamonu University Education Faculty Turkish Language Teaching Department between 1999-2012 and as an assistant professor between 2012-2015. Between 2015-2019, she was appointed by the Ministry of National Education as a Turkish lecturer at the Institute of Arab and Islamic Studies at the University of Exeter in England. Her study subjects include Teaching Turkish, Teaching Turkish to Foreigners, Teaching Grammar, Children's Literature, Reading Education, and there are national and international articles, papers and book chapters on these subjects. She is still working as an assistant professor in Kastamonu University Faculty of Education, Department of Turkish Language Teaching.

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