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## TABLE OF CONTENTS

Volume 18, Number 1 March 2023

#### Articles

8 The Distribution of Interactional Space and Collaboration in EFL Task-Based Peer Interactions

Author(s): Kadriye AKSOY-PEKACAR

31 The Impact of Gamification on Secondary School Students' Grammar Proficiency

Author(s): Gözde KOÇ - Selim Soner SÜTÇÜ

51 The Mediating and Moderating Effects of Knowledge Management in the Relationship between Technological Leadership Behaviors of School Principals and Data-Driven Decision-Making

Author(s): Mehmet Sabir ÇEVİK - Emine DOĞAN

78 Evaluation of the Training to Make Preservice Science Teachers Use Web 2.0 Tools during Teaching

Author(s): Ayberk ERDOĞAN - Nagihan YILDIRIM

100 Screen Time of Gifted Students During the Pandemic Period: A Mixed Method Research

Author(s): Çiğdem Nilüfer UMAR

135 Investigation of the Relationship between Individual Innovation Profiles of Special Education Teacher Candidates and Their Tendency towards the Use of Technology in Class

Author(s): Nergiz ATAK - Cansu ÇAKA

151 Evaluation of Educational Games Prepared by Mathematics Teacher Candidates According to Game Design Key Model

Author(s): Gülçin OFLAZ

182 Is Self-Criticism Really a Trigger of Psychological Problems? An Analysis of Self-Criticism in the Context of Turkish University Students

Author(s): Nesrullah OKAN

**204** Teaching the 21st Century Learning Skills with the Critical Thinking Technique Based on the Argumentation Method

Author(s): Okan SARIGÖZ

226 Investigation of the Relationship between Pre-service Social Studies Teachers' Attitudes towards Purchasing Geographically Indicated Products and their Status as Conscious Consumers

Author(s): Abdulkerim DİKTAŞ - Kenan BAŞ

## 245 Examination of Creativity Levels of Preschool Children

Author(s): Elçin YAZICI ARICI - Hasan Kağan KESKİN

## 259 The Effects of Out-Of-Class Learning on Students' Interest in Science and Scientific

## Attitudes: The Case of School Garden

Author(s): Esra SARAÇ YILDIRIM - Mustafa DOĞRU

# 281 The Relationship Between Students' 21st-Century Skills and Academic Performance in Science and Mathematics

Author(s): Mehmet Akif BİRCAN - Emrah AKMAN

## The Distribution of Interactional Space and Collaboration in EFL Task-Based Peer Interactions\*

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#### Abstract

This paper focuses on the influence of task types, namely divergent and convergent tasks, on the interactional space of learners and the amount of collaboration in EFL adult learners' interactions naturally emerging from performing each type of task. To define interactional space, behavioural engagement measurement was adopted, and the total number of turns and words were quantified to define the distribution of learner talk in each task. Additionally, the categories of collaborative behaviours were quantified for both task types to illustrate their distribution in the tasks. The data of this study involve eleven hours of learner interactions collected from an EFL context where the learners voluntarily participated in a speaking club and completed eight tasks. The interactions were audio-recorded and used for the analysis of the influence of task types on learners' L2 production and the distribution of collaboration in each task. The results yield a difference in the amount of L2 production between tasks; for example, convergent tasks facilitate more L2 turns and more L2 words than divergent tasks although the mean length of utterance is higher in divergent tasks. Similarly, the distribution of collaborative behaviours is mostly higher in convergent tasks. The results are discussed in relation to both interactionist and sociocultural theories of L2 learning and some implications are also provided based on the results.

Keywords: Convergent and divergent tasks, peer interaction, collaboration, task engagement

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#### Introduction

The theories of foreign/second language (L2) learning have different perspectives for a successful L2 learning. The interaction hypothesis, for example, emphasizes the importance of meaningful interaction for a successful L2 acquisition (Brown, 2014; Ellis, 2008; Mitchell et al., 2019). In L2 contexts, learners can only find opportunities to practise L2 in language classrooms. In these settings, though, it is the teacher who talks most and decides who can talk, when and about what (Walsh, 2006). To maximize the interaction between learners in L2 classrooms, Sato and Ballinger (2016) suggest using peer interaction activities as an ecological and effective tool since they create opportunities for everyone to speak and participate, and talking time for any student is dramatically expanded in peer interactions.

Peer interaction is different from teacher-learner interactions, and it is described as "any communicative activity carried out between learners, where there is minimal or no participation from the teacher" (Philp et al., 2014, p.3). Language tasks have been widely used for both triggering meaningful interaction among learners and also investigation of the types of tasks which can lead to more interaction. Ellis (2003; 2018) defines tasks as meaning-based language activities including a gap, and learners need to communicate with appropriate linguistic resources to achieve an outcome. Nunan (2004) states that there are many types of tasks as the number of people who have written on task-based language teaching (Duff, 1986; Long, 1990; Pica et al., 1993; Prabhu, 1987). For this study, Duff's (1986) proposal of convergent and divergent tasks has been favoured. Convergent tasks are coined from problem-solving tasks; and they are defined as tasks in which learners are required to converge on a single mutual correct answer (Tan Bee, 2003). On the other hand, divergent tasks resemble discussion tasks. These tasks encourage a range of possible responses and there is not a single correct answer in contrast to convergent tasks.

From the interactionist perspectives, the researchers investigated the interactional modifications such as negotiation of meaning, in other words, outcomes of this kind of interaction, in different types of tasks. There is a substantial body of research suggesting that the learning outcome of peer interaction tasks may be related to the nature of the task (Ellis, 2008; Philp et al., 2014). Pica et al. (1993), for example, studied the impact on task type on interaction patterns by using jigsaw, information gap, problem-solving, decision-making, and opinion exchange activities. They found that jigsaw and information gap activities provoke the most beneficial interaction patterns because the first type requires learners to converge on a single outcome after sharing what they have in hand; and the second one requires one learner to elicit information from other learner who holds the information. Fotos (1994) found that more negotiation was triggered in a task which involved split information and required a closed outcome. Duff (1986) found that convergent tasks promoted more interactional

modifications than divergent outcome tasks. Gass et al. (2005) examined the incidence of negotiation of meaning, language-related episodes (LREs), and recasts in three different tasks, two of which required information exchange between participants and the last one in which information exchange was optional. The findings show that there are more occurrences of 'focus on form' in the required information exchange tasks.

The researchers from sociocultural perspectives, on the other hand, investigated which tasks lead to more collaboration between learners by analysing LREs. They state that learners pool their individual knowledge and resources with each other; and as a result, they are mostly able to solve each other's problems and co-construct new language knowledge (Antón & DiCamilla, 1998; Donato, 1994; Swain, 2000). It is believed that the interaction emerging from the resolution of LREs will facilitate language learning. There is a considerable number of studies that investigated the task types by analysing LREs (Alegría de la Colina & García Mayo, 2007; Storch, 2001; Swain & Lapkin, 2001). They found that tasks with a closed outcome generated more language-related episodes. Dörnyei and Murphey (2003) also state that collaboration can be promoted by using certain tasks in which students work towards a common goal and a single group product.

Although there are studies (e.g., Foster & Ohta, 2005; Sato & Viveros, 2016) from both interactionist and sociocultural perspectives to investigate the impact of different task types on learners' discourse, there is a scarce number of studies that bring together both paradigms. This study, therefore, attempted to unveil the interactional distribution of learner talk between convergent and divergent tasks, and then present the amount of collaboration in quantity in different tasks. Although LREs have been widely used to quantify learners' collaboration, the categorisation in author's previous study (Aksoy, 2018) has been adopted for this study. Although it is suggested that tasks facilitate more interaction between learners, Donato (2004) states that interaction does not necessarily lead to or mean collaboration (Storch, 2002). Therefore, the following two research questions were formulated accordingly:

- 1. Is there an influence of different task types on learners' L2 production?
- 2. What are the proportions of collaborative behaviours in divergent and convergent tasks?

#### **Engagement in Different Tasks**

#### Number of Turns

Duff (1986) earlier compared the number of turns during a problem-solving task, which she categorised as a convergent task, with a discussion task which was defined as a divergent task. She reported that there were significantly more turns generated during the convergent task than the divergent task. The results also showed that the total number of turns in problem-solving tasks nearly

doubled the turns distributed in discussion tasks. Following this study, Long (1990) hypothesised that closed tasks, which require learners to reach one single solution, would produce more interaction either in pair or group work and further claimed that during free conversation tasks such as open or divergent tasks, there was a high possibility of learners to show less engagement with the task, maybe even drop in case of a crisis. His hypotheses were supported by the learners' less engagement during the open nature tasks. Similarly, in divergent tasks, some learners dominated the interaction and allowed others to take less turns than theirs. In another study, Altay (2004) used task-based and topicbased activities and compared the talk of the learners. Task-based activities were explained to carry the same features as convergent tasks in another study of the author (Erten & Altay, 2009). Additionally, topic-based activities were regarded as divergent tasks. The author reported that during the task-based sessions, the learners produced higher number of turns in total as a group than topicbased sessions. Erten and Altay (2009) also compared task-based and topic-based activities in learner groups and quantified the total number of turns. Their results report that the number of turns is higher during the task-based activities. Finally, Gass et al. (2005) compared three different tasks, two of which had a required information exchange while the third had an optional information exchange task. The researchers concluded the tasks which had the required information exchange as in convergent tasks produced more interactional patterns than optional information exchange task which resembles that of divergent tasks.

#### Number of Words

Duff (1986) observed that there were shorter turns during convergent tasks and more immediate feedback for the previous speaker's utterance as well. Additionally, these turns mostly included simple turns, which were also found in Altay's (2004) study. Duff also provided that during divergent tasks, extended discourse could be observed. She concluded that convergent tasks resulted in more words in total and further explained that there were more words per turn during divergent tasks. Altay (2004) measured the turns by making a distinction between mono-syllable, short and long turns. The results in her study also showed that shorter turns were more frequent in task-based activities. Learners had much longer turns during the topic-based activities. She concluded that learners tended to produce more words in task-based activities than topic-based activities. In another study, Erten and Altay (2009) found similar results. The researchers provided that there were more turns taken during task-based activity than topic-based activity. Moreover, they observed that learners produced a large proportion of short turns during task-based activity while they produced a large proportion of long turns during topic-based activity. Fujii et al. (2016) also provided that closed outcome tasks such as convergent tasks could result in short lexical exchanges while open tasks such as divergent tasks might result in longer expressions of opinion.

#### **Studies Reporting on Task Engagement**

Dörnyei and Kormos (2000) proposed a phenomenon named as 'task engagement' to refer to an active involvement in a learning task. They suggested measuring engagement in terms of actual language output measures such as the number of words and turns, as it has been done in this study as well. Recently, multidimensional frameworks of task engagement have been proposed by the researchers (Philp & Duchesne, 2016; Svalberg, 2009, 2018), and much of the recent research has followed the multidimensional framework of task engagement. In the model proposed by Philp and Duchesne (2016), there are for example four sub-components of task engagement: behavioural, cognitive, social and emotional. The authors describe behavioural engagement, which is relevant to this study, as the amount of time learners spend during on-task or off-task, which can be measured through language output. They state that measures involving word counts (Bygate & Samuda, 2009) and turn counts (Dörnyei & Kormos, 2000) help measuring behavioural engagement. Phung (2017), for example, examined the impact of task preference and engagement in L2 use in a US higher education context and found that the preferred tasks which learners found personally relevant in terms of topic and content familiarity led to more behavioural engagement. In another study (Qiu & Lo, 2017), more behavioural engagement was noted in tasks with familiar topics. The researchers stated that the learners produced significantly more words on tasks with familiar topics as well as showing a more positive response to those tasks.

Lambert et al. (2017) compared the benefit of learner-generated content (learners' actual lives and experiences) and teacher-generated content (fictitious ideas or events to create an environment for L2 use) and examined learners' engagement in both tasks. Their results showed that in learnergenerated content tasks, learners invested more time in performance and showed more responsiveness. Lambert and Zhang (2019) also found that learner-generated content condition allowed Japanese learners of both English and Chinese to engage more in tasks than teacher-generated content condition.

Dao (2021) investigated the effect of task goal orientation such as convergent and divergent tasks on learner engagement in task performance. The results indicated that learners more cognitively, emotionally and socially engaged in convergent decision-making task than divergent opinion-exchange task. Qiu and Cheng (2021) also examined the effect of task types, opinion-exchange and storytelling tasks, on L2 oral production and learner engagement. Their results showed that learners spent more time and had more turn-taking in story-telling tasks than the other type of tasks.

#### Method

#### **Participants**

The oral production of 15 adult learners while performing eight language tasks was analysed for this study. The participants were attending the language school of a state university in Turkey. Their ages ranged between 18-20, and they were reported to have B1+ proficiency level according to the Common European Framework of Reference (CEFR) by the school administration. They voluntarily participated in the study which was designed as a speaking club. Their participation or performances during these activities did not have any effect on their academic grades at the language school. The learners worked in groups and performed the language tasks orally.

#### Language Tasks

Two types of tasks; namely, convergent and divergent tasks were used to elicit oral data for the current study. The reason of choosing these tasks is that previous research has proven that closed (Long, 1990) or convergent (Duff, 1986) tasks create more opportunities for learners to co-construct meaning, and as a result, they collaborate more, which facilitates L2 development. To compare the influence of different task types, open (Long, 1990) or divergent (Duff, 1986) tasks were preferred as complimentary tasks to convergent tasks.

The tasks were either replicated from previous studies or designed by the researcher by considering the features of these tasks. During this process, the familiarity of the learners with the topics was ensured since previous research has suggested that more elaborate discourse is likely to be elicited by familiar topics (Li et al., 1995) and background knowledge such as topic familiarity facilitates performance on tasks (Leeser, 2007). There was not any attempt to elicit any linguistic outcome from the tasks. The oral interactions of learners while performing 8 tasks, four of which were convergent tasks and the remaining were divergent tasks, were used for the analysis (see Aksoy, 2018 for the tasks). Some of them are exemplified in Appendix A.

#### Procedure

The author carried out the study over an academic term, which allowed to collect 11 hours of peer interaction in total. After getting the required ethics committee approval for the implementation of the study, learners from the same language proficiency classes were invited to participate in the study. 15 learners consented to participate in order to practise their speaking in L2 after their regular classrooms. They were grouped into 3 peer groups by random assignment to minimize the effect of any interacting variables. One type of a language task was assigned to each learner group to complete as a group in each session. The learners attended the data collection sessions twice a week, and the whole data collection procedure lasted for two months. All of the tasks were assigned by the

researcher in L2(English) and the learners were asked to perform the tasks in English as well. In order not to interfere with the nature of peer interaction, the researcher did not participate in learners' interactions and acted as a non-participant observer to control the research context in terms of recording the interactions. There was not any time limit for the completion of tasks. Therefore, the duration of tasks differed among groups and across different tasks. The selected tasks were performed in an order below:

Table 1. Data collection procedure char
---

Step 1: Unstructured divergent task1
Step 2: Unstructured divergent task2
Step 3: Unstructured convergent task1
Step 4: Unstructured convergent task2
Step 5: Structured divergent task1
Step 6: Structured divergent task2
Step 7: Structured convergent task1
Step 8: Structured convergent task2

There were two sets of tasks, which are unstructured and structured tasks. The data collection started with an unstructured divergent task to avoid any effect of the task type and to have a more naturally occurring interaction data and see the collaborative behaviours. The first four tasks were completed by the learners without any possible intervention by the researcher. That's why the first set of tasks were regarded as unstructured tasks.

The researcher used an intervention between the first set and the second set of tasks. The reason of naming this second set of tasks as structured tasks is because learners had some specific roles during their interactions. Dörnyei and Malderez (1997) informs that roles contribute to the productivity of the group because if learners are given the right role, they will become useful members of the team. Therefore, the author decided to assign some group roles to the learners to perform during their interactions during the second set of tasks.

The nature of the tasks might be a factor on the types of the roles, but there are some typical roles such as the leader, the organizer, the information-seeker, etc. (Dörnyei, 2007). These roles may emerge naturally among the members, or teachers can distribute the roles for everyone (Dörnyei & Malderez, 1997). Dörnyei (2007) states that explicitly marked roles has the advantage of preparing learners to perform the roles effectively. For the intervention, some group roles such as facilitator, timekeeper, recorder, reporter, devil's advocate and checker were chosen and randomly assigned to the learners. The roles of timekeeper and facilitator were given to the same learner as both of the roles required managing the interactions of the group. The intervention session where learners practiced their roles were not included in the analysis. Only the last four tasks, while the learners performed these roles during their interactions were added to the analysis. It is noteworthy to mention here that structured tasks were performed by only two learner groups because the number of participants

unexpectedly decreased during the data collection process, which is also accepted as a limitation of the study. The oral interactions of learner groups were audio-recorded, and later transcribed in accordance with Jefferson's conventions (2004) for analysis by the researcher.

#### **Data Analysis**

#### Number of Words and Turns

To unveil the quantity of learners' engagement in different tasks, the number of words and the number of turns generated by the participants were counted. These measurements were previously used to understand learners' behavioural engagement or task engagement as well (Dörnyei & Kormos, 2000; Kormos & Dörnyei, 2004). Firstly, adopting a sequential-production model (Sacks, Schlegloff & Jefferson, 1974), turn constructional units were calculated based on the transcriptions of the interactions. Similar to García Mayo and Azkarai's (2016) measurement of turns, the starting point of a turn was taken when a learner started to talk and finished when another student initiated a new utterance. Ellis and Barkhuizen (2005) suggested using mean length of turns alongside with number of turns measurements. In this study, the total number of words was counted and then divided by the total number of turns to understand mean turn lengths. To clarify the calculations of the turns, the extract 1 was excerpted from a divergent task session. In this extract, it is seen that there are 9 turns exchanged by two learners, ZUL and SIM, in total. Additionally, ZUL had 5 turns while SIM had 4 turns.

Extract 1. What do you think about or	nline dating? (Unstructured	Divergent Task 1, Group 3)
---------------------------------------	-----------------------------	----------------------------

1	ZUL: I used wechat application and err I shake my phone and err my phones (1.0) found nearly err
2	SIM: people
3	ZUL: yes
4	SIM: in the peo- in the near people
5	ZUL: and use application
6	SIM: yes
7	ZUL: err and I meet (2.0)
8	SIM: one per[son
9	ZUL: [him yes

During the calculation of the number of turns, off-task talk where learners were talking something irrelevant to the task both in L1 and L2 was omitted. Only when the learners talked about the task either in L1 or L2, these turns were included in the calculations. Moreover, number of turns was further classified as target (TL) and non-target (NL). Target language (TL) turns involved the turns where learners were using English while non-target language (NL) turns consisted of the turns where learners were using their native language which was Turkish.

To examine the impact of task types on language production of the participants, the number of words was quantified as the unit of analysis. All parts of speech such as nouns, verbs, adjectives, adverb, pronouns, prepositions, conjunctions, determiners and exclamations were included in the calculations. However, lexical tokens such as hesitation markers e.g., 'erm and err (or different representations)' were not included in the calculation of the number of words. However, the lexical token 'huh' (hi in Turkish) was included in the calculations when it signalled a clarification request. The confirmation token 'hu huh' (hi hi in Turkish) was also included in the calculations.

The following extract was excerpted to exemplify the quantification of the number of words for the whole dataset. Only target language words were counted for the quantification of the number of words. Following this, the mean length of TL turns was calculated in order to compare the effect of task types on the complexity of learners' production.

Extract 2. What do you think about online dating? (Unstructured Divergent Task 1, Group 2)

ARZ:	when we go same course but (6 words)
TUG:	hi? (1 word)
ARZ:	we me- we go we went to same course but err (9 words)
TUG:	in the a- (2 words)
ARZ:	we (1 word)
TUG:	in the Azerbaijan (3 words)
ARZ:	yes (1 word)
TUG:	hı ( <b>1 word</b> )
ARZ:	and err we never meet (4 words)
TUG:	and you didn't know each other (6 words)
ARZ:	y- no (1 word)
	((head shakes))
TUG:	so it's a good thing (5 words)
ARZ:	yes (1 word)
TUG:	you to you (3 words)

#### **Collaborative Behaviours**

Collaborative behaviours were qualitatively defined with content analysis, and two broad categories of collaborative behaviours, namely language-related and task-related, emerged from the interactions. Language-related collaborative actions refer to the moments of the resolution of any language issues such as when learners struggled to find a word or provided corrections to group members' utterances. This kind of collaboration types also emerged in the resolution of any comprehension problems among learners. There are 8 different language related collaborative behaviours in the study. These are a)provision of the word/phrase, b)reconstruction of others' turn, c)request for clarification, d)comprehension check, e) summary of the others' turn, f) request for explanation, g)request for information, and h)provision of the L1 translation of the word/utterance. Task-related collaborative actions, however, refer to the task-related issues such as keeping group

members focused on task, simplification of the task and accomplishing the task in L2. They are a)pooling knowledge/ideas, b)encouragement for participation, c)task policing, d)simplification of the task, and e)language policing. A detailed description of these collaborative behaviours is available in author's previous study (Aksoy, 2018). For this study, the frequency of collaborative behaviours was summed, and the percentages were calculated for both convergent and divergent tasks to compare two types of tasks. The next section will present the results of the study.

#### Findings

#### Learners' Engagement During the Tasks

The total number of turns were counted for each group and for each task session (divergent vs. convergent and unstructured vs. structured) as described in the methodology section. This quantification allowed to measure the behavioural dimension of engagement and describe learner engagement by quantity (Dörnyei & Kormos, 2000). Edstrom (2015), however, warns that counting the words may not provide a clear picture of participation or information about its quality and depth (Ellis & Barkhuizen, 2005). However, it still gives an overview of the distribution of conversational space in each task. The following table presents the total number of turns for each task type along with the mean scores of target language turns per task. Since each task was performed by more than one learner group, i.e., 3 learner groups in unstructured tasks and 2 learner groups in structured tasks, mean scores of each task session were also calculated, and the findings were provided accordingly.

Session types	Number of turns	Number of TL turns	Mean of TL turns per group	Mean of TL turns per TASK
Unstructured Divergent Task 1	1096	981	327	
Unstructured Divergent Task 2	1074	956	318.7	322.83
Unstructured Convergent Task 1	2602	2246	748.7	903
Unstructured Convergent Task 2	2775	2566	855.3	802
Structured Divergent Task 1	1413	1197	598.5	450 75
Structured Divergent Task 2	781	642	321	459.75
Structured Convergent Task 1	1196	936	468	172 5
Structured Convergent Task 2	1179	958	479	473.3

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l able	Ζ.	Number	OT	furns	taken	ner	session
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Overall, table 2 shows that there is a difference in the total number of turns between divergent and convergent tasks. To start with, the total number of target language (TL) turns in the first and second unstructured divergent tasks are very close to each other. During the first unstructured divergent session, the learners exchanged a total of 981 TL turns with the mean value of 327 while

they exchanged 956 TL turns with the mean value of 318.7 per learner group. In terms of convergent tasks, the total number of TL turns during the unstructured convergent tasks doubles the total number of TL turns taken during the previous tasks. The learners had a total of 2246 TL turns with a mean value of 748.7 during the first unstructured convergent task while they had 2566 TL turns with a mean value of 855.3 per learner group in the second unstructured convergent task.

The scores of the structured tasks also shows that the number of TL turns taken during the convergent tasks are higher than the divergent tasks. For example, during the first structured divergent task, learners engaged in 1197 TL turns in total with a mean value of 598.5 while they had a total of 642 TL turns with the mean value of 321 during the second structured divergent task. Lastly, during the first structured convergent task session, learners exchanged a total of 936 TL turns with a mean value of 468 while in the second structured convergent task session, they engaged in 958 with a mean value of 479.

To see whether there is a task type effect on learners' engagement during the divergent and convergent tasks in terms of the total number of the TL turns, the overall mean values were further computed on a Microsoft Excel file. The results show that there is a task type effect on learners' engagement. For instance, the mean value of TL turns taken during the unstructured divergent tasks is 322.83 while it is 802 for the unstructured convergent tasks. In addition, the overall mean value of the TL turns for the structured divergent tasks is 459.75 which is relatively higher than the mean value of TL turns in unstructured divergent tasks. On the other hand, the overall mean value of the TL turns in structured divergent tasks is 473.5. Based on these results, it can be said that learners showed more behavioural engagement with the target language in convergent tasks compared to divergent tasks.

## Learners' Production During the Tasks

The total number of words produced by the learners were also calculated, and table 3 summarizes the number of TL words produced during each task session.

Session types	Number of TL turns	Sum of TL words	Mean length of turns per group	Mean length of turns per task
Unstructured Divergent Task 1	981	5176	5.28	
Unstructured Divergent Task 2	956	5065	5.30	5.29
Unstructured Convergent Task 1	2246	8461	3.77	2.71
Unstructured Convergent Task 2	2566	9393	3.66	5./1
Structured Divergent Task 1	1197	5272	4.40	1.65
Structured Divergent Task 2	642	3282	5.11	4.05
Structured Convergent Task 1	936	4075	4.35	4 20
Structured Convergent Task 2	958	3876	4.04	4.20

 Table 3. Number of words produced per session

The results show that learners produced 5176 TL words during the first unstructured divergent task session with a mean length of turn value of 5.28. On the other hand, there were 5065 TL words produced in the second unstructured divergent task session a mean length of turn value of 5.30 per group. The mean values of interactional measurement indicate that the complexity of learners' language production is similar to each other in those tasks. During the unstructured convergent tasks, there is an increase in the number of TL words produced by the learners. In the first unstructured convergent task session, the learners produced 8461 TL words with a mean length of turn value of 3.77 while they produced 9393 TL words during the second unstructured convergent task session a mean length of turn value of 3.66 per group. The mean difference between first and second unstructured convergent task session is also very close to each other.

The number of TL words that learners produced during the structured task sessions was also quantified to see whether there was a change in the mean length of turns in those tasks. The results show that during the first structured divergent tasks, the learners produced 5272 TL words with a mean length of turn value of 4.40 per group. On the other hand, there were 3282 TL words produced with a mean length of turn value of 5.11 per group. During the structured convergent tasks, it is observed that learners produced 4075 TL words with a mean length of turn value of 4.35. On the other hand, during the second structured convergent task session, learners produced 3876 TL words with a mean length of turn value of 4.04 per group.

In addition to the quantifications of the total number of TL words, the mean length of turn values was calculated to provide more convincing evidence for the influence of task types on the complexity of learners' production. The mean length of turn scores suggest that learners produced longer turns in divergent tasks than convergent tasks. In this regard, the overall mean length of turn value for two unstructured divergent tasks was calculated as 5.29. On the other hand, the overall mean length of turn value for two unstructured for the structured tasks as well. The overall mean length of turn value of two structured divergent tasks was calculated to be 4.65. On the other hand, the overall mean length of turn value during structured convergent tasks was calculated to be 4.40. There is yet a slight difference between convergent and divergent tasks in structured contexts as well.

#### The Frequency of Collaborative Behaviours Between Tasks

To see the impact of task types on learner's collaboration, the frequency of collaborative behaviours was quantified on Microsoft Excel file and the joint distribution of collaborative behaviours is presented in table 4 below.

	DIVERGENT				CONVERGENT					
	UNST	ST	TOTAL		UNST	ST	TOTAL		OVERALL	
	f	f	f	%	f	f	f	%	f	%
Language- related C.	191	123	314	43	276	140	416	57	730	100
Task- related C.	34	39	73	63	32	11	43	37	116	100
TOTAL	225	162	387	45.74	308	151	459	54.26	846	100

Table 4. The joint distribution of collaborative behaviours between tasks

The frequency of both language- related and task-related collaborative behaviours in convergent tasks is higher (f= 459), representing 54.26% of overall collaborative behaviours than divergent tasks (f=387). In terms of the categories of collaborative behaviours, the frequency of language-related collaborative behaviours is also higher in convergent tasks (f=416) which accounts for 57% of overall distribution of the language-related collaborative behaviours. However, the distribution of task-related collaborative behaviours is higher in divergent tasks (f=73), representing 63% of the overall distribution than convergent tasks (f=43) which accounts for 43% of the overall task-related collaborative behaviours. These findings suggest that there is a task type effect on learner's use of collaborative behaviours. However, these results should be interpreted carefully as there was an intervention of assigning group roles before the second set of language tasks.

Having presented the findings, the next section will discuss the results with relevant literature and present a conclusion with some implications for language learning.

#### **Discussion and Conclusion**

The aim of this paper was to show the distribution of interactional space and collaboration in adult EFL learners' interactions while performing convergent and divergent in unstructured and structured conditions. A quantitative analysis was carried out to investigate learners' engagement in the tasks and the complexity of their language production. The results may give an overall representation of conversational distribution in each task type; yet, word count may not provide a clear picture of learners' participation and its depth and quality. Collaborative behaviours previously defined in author's previous studies were also counted to see whether engagement would lead to observing more collaborative behaviours. The results will be discussed under separate subtopics as follows:

#### **Total Number of Turns**

The results can be summarised as the learners had more turns during convergent tasks compared to divergent tasks, and this may suggest more learner engagement in convergent tasks. However, the mean length of turn scores in convergent tasks was lower than in divergent tasks. This can be explained as the learners produced shorter turns such as one-word turns or more insert expansions in convergent tasks. On the other hand, the higher mean length of turn scores in divergent tasks suggest the learners produced more extended turns in this type of tasks. The number of turns taken especially in unstructured tasks which resulted in a naturally occurring interaction present similar results to earlier studies (Duff, 1986; Fotos, 1994; Long, 1990; Gass et al., 2005; Pica et al., 1993). These results can be explained by the inherent nature of the tasks (Duff, 1986; Gillies, 2006). For example, as convergent tasks require learners to produce one single outcome in the end, more shorter exchanges between learners were observed. Whereas, divergent tasks carry the same features as discussion tasks and learners can only present their ideas about the topic the task in extended turns without expecting any confirmation or counter argument from other participants. Therefore, the conversational unfolding of divergent tasks may follow an initiation, response, feedback (IRF) sequence without any elaborations on the current speakers' contributions. These results are congruent with what Erten and Altay (2009) stated in their paper. The authors suggested that tasks which require learners to achieve an outcome such as convergent tasks lead to a type of interaction that resembles everyday communication. They further stated that long turns are less frequent than shorter turns in everyday communication because it is much more important to convey meaning clearly rather than producing linguistically longer and complex sentences. The results of this study also support the findings of Altay's (2004) study in which the author reported that during the task-based sessions, the learners produced higher number of turns in total as a group than topic-based sessions which were regarded as divergent tasks. These findings also support what Dao (2021) recently reported that tasks with convergent goal orientation led to more learner engagement than divergent task orientation. Similarly, Qiu and Cheng (2021) stated that opinion-exchange tasks such as divergent tasks elicited less learner engagement than story-telling tasks.

The assignment of group roles could have allowed learners to show similar engagement in structured divergent and convergent tasks. An interesting result is to see that learners had more turns in the structured divergent tasks than the unstructured divergent tasks although these tasks shared similar features with one another. The reason of observing such a difference can be attributed to the nature of roles because the roles define how the work will be done (Cohen, 1994; Cohen & Lotan, 2014). During the structured tasks, each learner was given a role and they had to practise his or her role during their interactions. Cohen and Lotan (2014) state that unstructured grouping may lead to the dominance of some students and non-participation of others. For example, as the non-participant observer, the researcher realised that some learners dominated the discussions. During the first unstructured divergent tasks. Although the learners were chosen from the same proficiency level, one of these learners particularly had long inserted pauses and many hesitation markers in his formulations of L2, which may be regarded a lower proficiency compared to other participants of the

learner group. Another learner also was not eager to participate much as she refused to take turns and frequently claimed that she made a mistake in her use of L2. Another reason for the limited participation of these learners can be explained by social interdependence theory (Johnson & Johnson, 2009). As the participants came from different classrooms, they were randomly assigned to learner groups and they had to work with other learners they were unfamiliar. This may have avoided to form a positive relationship in their learner groups; and consequently, they did not participate in the following data collection sessions.

Phung (2017) and Qiu and Lo (2017) reported that preferred tasks or tasks with familiar topics allowed learners to show more behavioural engagement in those tasks. Although the task design of both unstructured divergent and structured tasks was similar to each other, the learners may have found the structured tasks more familiar to themselves, which in turn elicited more turns in structured tasks. These results suggest that even though task design can be a determining factor in task engagement, topic can also have an impact on learner's engagement (Li et al., 1995).

Learner-generated content has also been reported to an increase in learner's performance and engagement compared to teacher-generated content (Lambert et al., 2017; Lambert & Zhang, 2019). In addition to task design and topic, the tasks which allowed more learner-generated content may have caused a higher task engagement in convergent tasks. This can be also observed in the tasks with the same task design even though no group roles were assigned to the learners.

#### **Total Number of Words**

The results suggest that there is a task type effect on learners' production of target language words. Learners seemed to produce more words in convergent tasks than divergent tasks. The results also indicated that the mean length of turns was higher in divergent tasks than both of the convergent tasks. However, the mean difference between unstructured divergent and unstructured convergent tasks was observed to be higher than the mean difference between structured divergent and structured convergent tasks. Overall, these findings suggest that learners produced more turns and more words during convergent tasks; but the mean length of turns observed in convergent tasks was really small. This suggested that learners produced shorter turns such as one-word turns in convergent tasks, which provides similar results to Duff's study (1986). On the other hand, the results suggest learners produced extended turns in divergent tasks due to the fact that the mean length of utterance was bigger in divergent tasks.

Structuring was also observed to have an effect on the total number of words. The mean length of turn was smaller in structured divergent tasks. Assigning group roles might have caused the learners to engage in more like real conversations, leading to having much shorter turns during structured divergent tasks as of native speakers. Brown and Yule (1983 cited in Altay, 2004) stated that L1 speakers tended to produce short turns and chunks of language in their interactions even if

they gave an academic or formal speech. Unstructured convergent tasks seemed to resemble the features of L1 speakers' interaction more compared to the structured convergent tasks during which learners tended to produce more words per turn. The unstructured convergent tasks might have been interpreted as real-life tasks defined by Nunan (1989), and therefore, learners tended to have more L1 similar interaction. On the other hand, assigning roles might have created an academic atmosphere during the convergent tasks. Learners seemed to have longer turns during the structured convergent tasks than unstructured convergent tasks. Additionally, there was not an intention to search for the overlaps during the interactions, but it was observed that learners tended to have more overlaps during the convergent tasks. However, they waited for other speakers to finish turns in order to initiate a turn in divergent tasks.

#### The Effect of Task Types on Collaborative Behaviours

The results of the study suggest there is a task type effect on the quantity of learners' use of collaborative behaviours. The overall distribution of collaborative behaviours is more frequently observed in convergent tasks. In terms of the categories of collaborative behaviours, language-related collaborative behaviours are more frequently observed in convergent tasks whereas task-related collaborative behaviours are more frequently observed in divergent tasks. As Donato (2004) states that interaction does not necessarily lead to or mean collaboration (Storch, 2002), this study yielded results to show that the amount of interaction in terms of number of turns and words does not guarantee the emergence of collaborative behaviours.

These results present similar results to previous studies that investigated convergent tasks with a closed outcome (Duff, 1986; Erten & Altay; 2009; Fotos, 1994; Gillies, 2004; Gillies; 2006; Long; 1990). Similar to the studies that analysed LREs, it was found that tasks with a closed outcome generated more LREs (Alegría de la Colina & García Mayo, 2007; Storch, 2001). As Altay (2004) earlier stated that tasks with a required outcome lead to more everyday communication, it is not surprising to observe more language-related collaborative behaviours since these helped resolve any comprehension problems or any language issues.

The reason of observing more task-related collaborative behaviours in divergent tasks can be explained by both the nature of the tasks and the assignment of group roles to the learners to perform during their interactions. It is highly possible that the learners would engage in off-task talk in divergent tasks as there was not any requirement to produce an outcome while performing these tasks. Still, the learners can have used task-related collaborative behaviours, for example, to keep their partners on task during their conversations. Aslan also (2015) observed that structured group work generated more collaborative behaviours and group performance than unstructured group work. In addition, she found that the outcomes of structured group work yielded better results in terms of learners' vocabulary development, written products. Gillies (2003) also states that learners benefit

from working together only when groups are structured so that learners create a sense of group identification and psychological interdependence since the social dynamics of peers in groups or pair interactions greatly affect learners' ability to profit from each other (Sato & Ballinger, 2016). This in turn reduces the free-loading effect (Gillies, 2003) as well.

This study is not without any limitations. As earlier stated in the method section, the structured tasks were performed by two learner groups. Although the mean scores of both total number of words and turns were calculated, the numbers may not represent each learner's engagement in the tasks. Although the learners were chosen from the same language proficiency classrooms, some learners were observed to possess a higher proficiency level than their partners. Finally, some of the learners met their partners and worked together for the first time in the study. This may have affected their actual performances during the sessions.

#### **Implications and Suggestions for Further Research**

Engagement with language (Philp & Duchesne, 2016; Svalberg, 2009, 2018) or task engagement (Dörnyei & Kormos, 2000) has gained interest from researchers who conduct research on language tasks. The findings of this study can add to their studies in terms of which kind of tasks trigger more learner engagement. The results can also inform language teachers, task designers about types of tasks to facilitate more engagement which in turn can lead to a more successful language learning experience. In a broader context, policy makers can take actions based on the results such as integrating and implementing task-based language teaching into language education programmes. Not only adult learners as in this study, but also young learners can benefit from the implementation of such approaches in their language learning process. As the results of the study may suggest, using tasks will help learners more actively engage with language. This is especially important for foreign language contexts, such as the current research setting, where learners have no or limited opportunities to actively use or practise the foreign language.

Although the quantitative results can present an overview of the distribution of interactional space and collaborative behaviours, a qualitative analysis into learners' interactions can provide more robust insights to see the engagement of learners with the tasks. The pursuit of a language focus such as vocabulary, grammar or pronunciation, etc. can also be added to see the impact of different task types. The study can be replicated with younger learners or learners from different language proficiency levels to unveil possible differences. The same study can also be carried out in real classrooms by the classroom teachers as the research context may have had an impact on the results.

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The author declares that she has no conflicts of interest.

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## **Credit Author Statement**

The author confirms that she had all responsibilities for the following: conceptualization of the study and design, data collection, data analysis and interpretation of the findings, and preparation of the manuscript.

## **Ethical Statement**

Ethics committee approval has been obtained from the Hacettepe University ethics committee of scientific research with the decision numbered No: 35853172/438-2194 on 13.07.2015.

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Educational Policy Analysis and Strategic Research, V18, N1, 2023  $\ensuremath{\mathbb{C}}$  2022 INASED

## Appendix A: Examples of language tasks used in the study

What do you think about online dating?

Unstructured Divergent Task 1	<ul> <li>Have you ever met someone from online websites?</li> <li>Do you think it is a good idea to meet someone from online websites?</li> <li>Do you think you may fall in love with someone that you have never met in person?</li> <li>Are there any disadvantages? What may be disadvantages?</li> <li>Will you continue your relationship? Will you marry in the end?</li> </ul>
Unstructured Convergent Task 2	You are from the same student club. You want to go on a holiday together for the weekend. Unfortunately, you have a limited budget as most of the students do. So, as a group of friends, you should decide on the destination you would go. You might choose to go to a five-star hotel with all-inclusive option, but it is not possible to see around for instance the historical places or museums and so on.
	You might choose to go to a boutique hotel, but it only covers breakfast. You may see different places and so on.
	You might choose to go on a camping, but you have to stay in a tent in the nature.
Structured	
Divergent Task 2	What is the best age for marriage?
Structured	The craziest things each university students should do.
Convergent Task 1	- You will decide 5 of them and rank according to the more craziest one to the less craziest one.

## The Impact of Gamification on Secondary School Students' Grammar Proficiency\*

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## Abstract

The aim of this study is to investigate the academic achievement of 6th grade students in grammar course gamified with an online tool and their opinions regarding the application. The study employed quasi-experimental design and a semi-structured interview was utilised to obtain the qualitative data. The application lasted for 6 weeks during which the experimental group received gamified grammar education whereas the control group received content-based language learning. Pre-test and post-tests were applied to both groups to check if there were any differences between the scores. Since the quantitative data were not parametric, Wilcoxon Matched – Pairs Signed Ranks Test and Mann Whitney U Test were used in the analysis of the data. Also, a semi-structured interview was utilised to learn about the opinions of the students in experimental group. The results yielded a significant difference in favor of students who received gamified grammar learning. The results were also supported by the positive opinions of the students towards gamification of grammar with an online tool as an in-class material.

Keywords: English Language Learning, Grammar Proficiency, Computer Assisted Language Learning, Gamification, Kahoot

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#### Introduction

Traditional teaching strategies frequently concentrate on a single learning domain, such as the cognitive or psychomotor domain. Contrarily, this hardly satisfies the criteria of knowledge, competence, and attitude. As a result, teaching strategies that concentrate on a single learning area both impede active learning and cause learning to be delayed or stopped by lowering students' motivation. Students must employ multiple abilities at once to solve problems in the real world in order to develop the new century skills. This requires the development of the learning environments which consider new teaching strategies and surroundings. Even though traditional methods have been refined over hundreds of years and include tremendously valuable and useful knowledge, today's children need much more (Warschauer, 1998, p. 62). As a result of this urgent need triggered by the immense development in Internet and Communication Technologies (ICT), technology-based learning models, environments, and tools have started to replace traditional learning models. Language learning has always been open to these innovative technologies and been one of the first fields to adopt them, with an established approach namely Computer Assisted Language Learning (CALL) which serves as the key catalyst for the development of technology based pedagogical approaches. Grammar is the base of language learning and effective use of language skills calls for a high degree of grammatical competence. However, teaching of grammar has always been perceived as difficult to teach (Brindley, 1984; Baron, 1982) and boring to learn (Leki 1995; Schulz, 2001). CALL has been proved to be effective when teaching foreign language, and playing computer games with students has been shown to increase their understanding of the grammatical structures of the target language (Simoes, 2013, p. 13). There is a continual need to investigate the affordances of new emerging technologies that can be used to gamify grammar teaching. Hence, this study aimed to investigate the impact of one of these Technologies; Kahoot! as a gamification tool on the grammar knowledge achievements of English language learners as well as to assess students' attitudes and opinions on the usage of Kahoot! for grammar instruction.

#### Gamification

Technology advancements have led to a rise in the popularity and reality of games. Reality can resemble a game to certain people (Çağlar & Kocadere, 2015, p. 84). In the 1930s, Huizinga referred to our species as "Homo Ludens," which is Latin for "playful human people." Today, games have merged seamlessly into everyday life. The act of playing games is currently being used to increase learning and performance in learning-teaching processes, and there are many games and gamified apps related to learning and awareness that are readily available (Yıldırım & Demir, 2014, p. 660). The basic objective of gamification is to encourage and promote positive behaviours by integrating game design aspects into non-game themes, circumstances, or services. Huotari and

Hamari (2013) define gamification as a technique for boosting motivation and emphasising desired actions.

Games have increased in popularity and reality as a result of technological developments and have become an integral aspect of people's lives today. There are numerous games and gamified applications related to learning and awareness widely available, and the act of playing games is now being utilized to improve learning and performance in learning-teaching processes (Yıldırım & Demir, 2014, p.660). Gamification's main goal is to use game design elements in non-game topics, situations, or services to stimulate and promote desirable behaviors. Gamification is described as a motivation-enhancing method used to emphasize desired actions, according to Huotari and Hamari (2013).

Gamification in this context considers the requirements and objectives of users by offering an intrinsic motivation coupled with dedication (Kapp, 2012 p. 90). The game's rules and manner of thinking, according to Zichermann and Cunningham (2011), are created to hold players' interest and facilitate problem-solving. The term "gamification" was first used in the disciplines of digital media and marketing, but since 2010 it has also been applied to other fields (Deterding, Dixon, et. al., 2011). Gamification is also cited as being extremely helpful in learning by Pappas (2014) as listed below:

- Gamification will inspire interest in and dedication to the lesson,
- The idea of e-learning will be both enjoyable and educational,
- The information will become permanent,
- Students will have the chance to experience their real lives;
- It will offer an effective learning environment.

## **Theoretic Approaches in Gamification**

Along with the fact that gamification contains important parts of the game elements, motivation and motivational behavior change are seen on the basis of gamification. In this context, taking into account the theoretical approaches in gamification studies in the field of education, Malone Motivation Model, Self-determination Theory and Fogg Behavior Model are the main approaches that should be emphasized. These three approaches will help to achieve a better result by understanding the psychological basis of gamification in the process of implementing gamification on a system (Glover, 2013, p.64).

## Malone and Lepper Intrinsic Motivation Classification

This model, which was developed by Malone and Lepper whose starting point was educational computer games took the final form of the intrinsic motivation classification. This classification; consists of struggle, curiosity, fantasy and control elements.

- Struggle: Having the most appropriate level of difficulty according to one's performance towards a goal or result.
- Curiosity: The formation of a state of curiosity by taking into account the knowledge status of the person and presenting the appropriate level of information in a complex and contradictory way.
- Fantasy: Making the person think that s/he is in that environment or taking on a character by creating an imaginary environment or extraordinary environments.
- Control: The person has authority and can use his/her authority through different options within the structure. (Lepper, 1973, p.135)

## **Self-Determination Theory**

Self-determination theory is an important motivation theory that deals with extrinsic and intrinsic motivation problems. In this theory, three basic psychological needs, which are universal and human innate, are mentioned, namely autonomy, competence and relatedness. These needs must be nurtured for people to reach their potential (Ryan & Deci, 2000, p.72).

- Autonomy: The ability of a person to act according to his own will without being affected by any external factor, to make a choice.
- Competence: Having the motivation to do any job or affecting the level of motivation.
- Relatedness: One's need to be in contact with other people.

## **Fogg Behavior Model**

According to Fogg (2009), in order to achieve the desired behavior, one must have three components: sufficient motivation, skill and an effective trigger. (p.4)

- Motivation: The necessary motivation for the desired behavior to occur.
- Skill: The opportunity and skill that the person has to acquire the behavior.
- Trigger: Triggering the behavior to occur and initiate.

## Gamification in EFL

Learning a new language is an intense and challenging process that requires mental, emotional, and physical commitment on the part of the learner. The main objective of gamification is to increase user engagement and motivation through the use of game elements like points, leaderboards, and instant feedback. The L2 learning strategies also make use of these elements. Technology has been a significant factor in L2 learning over the years and has been essential to learning second languages Ybarra and Green (2003) (p.56). "In L2 learning, integrating technology has been crucial, and the incorporation of Computer Assisted Language Learning (CALL) has been instrumental for the development of teaching and learning," according to Flores (2015) (p. 37).

The effectiveness of gamification was the subject of a year-long study by University of Colorado Denver professor Traci Sitzmann (2011). She gathered data from 6,476 adults in total. The results showed that learners who learned in the following manner improved most quickly (p.512);

- Skill-based knowledge level increased by 14%
- Factual-knowledge level increased by 11%
- Retention of material learnt increased by 9%

Technology has a crucial role in EFL classrooms and enhances students' interest. Shyamlee and Phil (2012) claimed that;

The last two decades have deposed a revolution due to incipience of technology, and has shifted the dynamics of various industries, and has also affected the industries and the way people communicate and work in the society. This speedy rising and advancement of information technology has proposed a greater pattern to explore the new teaching model. As a result, technology plays a highly important role in English teaching (p. 69).

The use of games in the classroom environment attracts students' interest and boosts their motivation to meet learning objectives, according to a 2018 study by Bicen & Kocakoyun. Consequently, gamification might be utilised as a successful learning method when instructing L2 (p.22). Çakıroğlu et al. (2018) used gamification techniques to investigate the relationship between student engagement and academic success. The study involved 37 college students, ranging in age from 18 to 24. The use of gamification in the classroom was found to increase students' engagement and academic (p.175). There aren't many studies that concentrate on how gamified learning affects students' achievement in a particular area of language acquisition, such vocabulary learning. The pretest posttest quasi-experimental study on two separate groups of engineering students done by Yip and Kwan (2006) is one of these investigations. Websites provided assistance with the group's vocabulary instruction. Contrarily, the control group studied the words in the conventional way. The outcomes demonstrated that the experimental group outperformed the control group in terms of academic growth (p.240).

## Kahoot! in EFL

Since Kahoot! was launched in 2013, its popularity has grown significantly across the globe, especially in schools (Pede, 2017, p.23). According to Kapuler (2015), Kahoot! was the 36th-best Student Response System (SRS) application out of 100 (p. 15). According to Chiang there are three key aspects of Kahoot! which are classified as follows: "Kahoot! offers a game-like response platform for learners (Johns, 2015; Medina & Hurtado, 2017, p.89) and a multimedia tool promoting participation, which provides a competitive learning format (Dellos, 2015) and leads to easy acceptance by the click generation." (p. 34). Additionally, SRS applications are potent tools that

support by enhancing students' problem-solving and cognitive skills, critical thinking, and knowledge, claim Bicen and Kocakoyun (2018). Wichadee and Pattanapichet (2018) conducted a quasiexperiment study with thirty-eight students which are in experimental group and thirty-nine control group at a private university in Thailand on gamified learning performance in language learning. Ten vocabulary quizzes and five grammar quizzes were applied to participants. While the experimental group was assessed with Kahoot!, control group was assessed by traditional paper based quizzes. At the end of the experiment, a significant difference between control group and experimental group was found. Experimental group achieved success by means of fun and competitive environment provided by Kahoot! (p. 79). A literature review conducted by Klimova and Kacetl (2018) about effectiveness in vocabulary acquisition by using computer game-based learning showed that Kahoot! has a positive impact on students' motivation and concentration on vocabulary acquisition decreasing students' unwillingness and anxiety in the lesson. Uzunboylu (2009) conducted a study to determine the effectiveness of Internet-based education on English grammar teaching, while the experimental group used Kahoot! for English grammar exercises, the control group did similar grammar exercises with the traditional method. It was found that the success of the students in the experimental group was higher than the success of the students in the control group (pp. 140-150).

### Method

#### **Participants**

Students in a private college secondary school's sixth grade were used to collect research data. Since it is challenging to collect data using experimental approach for social sciences, including quasi-experimental technique, an appropriate sampling technique was utilized for determining the sample. This common sampling strategy is employed when it is very challenging for a researcher to create a sample and obtain the experimental subjects while using the method that is used for experimental methodology. Due to limitations in terms of time, money, and employment, the sample is chosen using this method from readily available and usable units (Büyüköztürk et al., 2008, p.32). For these reasons, the sample for this research was composed of 80 6th graders from 500 school children. The study was carried out using two groups in accordance with the quasi-experimental methodology. 40 and 39 B1 Preliminary level English sixth graders enrolled in a private school made up the experimental and control group respectively. For both groups, Cambridge University Press's "Power Up 6" book was utilized.

#### **Data Collection Tools**

In this study, quasi-experimental method was utilised. Two groups were created as experimental and control groups. Achievement tests with 20 questions were given to each group as a pre- and post-test, and the results were used to collect quantitative data for this study. The achievement
test questions were selected from a pool of questions with a high level of validity, reliability, and distinctiveness. The achievement tests used in the study were selected from the "Sınav College Assessment and Evaluation Unit Question Bank" of previously analysed questions. Statistics on each item is provided in Tables 1. and 2. Table 1. provides statistical data regarding the achievement test items that were used as the pre-test.

Question no	Difficulty level	Difficulty	Distinctiveness	Index of validity
1	Easy	0.66	0.68	0.64
2	Easy	0.58	0.83	0.79
3	Medium	0.55	0.58	0.61
4	Hard	0.38	0.71	0.68
5	Medium	0.58	0.83	0.82
6	Medium	0.61	0.68	0.69
7	Easy	0.58	0.72	0.69
8	Hard	0.50	0.78	0.80
9	Easy	0.58	0.83	0.81
10	Medium	0.61	0.44	0.43
11	Hard	0.40	0.67	0.69
12	Medium	0.61	0.78	0.69
13	Medium	0.63	0.32	0.36
14	Hard	0.37	0.73	0.71
15	Medium	0.67	0.44	0.39
16	Medium	0.47	0.72	0.78
17	Easy	0.50	0.89	0.85
18	Easy	0.53	0.74	0.72
19	Medium	0.50	0.78	0.75
20	Medium	0.47	0.80	0.81

Table 1. Statistical information about the achievement test used for pre-test

Reliability Co-efficient:0,71

Statistical data regarding the achievement test that was used as the post-test is given in Table 2 below.

Question no	Difficulty level	Difficulty	Distinctiveness	Index of validity
1	Medium	0.65	0.42	0.40
2	Easy	0.57	0.84	0.80
3	Easy	0.59	0.71	0.67
4	Medium	0.42	0.69	0.80
5	Medium	0.51	0.80	0.74
6	Medium	0.62	0.36	0.34
7	Hard	0.36	0.69	0.67
8	Medium	0.59	0.76	0.70
9	Easy	0.52	0.75	0.73
10	Medium	0.57	0.55	0.63
11	Hard	0.38	0.71	0.69
12	Medium	0.55	0.85	0.81
13	Hard	0.42	0.68	0.70
14	Medium	0.60	0.63	0.67

 Table 2. Statistical information about the achievement test used for post-test

Educational Policy Analysis and Strategic Research, V18, N1, 2023 © 2022 INASED

15	Hard	0.51	0.77	0.82
16	Medium	0.46	0.81	0.82
17	Easy	0.60	0.70	0.66
18	Medium	0.63	0.46	0.45
19	Easy	0.48	0.86	0.84
20	Easy	0.61	0.87	0.77

Reliability Co-efficient:0,70

Each group used a copy of the English textbook Power Up 6 by Cambridge Press, which is also used in many Turkish schools. Target grammar was taught to the experimental group via Kahoot! while the control group received conventional classroom teaching techniques over the course of four weeks. Semi-structured interviews were used to collect qualitative data for the study, which looked into the students' perceptions of the gamification programme Kahoot! Only members of the experimental group took part in the semi-structured interview after four weeks of instruction. Ten students from the experimental group volunteered to participate in interviews after the application was finished and the post-test was given.

Interview questions were utilised to get an answer to the sub-problem "What are the students' perspectives on learning English grammar using Kahoot! " To confirm the validity of the interview questions, an expert also reviewed the questions. A preliminary interview with five students who were familiar with the application was also conducted to see whether the questions were clear. The questions were modified as needed to produce the final interview form. The following are the interview questions, which are primarily composed of 5 items and are meant to ascertain students' opinions about Kahoot! and English grammar instruction:

- 1. What do you think about the game Kahoot! as an in-class activity that you have participated in?
- 2. How did you feel while you were playing Kahoot!?
- 3. Should the game Kahoot! be used for English lessons?
- 4. What do you think about learning English grammar via Kahoot!?
- 5. Has Kahoot! changed your opinions towards learning grammar?

#### **Data Analysis**

The Mann Whitney-U test was used for unrelated samples in the data analysis, while the Wilcoxon signed rank test was used for related samples in order to analyse the quantitative data obtained from the study. Data analysis was done using SPSS Statistics 22. By using content analysis, data from the semi-structured interview was obtained. Before the analysis, data accuracy was checked, and the data were organized. Afterwards, lost data were examined to check whether there was an extreme value and the initial data of one participant who could not attend the post-test, was excluded from the data set. During normality analysis, coefficients of kurtosis and skewness were

examined, and it was seen that the data were not distributed normally. Therefore, it was decided to continue analysis with non-parametric tests since the data were not distributed normally and the sample group was small (Büyüköztürk, 2011). From research questions, Wilcoxon signed rank test was conducted for related samples in order to examine the difference between the pre-test- post-test points of the experimental group who took grammar lessons via "Kahoot! and the difference between the pre-test-post-test points. Mann Whitney-U test was used in order to examine the difference between post-test grades of the experimental group who took grammar lessons via the difference between post-test grades of the experimental group who took grammar lessons via the control group who took grammar lessons via the control group who took grammar lessons via the control group who took grammar lessons by course-book based language education. Analysis results were reported.

Qualitative data from the research question of the study: "What are the EFL learners' attitudes and opinions about the use of Kahoot! for grammar instruction?" was analyzed using content analysis after the interviews ended. According to Yıldırım and Şimsek (2016), the process used in content analysis for the analysis of semi-structured interviews with students is to collect similar data within the framework of certain themes and concepts, organize and interpret these statements in a way that the reader can understand. The first step in data analysis in qualitative research is to prepare and organize the collected data for analysis. For this, the interviews are written on a piece of paper and arranged according to their types. The researcher separates the data into relevant wholes, assigns codes to these meaningful sections, and ensures that the data in these sections are grouped with comparable codes during the coding process. According to Yıldırım and Şimşek (2016), The generated codes are brought together and evaluated in the first step, and themes that can explain and categorize the data are discovered. This is referred to as thematic coding. In this study, the answers of 10 students from experimental group who voluntarily participated in the interview for the analysis of qualitative data to open-ended questions prepared in advance were analyzed as mentioned above. First, the data was written down, arranged for analysis, carefully read and coded, the themes were determined, the themes were associated with each other, and the meanings of the themes were interpreted, as in Creswell's (2014) Data Analysis Chart in Qualitative Research. Finally, an experienced analyst analyzed the data to ensure the accuracy of the information acquired.

The interview questions used in the study were examined by three consultants to ensure the validity. At the same time, it was determined that the questions were understandable by conducting a preliminary interview with five students who knew the application before. The final version of the interview form was created by making necessary adjustments to the questions. According to Stewart and Cash (1985), interviewing is defined as a reciprocal and interactive process by asking and answering questions in line with a predetermined purpose. Stewart and Cash (1985) divided the interview types into two as structured and unstructured. Interviews with predetermined questions and answers are structured and open-ended interviews are unstructured interviews (Yıldırım & Şimşek,

2016). Karasar (2013), on the other hand, described the interview as a data collection technique through oral communication. Karasar (2013) divided the interview types into three as structured, semi-structured and unstructured. In this interview, both pre-prepared questions, which are the requirements of the structured interview, were used, and new questions were asked when deemed necessary according to the rule that new questions can be asked according to the developments in unstructured interviews. Therefore, this interview can be qualified as a semi-structured interview. Karasar (2013) stated that personal information can be obtained more easily in individual interviews. For this reason, individual interviews were conducted to make the students feel comfortable.

#### Findings

# Findings related to the first question of the research "Does Kahoot! have any significant impacts on 6th grade EFL learners' achievements with respect to grammar knowledge?"

Wilcoxon signed rank test results regarding pre-test and post-test results of the students who are amongst the experimental group and received grammar lessons via Kahoot! are given in Table 3.

**Table 3.** Wilcoxon signed rank test results regarding pre-test and post-test results of the students who were in the experimental group and received grammar lessons via Kahoot!

Post-test-Pre-test	Ν	Rank average	Rank total	Z	р
Negative Rank	2	23.50	47.00	4.70	.000*
Positive Rank	36	19.28	694.00		
Equal	1				

The analysis results show that there is a significant difference between pre-test and post-test points of the students who are amongst the experimental group (z=4.70, p<.05). When the rank total of the difference points is considered, this observed difference is in favour of positive ranks meaning post-test points. As per the analysis results, application of grammar lessons via Kahoot! programme is effective in increasing the success points of the students.

Wilcoxon signed rank test results regarding pre-test and post-test results of the students who were in the control group and received course book-based grammar lesson are given in Table 4.

**Table 4.** Wilcoxon signed rank test results regarding pre-test and post-test results of the students who were in the control group and received course book-based grammar lesson.

Post-test-Pre-test	Ν	Rank average	Rank total	Z	р
Negative Rank	13	17.88	232.50	1.58	.114
Positive Rank	23	18.85	433.50		
Equal	3				

The analysis results show that there is not a significant difference between pre-test and post-test points of pre-test and post-test of the students who are in the control group (z=1.58, p>.05). As

per the analysis findings, there is not a meaningful difference between the success results of the students who received course book-based grammar lessons before and after the implementation.

Table 5. examines whether there is a change in the achievement test post-test points of the experimental group students who received grammar lessons via Kahoot! and the students who received course book-based language education.

**Table 5.** Mann Whitney U Test Results regarding post-test grades of the experimental group who received grammar lesson via Kahoot! and the control group who received grammar lessons through course book-based language education.

Group	Ν	RT	RA	U	Z	р
Experimental	40	45.28	1811.00			
Control	39	34.59	1349.00	569.00	-2.08	.038*

As per the applied Mann-Whitney U test results, achievement test points of the students who received grammar lessons via Kahoot! differs significantly compared to the students who received course book-based language education (U=569.00, p<.05). When the rank average is considered, success point averages of the experimental group students who received grammar lessons via Kahoot! are higher compared to the control group students who received grammar lessons through course book-based language education. As a result, it can be said that receiving grammar lessons via Kahoot! has an effect on achievement test results in language learning.

Table 6. examines whether there is a change in the pre-test points of the experimental group students who received grammar lessons via Kahoot! and the students who received course book-based language education.

**Table 6.** Mann Whitney U Test Results regarding pre-test grades of the experimental group who received grammar lesson via Kahoot! and the control group who received grammar lessons through course book-based language education.

Group	Ν	RT	RA	U	Z	р
Experimental	40	29.78	1191.00			
Control	39	50.49	1969.00	371.00	-4.38	.000*

As per the applied Mann-Whitney U test results, achievement test points of the students who received grammar lessons via Kahoot! differs significantly compared to the students who received course book-based language education (U=371.00, p<.05). When the rank average is considered, success point averages of the control group students who received grammar lessons through course book based language education are higher compared to the experimental group students who received grammar lessons via Kahoot!. Experimental group had lower points on achievement test before the commencement of the experiment. As a result of the conducted analysis, an additional Mann Whitney- U analysis regarding the difference between the post-test and pre-test results is shown

below in order to support the conducted analysis when the meaningful difference of pre-test and posttest points are taken into consideration.

Mann Whitney U test results regarding the difference between the post-test points and pre-test point of success points are given in Table 7.

**Table 7.** Mann Whitney U Test Results regarding post-test pre-test difference of the experimental group who received grammar lesson via Kahoot! and the control group who received grammar lessons through course book-based language education.

Group	Ν	RT	RA	U	Ζ	р
Experimental	40	50.00	2000.00			
Control	39	29.74	1160.00	380.00	-3.93	.000*

As a results of the conducted Mann-Whitney U test, it was seen that the achievement test points of the students who received grammar lessons via Kahoot! differed in a meaningful way compared to the students who received course book-based language education (U=380.00, p<.05). When the rank averages considered, it is seen that the success point averages of the experimental group students who received grammar lesson via Kahoot! are higher compared to the control group students who received grammar lessons through book-based language education. As a result, taking grammar lessons via Kahoot! has an effect on language learning.

# Findings related to the second question of the research "What are the EFL learners' attitudes and opinions about the use of Kahoot! for grammar instruction?"

The answers received from the students as a result of the semi-structured interview are as follows;

"What do you think about the game Kahoot! as an in-class activity that you have participated in?" to this question S1 answered that; "I think that Kahoot! application is a very useful tool." S2 told that; "I can understand the subjects better with Kahoot!." S3; "I find this tool very enjoyable." S4; "It is very useful." S5; "It's a very fun tool." S6; "Kahoot! is a very fun game." S7; "I like competitive games like Kahoot!." S8 told; "A game tool which makes the lesson fun." S9; "I think it's a very fun game." S10 said; "It was enjoyable and educational."

"How did you feel while you were playing Kahoot!?" to this question S1 answered that; "I liked it very much." S2; "I got very stressful while playing." S3 said that; "I got so excited." S4; "I got panicked because I don't like losing." S5; "I got bored." S6 said; "Kahoot! was so exciting!" S7; "I felt competitive." S8; "It was very fun, I really enjoyed while playing it." S9; "I got panicked a little." S10 said; "I felt happy while playing the game."

"Should the game Kahoot! be used for English lessons? Why?" to this question S1 answered; "Yes it should because it makes the lesson more fun." S2; "Yes, because I understood grammar better." S3; "Yes, it made me happy." S4; "No, actually it wasn't fun that much." S5; "Yes, because I like competitions and winning. It's a good way of practicing." S6; "Yes, I can understand better with Kahoot!." S7; "Kahoot! is a very useful tool in English lessons, so yes." S8; "Yes, because it motivates me." S9; "Yes, because it's a fun game." S10; "Yes, I understood the topic very well."

"What do you think about learning English grammar via Kahoot!?" to this question S1 answered; "Grammar learning is more fun with Kahoot!." S2; "I understood the grammar topic better." S3 said; "It's a fun way to exercise so I think we should use this tool while learning grammar." S4; "It didn't make any difference in learning the grammar." S5 said; "English grammar will be very fun with Kahoot!." S6; "Learning grammar will be easier with this tool." S7; "Kahoot! is a very useful tool in learning English grammar." S8; "Grammar is easier this way!" S9; "I can understand English grammar better with this tool." S10; "I think it was a very fun lesson and I understood the grammar better with this tool."

"Has Kahoot! changed your opinions towards learning grammar?" to this question S1 answered; "Grammar wasn't that hard I guess." S2 said; "Yes, it changed my opinions towards grammar." S3; "I guess I learnt better with Kahoot!." S4; "Yes, it has." S5; "No, it hasn't grammar is still very hard for me to learn." S6; "Yes, it has." S7; "Grammar is fun now." S8; "It's a fun way of practicing grammar so yes." S9; "Yes, it has." S10; "Grammar learning is easier this way."

#### Discussion

# The first question of the study; "Does Kahoot! have any significant impact on 6th grade EFL learners' achievements with respect to grammar knowledge".

The answers to this question demonstrate that using Kahoot! to teach grammar increases student performance. Students in the experimental group who received grammar instruction using Kahoot! outperformed those in the control group who received grammar instruction using contentbased language education on achievement tests. Students' academic success is clearly increased when learning environments are enhanced with new approaches and tools that grab students' attention rather than using conventional approaches. This outcome is consistent with other research in the area. 90% of university students who used Kahoot to learn grammar had success, according to a 2016 study by Zarzycka-Piskorz on this topic (p. 47). A further study by Genç & Ersoy (2017) revealed a substantial difference between the students' pre-test and post-test average grammar scores. Additionally, Kapp (2012) discovered a link between grammar instruction and the usage of gamification tools in the classroom. Wichadee & Pattanapichet (2018) shown through a different experiment that Kahoot! had a significant influence on student achievement. Kahoot! is particularly good at teaching grammar concepts, according to a comparable study by Turan and Meral (2017). (p. 46). According to a different study by Chotimah & Rafi (2018), students who used Kahoot! had greater success with reading comprehension and were more motivated. Because the students enjoyed playing the game on their phones and their focus improved to comprehend the questions regarding the reading text.

The achievement test results from the experimental group students were lower than those from the control group students prior to the experiment. A considerable difference between the pretest scores was shown by the analysis's findings. To fully comprehend this situation, it was discovered through the analysis of the variations in post-test and pre-test scores that the achievement test scores of students who participated in grammar lessons using Kahoot! were very different from those of students who took a content-based language education lesson. The experimental group was able to close the gap and even surpass the control group as a result of the Kahoot! application, which had been lagging behind the control group at the outset. Another finding of this study indicated that there wasn't much of a difference between the exam results of the students who completed content-based grammar courses before and after the course. The employment of traditional methods may affect students' success with grammar but may not produce a gratifying difference, which is in line with the findings of the study done by Turan and Meral (2018). Gamification enhanced students' cognitive and achievement levels, whereas learning grammar via a text book had minimal impact on students' performance with grammar, according to a comparison of gamification and traditional techniques.

## The second queston of the study; "What are the EFL learners' attitudes and opinions about the use of Kahoot! for grammar instruction?".

The majority of pupils showed support for the gamification of grammar using Kahoot! They claimed that using this strategy made learning enjoyable and that it ought to be used in other sessions as well. Additionally, they mentioned how Kahoot! helped them learn more effectively and with greater retention. The findings of this study are consistent with those of numerous other studies in the literature. According to the research done by McLaughlin & Yan (2017), this strategy had a positive impact on the students' cognitive abilities as well as their self-regulation, learning performance, motivation, and attitudes about the lesson. By fostering an enjoyable learning environment and allowing students to engage in more active learning, the technique significantly improves learning performance (p. 54). According to a research by Krause (2015), students' accomplishment and retention scores on exams increased by 25% and their average scores by 23% in classrooms that used gamification. It was discovered that the students' performance has improved by 40% in terms of memorability. Also in 2007, Dietz-Uhler et al. created an online course. By incorporating gamification components, they gave students access to an interactive learning environment. The statistics compiled at the completion of the courses revealed that the students' success was 95% higher than the average of the preceding six terms. According to Yıldırım & Demir (2014), game designs boost students' motivation and participation in class. According to research done by Güler & Güler (2015), incorporating game aspects into educational design has a good impact on students' motivation.

In a similar vein, Kocadere & Alar (2015) found that the gamified systems they utilised had a beneficial impact on students' motivation, fun, and success. They conducted a study in which they built a gamified evaluation system. In particular, Kahoot! is unmistakably a gamification tool that not only has a significant impact on students' academic achievement but also has an immediate impact on their motivation and interest.

#### **Policy Implications**

In terms of technology use in language education, this study is expected to contribute greatly to Türkiye's educational policies. By providing new insights for the use of cutting-edge technologies in education, such as digital gamification tools, this study is also believed to be helpful to other researchers and practitioners.

## **Conclusion and Recommedations**

In recent years, technological applications have been seen as crucial tools for improving students' motivation and interest in learning a foreign language and acquisition (Licorish, 2018, p.12). According to Godwin-Jones (2015), teachers believe that using technology as a teaching tool contributes to learners' learning process. In teaching and learning, using technology provides enjoyable environment to the learners (p.15). The results of this study are inline with these findings. Gamification of grammar course help students better understand the grammar topics which are sometimes perceived as difficult to learn and least interesting in language learning. Using online gamification tools like Kahoot!, which was also the topic of this study, boost students' success together with their willingness and motivaton. Furthermore, the continual use of traditional techniques and tools could decrease students' motivation to learn and could be less effective. According to James Paul Gee (2003) well-organized and adapted technological games increase students' motivation and positively affect their participation in the classroom. Technological games are used for improving classroom dynamic, increasing students' success and motivation (p.18). English teaching can be made more effective with new technologies by using the sense of mystery and humor that strengthen students' motivation (Lee & Hammer, 2011, p.4). At the same time, a successful learning environment can be provided by integrating technology and English lessons by using the student's interests. With the help of available technology, students can develop their self-confidence and improve their competence to learn.

The findings of this study are also supported with answers given by the students to interview questions. Students mostly viewed Kahoot! as an effective tool in learning grammar topics much better than ever. They stated that they had so much fun that they lost the track of time when learning grammar topics via Kahoot! and their perspectives on learning grammar have changed in a positive way. They wanted the tool to be used in their other courses as well. Finally, the students stated that

Kahoot! facilitated grammar learning because it created an enjoyable opportunity to practice what they learnt.

It is believed that this study is important in terms of revealing how learning methods other than traditional learning methods contribute to students' learning. It might pave the way for studies with different variables effective in language learning. Also, gamification tools which take cultural aspects, different learner characteristics into consideration and adaptable to different learning needs could be designed and developed with the cooperation of experts from computer sciences.

### **Conflict of interest**

No potential conflict of interest was declared by the authors.

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## **Ethical Statement**

This research was ethically reviewed by Başkent University/Social And Humanities And Arts Research Committee and was approved ethically with the approval number 17162298.600-13 on 23 January 2021.

#### **Credit Author Statement**

*Author 1* : Conceptualization and Methodology, Investigation, Formal Analysis, Original draft preparation. *Author 2* : Supervision, Methodology, Reviewing and Editing.

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## The Mediating and Moderating Effects of Knowledge Management in the Relationship between Technological Leadership Behaviors of School Principals and Data-Driven Decision-Making

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### Abstract

The objective of this study is to contribute to the increasing database regarding the effects of school leadership on teachers' data usage by investigating the relationship between the technological leadership behaviors of school principals and data-driven decision-making at their schools based on the mediating and moderating effects of the knowledge management variable. 408 teachers from 14 provinces of Turkey in the 2020-2021 academic year were included in the study. The School Principal Technological Leadership Competency Scale, the Knowledge Management Scale, and the Data-Driven Decision-Making in Schools Scale were used as data collection tools in this cross-sectional quantitative study. Descriptive statistics, correlation, and structural equation modeling (SEM) were used in data analysis. The study results demonstrate the school principals' practices of technological leadership, knowledge management at schools, and data-driven decision-making to be high. It has been found out in the study that knowledge management implementations play a mediating role in data-driven decision-making at schools by increasing the technological leadership competency levels of school principals, while not having a moderating effect on the relationship between technological leadership and data-driven decision-making. In addition, technological leadership and knowledge management have been identified to be significant and positive predictors of data-driven decision-making. Based on the study results, suggestions have been made to improve the technological leadership behaviors and knowledge management implementations of school principals at schools.

**Keywords:** Technological Leadership, Knowledge Management, Data-Driven Decision-Making, Mediating Effect, Moderating Effect

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#### Introduction

It is imperative for schools to use data that they can base on rational and scientific grounds in decision-making processes for them to meet the social expectations, provide public accountability, and solve the problems they encounter (Schildkamp & Kuiper, 2010). School principals need to know how to analyze, interpret, and use data to access the correct information that can enable them to make informed decisions in every field from resource allocation to instructional implementations as a result of increased standardization and accountability in education (Datnow et al., 2007; Mandinach & Gummer, 2016). In this respect, the usage of technology by principals can be a critical tool to improve teaching and learning (Chappuis & Chappuis, 2008; Schildkamp et al., 2017).

Studies show that data used for decision-making and effective implementations can increase the learning abilities of students and affect school improvement positively (Byrd & Eddy, 2010; Dejear, 2016; Huguet et al., 2014; Kerr et al., 2006; Petersen, 2007; Slavit et al., 2013). Data usage at schools has enabled software systems and technological processes to improve (Datnow et al., 2007). Similarly, developments in technology have provided educators with better opportunities to access data and facilitated data analysis, and increased data usage in education (Mandinach & Gummer, 2013). Wu (2009) has put forth the importance of school principals being trained to become competent in technology usage, and being supported with technological resources in increasing their data literacy. In this way, a principal theoretically thought to be efficient in technology usage will have made a data-driven decision by providing the necessary atmosphere to convert data into knowledge in the decision-making processes of the school. In this respect, technological leadership and knowledge management implementations in data-driven decision-making can be evaluated as factors that can increase competency for schools.

Although data-driven decision-making appears to have been initiated with the "No Child Left Behind Act" enacted in 2001 in the United States, grading the steps of knowledge management and data process in knowledge creation (Davenport & Prusak, 1998) had an effect on laying the theoretical grounds for this act. Mandinach et al. (2006) state that raw data must be converted into knowledge by locating them into an actionable context to make data-driven decisions. The significance of the created knowledge varies based on the knowledge and skills of the users, which is regarded to be the most crucial component of data-driven decision-making (Mathews, 2002).

The usage and integration of technology is an important component of knowledge management theory (Petrides & Modine, 2003). When knowledge management functions commune with principals' leadership activities, educational activities and student success rates may increase (Marsh, 1992). Regarding the issue, Dickerson et al. (2008) state that school principals competent in information and communication technology and efficient knowledge management will encourage a considerable school reform, and in this way, academic success will be able to be maintained with the

start of a transformation at schools. It is also possible to come across studies that put forth the roles of operational and transformational leadership in knowledge management that can use technology efficiently and integrate it into educational activities (Afshari et al., 2009; Analoui et al., 2013; Ng, 2008).

Technological developments have been reflected at schools in Turkey in numerous applications, especially the ones within the scope of the FATIH project (Ministry of National Education [MEB], 2012) initiated in 2010, such as the formation of computer classes, web domains created for schools, education portals, interactive boards at schools, access to overhead projectors and the internet, and knowledge management systems such as MEBBIS, TEFBIS, and e-school in which teachers, students, and education administrators can transact. These technological applications are known to be used in routine operations of educational activities. However, the position of these applications must be specified with regard to performing education in a data-driven way within the scope of a model in a leadership context. Turkey is a developing country and the Turkish education system has a centralist structure. All the decisions made for critical planning, personnel, coordination, and budget works at schools in Turkey are the responsibility of the Ministry of National Education. Although efforts were made to break the strict centralist behavior with the principle of "decentralization", it ended up being highly limited. Therefore, there is always a need to create knowledge access models that are based on the Turkish education system dynamics, comprehensive, detailed, holistic, and native data resource-based. Besides, it has been seen that school principals need to lead other partners, teachers in particular, both in remote education activities and in data-driven decision-making processes due to Covid-19. Therefore, identifying possible variables in the relationship between the technological leadership behaviors of school principals and data-driven decision-making levels is extremely crucial.

The objective of this study is to investigate the mediating and moderating effects of knowledge management on school principals' relationship with technological leadership behaviors regarding data usage in decisions made to implement necessary changes at schools. The focal point of this study is data-driven decision-making. The participants have shared their opinions as teachers about the management of knowledge used in decision processes based on available data at their schools by assessing the technological capacity of their principals within the context of leadership. The opinions of teachers, who actively use knowledge in educational processes and need data usage and technological support in knowledge creation, are regarded to be important regarding these processes. With regard to being a guide for data-driven decision-making studies in Turkey, the holistic and detailed analysis of this study with the help of current information and in the model created within the study scope may contribute to the field of education management since studies holistically based on comprehensive literature research are few in number. It can also provide

policymakers, researchers, and educators with theoretical and practicable knowledge and increase awareness. It is also our hope that the study will contribute to societies and countries with educational policies and structures similar to Turkey. In this respect, the study aims to identify the mediating and moderating effects of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making and answer the following questions;

- 1. What are school principals' technological leadership behaviors, and schools' knowledge management and data-driven decision-making levels?
- 2. Is there a significant relationship between school principals' technological leadership behaviors and schools' knowledge management and data-driven decision-making levels?
- 3. Does knowledge management play a mediating role in the relationship between school principals' technological leadership behaviors and data-driven decision-making?
- 4. Does knowledge management play a moderating role in the relationship between school principals' technological leadership behaviors and data-driven decision-making?

### **Theoretical Frame**

The theoretical frame of this study has been composed of theoretical and empirical studies in the field of education management and leadership (see Figure 1). This frame is concerned with competencies that principals are expected to have (technological leadership) and organizational processes (knowledge management, data-driven decision-making). Also, the theoretical frame of this study has revealed some organizational (cultural, technological structure) and individual (leadership, data/information literacy) factors affecting technological leadership, knowledge management, and data-driven decision-making. The study focuses on how principals' roles and competencies may affect the implementation and behavior processes at schools.

## **Technological Leadership**

Technology provides access to more data and more accurate information (Golden, 2004). By collecting data in a central place, technological developments help school principals collect and analyze data and decrease their workload and accountability stress by creating reports in a faster way (Marsh et al., 2015). In a study conducted in Turkey, Töremen and Kolay (2003) classify the competencies of school principals as technical, humane, and conceptual, and emphasize the importance of training for technical competency. Technologically literate school principals are expected to unify technology with their leadership characteristics effectively in decisions made for schools to contribute and adapt to 21<sup>st</sup> century knowledge-driven society (McLeod & Richardson, 2011). Technology finds meaning with people who can create new ways and methods by focusing on the systematic development of the organization (Hayytov, 2013). Durnalı (2018) elaborates on

technological leadership under four dimensions, namely motivation, orientation, precaution, and support. The dimension of motivation covers teachers being motivated to utilize technology at schools; the dimension of orientation covers technology being enabled to be applied to the educational processes; the dimension of precaution covers the necessary information technology tools being ready for use; and the dimension of support covers the awareness of legal issues concerning the usage of technology.

The technological leadership phenomenon starting to appear in the United States in the early 1990s was analyzed by the International Society for Technology in Education (ISTE) the most extensively. ISTE listed the standards required for a technological leader under the headings of leadership and vision, learning and teaching, productiveness and professional implementation, support, execution and operations, evaluation, and social, legal, and ethical issues (ISTE, 2002). Curcio (2016) found out that teachers benefit from school principals more so than external resources for professional development regarding the usage of technology. Similarly, Hayytov (2013) detected that the technological leadership competencies of school principals have a positive effect on teachers' behaviors toward technology. According to Flanagan and Jacobsen (2003), a school principal with technological leadership characteristics needs to create a vision shared at the school, provide access to technology, and develop an atmosphere for professional development. In studies conducted on technological leadership in Turkey, it has been found that school principals usually receive training on educational technology in school administration and have high levels of self-competency regarding the usage of technology (Gültekin, 2013; Ulukaya, 2015). If the aforementioned studies are analyzed as a whole, it can be concluded that school principals need to set an example for and be leading others in the usage of technology.

## **Knowledge Management**

The concept of knowledge management is based on a theory grounded on a set of principles by Davenport and Prusak (1998). The "scientific method" is the safest way to produce knowledge (Çınar, 2002). Knowledge management is defined as a process in which individuals turn data, information, and their intellectual existences into a lasting value. In this process, data is taken as a basis, and knowledge is produced, moderated, and used (Duffy, 2000; Palacios et al., 2009; Kianto et al., 2016; Gao et al., 2018).). The data do not provide any judgment, interpretation, or sustainable action; they are divided into categories by being placed within a context with calculations and moderations and turned into knowledge along with their content. Information is turned into knowledge by forming links through comparisons and interpretations (Davenport & Prusak, 1998). In short, it can be defined as knowledge when data are interpreted. The processes of data being turned into knowledge and data-driven decision-making are shown in Figure 1.

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Figure 1: Knowledge spectrum (Source: Barutçugil, 2002)

Knowledge management in education is thought to be an approach of acts improving educational services and results by providing the development of a set of applications to create and share knowledge. The knowledge management theory within the context of schools demonstrates the value of data to make informed decisions (Petrides & Modine, 2003). The data make sense for educators when they are turned into practicable knowledge about educational decision-making (Duffy, 2000). Çınar (2002) models knowledge management as obtaining, sharing, using, and storing information.

Studies have put forth the necessity for information technology tools (Al-Alawi et al., 2007; Gupta & Govindarajan, 2000; Mohamed et al., 2006), that leadership characteristics play an important role in every stage of knowledge management (Donate & de Pablo, 2015; Singh, 2008), and the importance of organizational culture in the distribution of knowledge (Özgözgü, 2015; Suppiah & Sandhu, 2011). Besides, emphasizing that education is necessary to produce knowledge, Hemmati (2017) underlines a significant relationship between knowledge literacy and knowledge management. In studies carried out on the knowledge management competencies of school principals and teachers in Turkey, it has been found that educators receiving training on knowledge management have higher averages than those not receiving such training (Akçakaza, 2009).

#### **Data-Driven Decision-Making at Schools**

Data-driven decision-making at schools is defined by Schildkamp and Kuiper (2010) as reviewing, systematically analyzing, and interpreting data, and implementing the outcome of data resources to educational developments at schools. From this definition, it can be said that the datadriven decision-making process is the center of significant school reforms and an educationmanagement system where educators can acquire accurate information. The data-driven decisionmaking process at schools sets the ground for revealing strong and weak aspects, recognizing the interval between the intended and the current profile, and clearly understanding the areas needing improvement by acting on a mutual purpose (Bernhardt, 1998).

Accountability, school-based decision-making, and data-driven decision-making concepts came to the forefront and started to be examined in the United States with the NCLB Act. With these developments in the United States, these concepts went beyond accountability and started to develop as a process. Data usage in all associations under the Ministry of National Education in Turkey became a current issue with "data-driven management" mentioned in the 2023 Vision Statement introduced to the public in 2018. In the Vision Statement, data-driven applications are predicted to have a great potential to monitor student statuses in a detailed way, decrease the difference of success rates among schools and regions, eliminate failures in educational reforms, and create an educational atmosphere needed by educators and students (Ministry of National Education [MEB], 2018).

Studies discussing schools within a system theory emphasize creating an organizational, professional, technical, and processual capacity in data-driven decision-making processes (Breiter & Light, 2006; Datnow et al., 2007). Doğan and Ottekin Demirbolat (2021) divide data usage at schools based on the literature into four components, namely *data usage culture, data literacy, technological infrastructure and hardware, and data usage purpose.* The data usage culture dimension covers open norms for data usage at schools; the data literacy dimension covers necessary knowledge and skills to use and understand data; the technological infrastructure and hardware dimension covers basic systems such as access to data, data collection, analysis, and storage; and the data usage purpose dimension covers the usage of data fit for purpose at schools.

Studies show school principals to be the key actor in and primarily responsible for data usage implementations (Buttram & Farley-Ripple, 2016; Christman et al., 2009; Huguet et al., 2014). Expected to have data literacy knowledge and skill, school principals should set a model for teachers regarding data usage, provide necessary structures and support, and create a culture in which data implementations are turned into norms (Marsh et al., 2015; Park & Datnow, 2017). In the Turkish educational system, which has a centralist administration, decisions are mostly made by the ministry, and school principals have to play the role of "implementers" of orders coming from their superiors (Doğan, 2021). Therefore, studies on data-driven decision-making in Turkey are extremely limited (Demir, 2009; Dilekçi et al., 2020).

Educators need to be able to access reliable information for them to make accurate decisions. Knowledge and skills necessary for data collection, analysis, and interpretation are defined as data literacy, also known as the process of converting raw data into knowledge. The management of knowledge acquired by turning data into information is also important for the process of data-driven decision-making (Mandinach, 2012). Regarded to be an important component of data literacy, technological literacy requires having basic technological knowledge and skills and is a primary

factor in data-driven decision-making (Means et al., 2010). However, despite these relations seeming to be theoretically strong, no study focusing on the effects of knowledge management and technological leadership role on data-driven decision-making has been encountered in the literature. In this respect, the theoretical relations network formed among the variables of the study is given in Figure 2.



Figure 2. Conceptual model

#### Method

### **Research Model**

Aiming to detect the mediating and moderating effects of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making, this study was designed in a relational screening model, which is a research model that aims to find the relationship among variables without any intervention (Fraenkel & Wallen, 2000). Mediating and moderating effects analysis was used to find out in which situations the indirect effect and relationship among variables increase or decrease. In this context, the independent variable, mediating and moderating variable, and dependent variable of the study are school principals' technological leadership behaviors, knowledge management, and data-driven decision-making respectively.

### **Research Group**

The study has been conducted with the participation of 408 teachers working in different provinces, primarily Siirt and Kahramanmaraş, of Turkey (also including Istanbul, Balıkesir, Gaziantep, Hatay, Konya, Eskişehir, Nevşehir, Şanlıurfa, Aksaray, Kayseri, Muğla, and Malatya) during the 2021-2022 academic year. It is not an external but an internal validity study as it aims to detect the relationship among variables. Therefore, the study does not aim to make a generalization for any universe (Büyüköztürk et al., 2021). Among the participants, 150 (36.8%) are male, 258 (63.2%) are female; 66 (16.2%) are single, 342 (83.8%) are married; 59 (14.5%) work in Siirt, 81 (19.9%) work in Kahramanmaraş, and 268 (65.7%) work in other provinces (Istanbul, Balıkesir, Gaziantep, Hatay, Konya, Eskişehir, Nevşehir, Şanlıurfa, Aksaray, Kayseri, Muğla, and Malatya). The mean age and professional seniority values of the teachers are 39.54 and 15.26 respectively.

#### **Data Collection Tools**

The study data were collected with the "School Principals Technological Leadership Behavior Scale" (SPTLB-S) developed by Durnalı (2018), the "Knowledge Management Scale" (KM-S) developed by Özgözgü (2015), and the "Data-Driven Decision-Making in Schools Scale" (DDDMS-S) by Doğan and Ottekin Demirbolat (2021).

The School Principals Technological Leadership Behavior Scale (SPTLB-S) is composed of 18 items and 4 dimensions (motivation, orientation, precaution, and support). SPTLB-S is developed to measure the technological leadership behaviors of school principals based on teachers' points of view, and is a 5-Likert type scale answered with the choices of "strongly disagree", "disagree", "undecided", "agree", and "strongly agree". High points obtained from the scale reflect the school principal to exhibit high levels of technological leadership behaviors, while low points obtained from the scale reflect the school principal to exhibit low levels of technological leadership behaviors. The Cronbach's alpha coefficient of the scale is .90 for the motivation dimension, .88 for the orientation dimension, .87 for the precaution dimension, .70 for the support dimension, and .72 for the whole scale. The goodness of fit values found as a result of the confirmatory factor analysis (CFA) conducted during the developmental process of SPTLB-S ( $x^2/df=1.68$ , RMSEA: .053, SRMR=.060, CFI=.92, NFI=.83, NNFI=.90, GFI=.91) have been reported to be fit (Durnali, 2018). The validity and reliability of SPTLB-S have been recalculated for this study. The CFA goodness of fit values of the current study ( $x^2$ /df=3.63, RMSEA:.080, SRMR=.041, CFI=.94, TLI=.93) have also been found to be fit (Kline, 2011; Schumacker & Lomax, 2004). The Cronbach's alpha reliability coefficient of the study has been found to be .90 for the motivation dimension, .89 for the orientation dimension, .92 for the precaution dimension, .87 for the support dimension, and .93 for the whole scale. Based on all these results, SPTLB-S can be stated to be a valid and reliable scale tool for the study data.

The Knowledge Management Scale (KM-S) is composed of 25 items and 4 dimensions (obtaining information, using information, sharing information, and storing information). Developed to measure the knowledge management levels of schools from teachers' point of view, KM-S is a 5-Likert type scale composed of the choices "never", "slightly", "somewhat", "very much", and "completely". High scores obtained from KM-S reflect the school to have high levels of knowledge management, while low scores obtained from KM-S reflect the school to have low levels of knowledge management. The Cronbach's alpha reliability coefficient of the scale is .90 in the obtaining knowledge dimension, .93 in the using knowledge dimension, .91 in the sharing knowledge dimension, .90 in the storing knowledge dimension, and .97 for the whole scale. The four-factor structure of the scale was determined with CFA. The CFA results obtained during the developmental process of the scale show the goodness of fit values ( $x^2/df=3.07$ , RMSEA: .07, SRMR=.04, PNFI=.87, NNFI=.98, CFI=.98) to be fit (Özgözgü, 2015). In the context of this study, the validity and reliability of KM-S were recalculated, and the CFA goodness of fit values ( $x^2/df=3.81$ , RMSEA:.083, SRMR=.041, CFI=.92, TLI=.91) were determined to be fit (Kline, 2011; Schumacker & Lomax, 2004). The Cronbach's alpha reliability coefficient of the study has been found to be .92 in the obtaining knowledge dimension, .90 in the using knowledge dimension, .94 in the sharing knowledge dimension, .91 in the storing knowledge dimension, and .97 for the whole scale. Based on the validity and reliability results of the current study, KM-S is understood to be a valid and reliable scale tool in terms of the study data.

The Data-Driven Decision-Making in Schools Scale (DDDMS-S) is composed of 23 items and 4 dimensions (technological infrastructure and hardware, data usage culture, data usage purpose, and data literacy). DDDMS-S was developed to measure data-driven decision-making levels at schools from teachers' point of view. It is a 5-Likert type scale with the choices "never", "seldom", "sometimes", "frequently", and "always". High scores obtained from DDDMS-S reflect schools to have high levels of data-driven decision-making, while low scores obtained from the scale reflect schools to have low levels of data-driven decision-making. Doğan and Ottekin Demirbolat (2021) determined the construct validity of the scale with only exploratory factor analysis (EFA), based on which the first dimension variance ratio of the scale is 16.211%, the second dimension variance ratio of the scale is 15.407%, the third dimension variance ratio of the scale is 13.294%, the fourth dimension variance ratio of the scale is 8.522%, and the total explained variance is 53.435%. The item factor load values of DDDMS-S range between .491 and .789, its total item correlation values range between .313 and .719, and its eigenvalues range between 1.960 and 3.729. The Cronbach's alpha reliability coefficient of the scale has been found to be .850 for the technological infrastructure and hardware dimension, .814 for the data usage culture dimension, .789 for the data usage purpose dimension, and .602 for the data literacy dimension (Doğan & Ottekin Demirbolat, 2021). In the context of this study, the validity and reliability of DDDMS-S were recalculated and the CFA goodness of fit values ( $x^2$ /df=3.45, RMSEA: .078, SRMR=.055, CFI=.90, TLI=.88) were deemed fit (Kline, 2011; Schumacker & Lomax, 2004). The Cronbach's alpha reliability coefficient of the study has been found to be .84 for the technological infrastructure and hardware dimension, .85 for the data usage culture dimension, .84 for the data usage purpose dimension, .90 for the data literacy dimension, and .93 for the whole scale. Consequently, the validity and reliability results of the study deem DDDMS-S to be a valid and reliable scale tool in terms of the study data.

### **Data Analysis**

The study-related data were obtained through an online form. It took about 18 minutes to fill out the scales. It was initially analyzed in the study whether the data obtained from 422 teachers were suitable for the analyses to be performed. In this respect, the extreme values of the data were checked. The scores of the scales were converted to Z scores and 14 data that were out of the -3 and +3 range (Çokluk et al., 2012) and whose Mahalanobis distance was not suitable were excluded from the scale, after which the assumptions of normality of the data obtained from 408 teachers were reviewed. In this respect, the total scores of the scales were examined in terms of the skewness and kurtosis values. The skewness and kurtosis values of the school principals' technological leadership behavior scale were -.301 and -.396 respectively; the skewness and kurtosis values of the knowledge management scale were -.314 and -.777 respectively; and the skewness and kurtosis values of the data-driven decision-making in schools scale were -.242 and -.676 respectively. The skewness and kurtosis values of the study data being between -1.5 and +1.5 reflect a normal distribution on part of the data (Tabachnick & Fidell, 2013). Different values were determined as criteria in the study to find out whether there were multicollinearity and autocorrelation problems in the study. Accordingly, the relationship among variables being between .67 and .89 and therefore less than .90, and the Durbin-Watson value being 1.637, the Tolerance value being .539, the VIF value being 1.854, and the CI value being between 1 and 24.413 and less than 30 demonstrate that there are no multicollinearity and autocorrelation problems in the study (Field, 2005; Green & Salkind, 2010; Sümer, 2000). All these values indicate that the study data meet the necessary assumptions for the analyses to be performed.

The descriptive statistics and Pearson's product-moment correlation analyses of the study were conducted with SPSS 24.00, while its confirmatory factor analysis and mediating and moderating effect analyses were performed with the Mplus 7.00 statistics software program. Whether the variables had a significant predictiveness and the mediation test was determined with a structural equation modeling (SEM). The bootstrapping coefficient and confidence intervals (GA/CI) were reviewed with 10000 resamplings to examine the significance of the indirect effects of school principals' technological leadership behaviors on data-driven decision-making via knowledge management. The significance of the confidence intervals determined as a result of the bootstrapping analysis was evaluated based on whether they contained zero (Hayes, 2013), and all the study-related

analyses were interpreted according to the significance level of .01 and .05. The evaluation of the standardized  $\beta$  coefficients was conducted based on Kline's (2013) effect size classification accepting .10 - .30 to be small, .30 - .50 to be medium, and .50 and above to be large.

#### Results

#### **Results Related to Descriptive Statistics and Correlation Analysis**

The relationships between the levels of school principals' technological leadership behaviors and schools' knowledge management and data-driven decision-making from teachers' point of view, and the variables were analyzed. Accordingly, the descriptive statistics and correlation analysis results related to the study are given in Table 1.

Table 1. Descriptive statistics and correlation analysis results	

Variables	$\overline{\mathbf{X}}$	sd	Skewness	Kurtosis	Technological Leadership	Knowledge Management	Data-Driven Decision- Making
Technological Leadership	4.26	.51	301	396	1		
Knowledge Management	4.22	.56	314	777	.67**	1	
Data-Driven Decision-Making	4.23	.44	242	676	.84**	.89**	1
$**_{m} < 01$							

\*\*\*p < .01

As is seen in Table 1, school principals' technological leadership behaviors ( $\overline{X}$  =4.26; sd=.51), schools' knowledge management ( $\overline{X}$  =4.22; sd=.56), and data-driven decision-making ( $\overline{X}$  =4.23; sd=.44) levels were found to be "high". The skewness values of the variables are observed to range from -.242 and -.314, while their kurtosis values are seen ranging from -.396 and -.777. Based on Pearson's product-moment correlation values, while there is a moderate positive correlation (r = .67; p< .01) between school principals' technological leadership behaviors and knowledge management, a strong positive correlation between school principals' technological leadership behaviors and data-driven decision-making (r = .84; p< .01) and also between knowledge management and data-driven decision-making (r = .89; p< .01) has been observed.

### **Mediating Effect-Related Results**

A structural equation model (SEM) was used to determine the mediating effects of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making. In this respect, the standardized path coefficients related to the developed structural equation model are shown in Figure 3 (in Figure 3 - *tlo*: Technological leadership scale; *mtv:* Motivation; *ynldrm:* Orientation; *alyp:* Infrastructure; *hkk:* Support; *byo:* Knowledge management scale; *biel:* Obtaining knowledge; *bilk:* Using knowledge; *bilpy:* Sharing

knowledge; *bildp:* Storing knowledge; *vdk:* Data-driven decision-making scale; *dnm:* Technological infrastructure and hardware; *kltr:* Data usage culture; *amac:* Data usage purpose; *okur:* Data literacy).



**Figure 3.** The mediating effect of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making

As is seen in Figure 3, it has been observed in the developed structural equation model that while technological leadership predicts knowledge management ( $\beta$ =.76, p< .01, 95% GA/CI= .743, .972) and data-driven decision-making ( $\beta$ =.38, p< .01, 95% GA/CI= .226, .524) in a positive and significant way, knowledge management also predicts data-driven decision-making positively and significantly ( $\beta$ =.34, p< .01, 95% GA/CI= .143, .351). In terms of indirect effects, technological leadership predicts data-driven decision-making significantly via knowledge management ( $\beta$ =.26, p< .01, 95% GA/CI= .152, .372).Accordingly, it has been discovered that technological leadership has a large effect on knowledge management, technological leadership and knowledge management have a moderate effect on data-driven decision-making, and technological leadership has a small indirect effect on data-driven decision-making via knowledge management (Kline, 2013). Besides, the model constructed in Figure 3 has been detected to have required fit values ( $x^2$ /df=2.56, RMSEA: .062, SRMR=.033, CFI=.97, TLI=.96) (Kline, 2011; Schumacker & Lomax, 2004). The standardized path coefficients of the structural equation model developed in relation to the study model are summed in Table 2.

	%S Int			onfidence (GA/IC)	Effect
Direct Effects		β	Lower Limit	Upper Limit	Size
Technological Leadership	→ Knowledge Management	.76	.743	.972	Large
Technological Leadership	→ Data-Driven Decision-Making	.38	.226	.524	Moderate
Knowledge Management	→ Data-Driven Decision-Making	.34	.143	.351	Moderate
Indirect Effects					
Technological Leadership →Know Decision-Making	ledge Management → Data-Driven	.26	.152	.372	Small

#### Table 2. Bootstrap analysis results related to the mediation test

Based on the direct and indirect effects shown in Table 2, the VAF (Variance Accounted For) was calculated to determine whether the effects of knowledge management were partially or completely mediating between technological leadership and data-driven decision-making. The VAF value being less than .20 reflects no mediating effect, while it being between .20 and .80 reflects a partial mediating effect, and it being .80 and above reflects a complete mediating effect (Hair et al., 2013). The VAF value of this study has been calculated to be .41. Therefore, it is understood that knowledge management has a partial mediating effect between technological leadership and data-driven decision-making.

#### **Moderating Effect-Related Results**

The regression analysis results containing the bootstrap method related to the moderating effect of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making are given in Table 3.

Variables	$b^*$	SE	t	р	%95 Confidence Interval (GA/IC)		
					Lower Limit	Upper Limit	
Constant	4.222	.008	528.624	$.000^{**}$	4.206	4.238	
Technological Leadership	.38	.016	24.300	$.000^{**}$	.349	.410	
Knowledge Management	.47	.015	31.082	$.000^{**}$	.442	.501	
Interaction Variable							
(Technological Leadership x Knowledge	.03	.022	1.130	.258	020	.068	
Management)							

Table 3. Analysis results related to the moderating effect

\*b: Unstandardized beta coefficient, \*\*p<.001, SE: Standard Error, R=.95, R<sup>2</sup>=.91

Based on Table 3, all the variables included in the regression analysis have been determined to explain 91% ( $R^2$ =.91) of the change in schools' data-driven decision-making levels. Both technological leadership (*b*=.38, p<.001) and knowledge management (*b*=.47, p<.001) have been

identified as positive and significant predictors of data-driven decision-making. It can also be seen that the interaction variable, obtained by multiplying technological leadership by knowledge management, does not have any significant effect on data-driven decision-making (b=.03, p>.05). Therefore, knowledge management can be stated to have no moderating effect on the relationship between technological leadership and data-driven decision-making.

### **Discussion, Conclusion and Recommendations**

The objective of this study is to determine the mediating and moderating effects of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making. The initial study results show schools' knowledge management and data-driven decision-making levels, and school principals' technological leadership levels to be high. These results are supported by various studies in the literature (Akçakaza, 2009; Almış, 2010; Anderson & Dexter, 2005; Baybara, 2018; Demirsoy, 2016; Durnalı, 2018; Fidan, 2007; Irmak, 2015; McCray, 2014; Özsarıkamış, 2009; Sakarya, 2006). The results can be interpreted to state that school principal leadership is imperative in the implementation and usage of the Fatih Project, which aims to combine technology with education, and such systems as e-school, MEBBIS, and TEFBIS, and that these implementations accelerate information flow. In addition, this result may be related to the fact that remote education activities, which have gained more importance during the Covid-19 period, have contributed to the technological leadership behaviors of school principals who may have recognized their technological shortcomings.

A significant correlation between data-driven decision-making, and knowledge management, and technological leadership. It can be claimed that at a school with high levels of technological leadership and knowledge management, there will also be high levels of data-driven decision-making. The literature related to data-driven decision-making has created the theory of data-driven school leadership (Sun et al., 2016). The two most important dimensions of data-driven school leadership are principals providing the necessary support and help in technology usage, and creating an atmosphere where teachers can cooperatively share knowledge by enabling them to access accurate information. Considering these conceptual definitions, technological leadership and knowledge management are expected to be positively correlated to data-driven decision-making. Also, a moderate correlation has been observed between knowledge management and technological leadership. This result has parallels with the study results of Durnali (2018). Flanagan and Jacobsen (2003) explain this correlation by defining technological leadership as a function-based leadership incorporating technology to the daily activities of an organization, increasing the database and data usage skills of workers, and encouraging them to share knowledge.

Another important result of the study is the discovered mediating effect of knowledge management between school principals displaying technological leadership characteristics and datadriven decision-making at their schools. Accordingly, it can be stated that via knowledge management, school principals with technological competencies improve educational activities and make decisions using current data by cooperating with partners at the school. In other words, it is understood that as principals encourage and orientate teachers for technology usage, and provide necessary infrastructure, data-driven decision-making is supported through the encouragement of obtaining, using, sharing, and storing knowledge. Bahar's (2011) finding that human resources with technological competencies give importance to knowledge management and provide improvements by making organizational arrangements with accurate decisions supports the model developed for this study.

It has been determined in the study that knowledge management implementations at schools do not have any moderating effect between school principals' technological leadership characteristics and data-driven decision-making at their schools. In other words, it can be stated that knowledge management is not a variable that decreases, increases, or eliminates the strength of the relationship between technological leadership and data-driven decision-making. It can also be said that a low, moderate, or high level of knowledge management is not a determinative variable for school principals" technological leadership behaviors and data-driven decision-making levels. On the other hand, upon reviewing the direct effects, it can be seen that school principals displaying technological leadership characteristics have a large, positive, and significant effect on knowledge management implementations at schools. The most important role in the world in which the age of information has arrived lays, without a doubt, on the shoulders of school leaders (Buluç, 1998). Teachers can be stated to need their principals to have technological competencies on the basis of motivation, orientation, precaution, and support dimensions so that they can actively operate the processes of obtaining, using, sharing, and storing knowledge. This result has parallels with the study results of Durnali (2018), and Srivastava and Joshi (2018). Similarly, in some studies conducted in Turkey, Yavuz and Coskun (2008) define principals' technology usage as the ability to put scientific knowledge into practice regarding educational issues, while Çavaş (2005) has discovered that principals' technology usage improves teachers' top tier skills such as the configuration of knowledge, analysis, synthesis, and execution. However, Ergiși (2005) states that although school principals in Turkey are attentive to technology usage in executive actions, they do not provide the necessary support for technological usage in educational processes or other units of schools. Principals distancing themselves from information and communications technology are highly unlikely to monitor teachers and help them access information for the fields where they have shortcomings (Benedetto, 2006).

According to the study results, knowledge management implementations at schools affect data-driven decision-making positively and significantly. Data and knowledge are the main factors of the knowledge management theory, and the literature states that knowledge management has played a

role in the historical development of data-driven decision-making (Duffy, 2000; Mandinach et al., 2006). The result that knowledge management is an important predictor of data-driven decision-making at schools confirms theoretical knowledge. Datnow et al. (2007) mention that knowledge management systems are mandatory for data-driven decision-making at schools. Knowledge management makes use of data-driven processes to discover the secret messages and information found in great quantities within data, explains what kind of a correlation there is among data in these processes, and helps educators form a correlation between these data and contextual information (Johnson, 2015; Swan, 2009). It is apparent that there is a need to create a knowledge management capacity for data-driven decision-making implementations at schools.

Lastly, school principals' technological leadership competenciesaffect data-driven decisionmaking at schools positively. The literature on data-driven decision-making shows that leadership is the most important organizational factor that affects teachers' data-driven decision-making (Schildkamp et al., 2017). Studies suggest that school principals' tendencies to use technology, and support and encourage teachers in this issue affect how teachers discover and use data, and put forth the relationship between these data and different contexts (Copland et al., 2009; Ikemoto & Marsh, 2007; Park & Datnow, 2009). The data from Epp's (2011) study suggest that principals' shortcomings in technological skills are a factor that hinders data-driven decision-making. According to Epp (2011), school principals wanting to use data efficiently must have necessary technological structures and a sufficient competency to make use of technology because having technological skills in collecting and analyzing data requires being able to use technology efficiently in educational activities (Datnow et al., 2007). Technology provides teachers with numerous opportunities such as storing data, accessing data rapidly, and developing programs and applications (Mandinach et al., 2006). Indeed, a school principal who can make use of technology efficiently is also an efficient data warehouse user (Drake, 2015).

This study indicates that technological leadership has an effect on data-driven decisionmaking at schools, which is regarded to be crucial in increasing student success levels, both directly and via knowledge management, and supports previous study results. On the other hand, knowledge management does not have a moderating effect on the relationship between technological leadership and data-driven decision-making. Based on the study results, it can be suggested that awareness studies and activities be concentrated on so that principals' technological leadership competencies can increase in educational organizations that are both trainers and operators of human resources, and principals that have high levels of technological leadership behavior be awarded. Also, that school principals thriving in technological leadership behaviors share their experiences with other school principals may be beneficial. Schools can be provided with tools of informatics that will lead to efficiency in every knowledge management and technological leadership process. The study results related to researchers can be reviewed with qualitative data in a more detailed and comprehensive way. Confirmative studies can be conducted on the conceptual model created within the theoretical frame of this study. Reasons behind the significant effects found in the study can be investigated in a more detailed fashion with demographically varying participant groups. Lastly, it is believed that this study, designed cross-sectionally, can also be reviewed longitudinally.

## **Policy Implications**

School administrators must exhibit technological leadership behaviors for the developing technology to be successfully applied in educational organizations (İbili & Özbaş, 2022). In other words, the technological leadership of school administrators is essential in ensuring the efficiency of educational processes (Turan, 2020). However, technological leadership has a dynamic feature and is highly affected by environmental conditions (Hoy & Miskel, 2015). For this reason, many variables, especially environmental conditions, should be considered when determining educational policies and strategies for technological leadership (Özdemir, 2019; Şimşek, 1999). On the one hand, processes related to technological leadership in schools can be shaped according to the characteristics of schools and teachers, as well as the contents of education policies and strategies (Petko et al., 2018; Taimalu & Luik, 2019). The ability to obtain and manage information can be considered one of these contents (Ololube et al., 2015). Because the ability to acquire knowledge or manage knowledge is closely related to the technological leadership characteristics of school administrators (Roblyer & Doering, 2014).

Knowledge management is a necessary implementation strategy for organizational learning, globalization, and competition. Knowledge management is a management strategy that can be functional in organizations (Cheng, 2015; Glines-Kotecki, 2011). However, the functionality of knowledge management in the school context depends on the school administrators' ability to use technology effectively in the decisions to be taken (McLeod & Richardson, 2011). Research proves a significant positive relationship between technological leadership and knowledge management (Durnalı, 2018; Srivastava & Joshi, 2018). On the other hand, it can be said that technological leadership in schools and knowledge management facilitates realistic and applicable decision-making processes and contributes to the formation of a data-based culture. In other words, data-based decisions can gain meaning with school administrators' technological leadership behaviors and knowledge management skills (Epp, 2011; Means et al., 2010). This inference points to the importance of data-based practices that are recommended and expected to become widespread in school organizations (Schildkamp et al., 2017). Similarly, policymakers support the data-based decision-making processes of schools and expect them to make data-based decisions (Mandinach & Schildkamp, 2021).

Ikemoto and Marsh (2007) state that determining education policies and strategies based on data can be realized by providing educators with professional development and helping them access information. Thus, data-based decision-making became a common discourse and widespread practice influencing education policies worldwide, especially in US public schools (Lai & McNaughton, 2016; Young et al., 2018). In Turkey, this situation has shaped education policies and strategies. For example, in the 2023 Education Vision Document of the Ministry of National Education (MEB, 2018), it was stated that all the ministry's decisions would be based on data, data control units would be established, and educational data warehouses would be worked on. Furthermore, within the framework of schools, it was stated that teacher-parent-school interaction would be included through the "Data Information System", and a "Geographic Information System" would be included to determine the schools' capacities in effectively managing educational resources. All these explanations can be shown as evidence that school administrators' technological leadership, knowledge management skills, and data-based decision practices are related to education policies and strategies.

### **Conflict of Interest**

No potential conflict of interest was declared by the authors.

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Author 1: Conceptualization and Methodology, Writing- Original draft preparation, Visualization, Investigation, Data Curation, Formal Analysis, Writing - Review & Editing, Validation. Author 2: Conceptualization and Methodology, Writing - Original draft preparation, Visualization, Investigation, Data Curation, Formal Analysis, Writing - Review & Editing.

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# **Evaluation of the Training to Make Preservice Science Teachers Use Web 2.0 Tools during Teaching\***

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# Abstract

This study examines the effect of a training program on pre-service teachers' ability to design materials using Web 2.0 tools by applying training to pre-service science teachers to use Web 2.0 tools. In the research, a holistic single case study method was used. Semi-structured interviews, "Teachers' Digital Teaching Material Development Self-Efficacy Scale" and document analysis were used as data collection tools. The sample of the research consists of 16 pre-service science teachers studying in the Science teaching program of the Faculty of Education of Recep Tayyip Erdogan University in the fall semester of the academic year 2021-2022. The "Teachers' Digital Teaching Material Development Self-Efficacy Scale" was applied to the pre-service teachers twice as a pre- and post-test. The training for the teaching of Web 2.0 tools was completed during a total of 25 40-minute lessons outside of the participants' class hours and in three weeks. At the end of the study, improved teaching Web 2.0 tools for education, pre-service teachers teaching material that has a positive impact on developing digital competencies, to increase their awareness of Web 2.0 tools for use in the learning process, it provides enough about to be able to use Web 2.0 tools to start to see and realize the importance of the concept of Web 2.0 tools in teaching that the use is concluded. In accordance with these results, in order to use the Web 2.0 tools for research, pre-service teachers, elective courses in undergraduate programs, etc. the proposals have been terminated.

Keywords: Preservice science teachers, science education, Web 2.0 tools

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#### Introduction

A good teacher is a person who fulfills their duty under all conditions (Erişen & Şen, 2002). In this context, teachers have an important place in raising individuals who research and question, perceive and adopt all kinds of changes, try to reach the source of information, and keep up with technology. In order to achieve this, they naturally need to have various competencies (Küçük & Küçük, 2020). In this process, the competencies expected of science lessons and teachers, which are directly related to students' lives and include many concepts and information that students should have in order to solve the problematic situations they encounter in their daily lives, are of great importantance. It is necessary for science teachers to have sufficient knowledge of contemporary learning-teaching strategies and to apply them in the best way in learning environments (Akpınar & Ergin, 2005; Bakırcı, Çepni & Ayvacı, 2015; Düşkün & Ünal, 2015; Hancer, Şensoy & Yıldırım, 2003; Küçük, 2006; Özmen, 2004). Considering that our age is the age of technology and students' interest and intense use of technology, it will be inevitable for teachers to benefit from technological tools in this process. It is stated that in the science curriculum the development of scientific knowledge and the use of technological tools such as computers in the implementation of this process facilitate science teaching. Additionally, it is expected that appropriate course material should be prepared by integrating technology regarding the achievements in the program and teachers are expected to have digital competence in this sense (MEB, 2018). These expectations are also seen in the 2023 Education Vision document published by the Ministry of National Education. In this publication, there is a section called digital content and skillful transformation in learning processes. Some of the prominent features at this point are,

- Creating a digital education and training content development ecosystem
- Creating a national digital content archive,
- Training of leading teachers who develop digital learning materials,
- Developing tools for measuring and evaluating learning environments and materials,
- Expanding the use of digital materials as main materials,
- Developing new generation digital assessment materials that support metacognitive skills so that students can get the desired results in international exams such as PISA (MEB, 2018).

While this situation regarding the digital competence of teachers was emphasized in 2018, the pandemic and distance education process that took place in our country and in the world in 2019 revealed that our teachers actually have deficiencies in this regard (Çakın & Külekçi Akyavuz, 2020; Sertkaya Dinler & Dündar, 2019; Temiz, 2021). The main reason why teachers experience these deficiencies may be their lack of in preparing digital content and digital material during the pre-vocational education process. There are also studies in the literature regarding this situation

(Sarıtepeci, Durak, & Seferoğlu, 2016; Usluel, Mumcu, & Demiraslan, 2007). The fact that the pandemic process lasted for about two years also had positive effects on teachers in using technology (Bakioğlu & Çevik, 2020; Sertkaya Dinler & Dündar, 2019). The compulsory use of technology has led teachers to do research on this subject and has enabled them to meet many new technologies. In this process, one of the technologies that will facilitate the work of teachers is Web 2.0 tools. With Web 2.0, individuals can communicate socially and transfer information to each other, the transferred information can be recorded and information can be accessed more quickly. In Web 2.0, e-mail, phone applications, messaging over the web, etc. Thanks to the use of applications, XML, API, AJAX, RSS, blog, etc., technologies and applications have improved. As an example, some apps such as StoryboardThat, Mentimeter, Blendspace, Phet app, Infogram app, Oppia, Book Creator, KialoEdu, Canva, Creately, etc. can be given. It has been determined that the use of Web 2.0 tools in learning environments has a positive effect on students' actively producing content, acquiring and sharing information, collaborating with peers in the classroom, and increasing academic success, interest and motivation towards the course (Batıbay, 2019; Isaias, Miranda & Pifano, 2020; Onbaşılı, 2020; Özpınar, 2020; Weller, 2013). It is critical that the teachers to be using these tools in learning environments have sufficient knowledge and equipment. In this sense, the aim of the study is to examine the material development situations by using these tools after the training program developed for the teaching of Web 2.0 Tools for pre-service science teachers.

# Method

In this study, a holistic single case study, one of the qualitative research designs, was used. In this design, an event is examined by the researcher at the place where the event occurred and it is used in cases where there are many evidence or data sources and the boundaries of the case cannot be drawn precisely in terms of content. By this way, the researcher seeks in-depth answers to the questions of why (Sığrı, 2018; Özmen & Karamustafaoğlu, 2019). In this study, researchers developed a training program for pre-service science teachers to teach Web 2.0 Tools. Along with this program, an in-depth analysis was made on the situation of pre-service teachers to get to know and use Web 2.0 tools, develop course materials using these tools subsequently and prepare course plans suitable for the developed course materials. It is known that document analysis, archive analysis, interview, focus group interview, direct observation, participant observation, etc. are used as data collection tools in such studies (Sığrı, 2018). In this context, "Teachers' Digital Teaching Material Development Self-Efficacy Scale", lesson plans prepared by pre-service teachers after the training, and semi-structured interviews were used as data collection tools in the research.

#### **Study group**

In the study, typical case sampling among the purposive sampling methods was used. Typical case sampling "requires determining a situation typical of many situations in the universe regarding

the research problem and collecting information from this sample" (Büyüköztürk et al., 2020). The study group consists of 16 pre-service science teachers (12 females and 4 males) studying in the second year of science teaching in the 2021-2022 academic year. Since the pre-service teachers in the study group took the "Information Technologies" course in the first two semesters, it was assumed that they had prior knowledge of computer usage skills and they were determined on a voluntary basis.

# **Data Collection Tools and Process**

"Teachers' Digital Teaching Material Development Self-Efficacy Scale", course plans prepared by pre-service teachers following the training, and semi-structured interviews were used as data collection tools in the research.

#### Teachers' Digital Teaching Material Development Self-Efficacy Scale

Within the scope of the research, the "Teachers' Digital Teaching Material Development Self-Efficacy Scale" developed by Korkmaz, Arıkaya and Altıntaş (2019) was used as a data collection tool. The scale consists of three sections. These sections consist of 38 items in total: Web 2.0 Development (15 items), Design (17 items), Negative view (6 items). The scale was applied to preservice teachers as a pre-test before the training and then as a post-test after the training.

# **Course Plans**

By using the Web 2.0 tools they learned after the Web 2.0 tools training, the pre-service science teachers developed course plans covering two-course hours for the achievements they determined from the science curriculum. Course plans were analyzed with the rating scale developed by the researchers. The Rating Scale is in a 3-point Likert format and consists of 21 items. In order to ensure the content validity of the Rating Scale, opinions were received from 5 faculty members who are experts in the field of science education. In line with expert opinions, the rating scale was finalized.

# **Semi-Structured Interview**

Before the research, semi-structured interview questions were prepared as a draft. After the unstructured observations made during the implementation process, the interview questions were rearranged. The interview questions, consisting of five questions in total, were submitted to expert opinion, evaluated in terms of content validity, and given their final form. After the pre-service teachers presented their course plans in front of the experts, the course plans were classified into three groups as upper, middle, and lower levels in line with the opinions of the experts. Two people were selected from each of these groups and semi-structured interviews were conducted with six preservice science teachers in total. Interviews were conducted with each pre-service teacher in

approximately 15 minutes. In order to prevent data loss during the process, all interviews were recorded via Google Meet with the permission of the participants.

#### **Data Analysis**

During the data analysis process, 16 pre-service science teachers were coded as T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15 and T16. The analyzing method of the data is presented below under separate headings.

"Teachers' Digital Teaching Material Development Self-Efficacy Scale" was applied to the participants twice as a pre- and post-test. SPSS 26 analysis application was used for the analysis of the obtained data. Wilcoxon Signed Rank Test was used to analyze the data.

Within the scope of the research, pre-service teachers were asked to determine the learning outcomes from the science curriculum and develop course plans by using the Web 2.0 tools they learned following the Web 2.0 tools training. Course plans were prepared in groups of two. The group members were formed by the pre-service science teachers themselves. In this context, a total of eight course plans were examined. While examining the course plans, the students were given a code number. The coding process was created by using the defined codes of the pre-service teachers in each group. For example, it was coded as Group 1 (T2-T8) to indicate that the first group consisted of the second and eighth pre-service teachers. Thus, a total of eight groups were formed, [G1(T2-T8),G2 (T9-T11), G3 (T4-T13), G4 (T1-T14), G5 (T5-T15), G6 (T3-T12), G7 (T10-T16) and G8 (T6-T7)]. In the analysis of the data, the developed "Rating Scale" was used. The obtained data were analyzed using thematic analysis (Braun & Clarke, 2006). The course materials developed by the preservice science teachers were classified into three thematic areas and analyzed individually. These thematic areas are "Web 2.0 Tools Used in Materials", "Subject Areas Used in Materials" and "Topics Covered in Materials". A total of eight course plans developed by the pre-service science teachers as a group were analyzed and discussed simultaneously by the researchers, and a common decision was reached. The data obtained are included in the Findings section.

Content analysis was used to collect the data from the interviews. Interview data analysis process includes coding the data, finding the themes, arranging the codes and themes, creating the tables with the frequencies of the codes and themes.

# Validity and reliability studies

In order to ensure reliability and validity in the study, the following studies were carried out:

• Data were collected with three different data collection tools. Thus, in the study, the data were compared with each other and examined whether they showed consistency.

- In order to prevent data loss during the semi-structured interview process conducted with pre-service science teachers, all interviews were conducted over Google Meet and the interviews were recorded with their permission.
- Expert opinions regarding the data collection tools to be used in the research were sought.
- Care was taken to be objective in the description and interpretation of the data.
- While interpreting the data, direct quotations were made from the views of pre-service science teachers.
- Evidence for how the research results were reached and the inferences made are presented clearly and in detail so that readers can understand the research process.
- The first researcher participated in TEDA 8 (Technology Supported Argumentation Training for Undergraduate Science Students) supported by TUBITAK, although he took the master's course named "Design of Technology Supported Learning Environments in Science Education" in order to carry out this research in a more qualified way. After participation, the researcher was given a certificate of participation by the event coordinator.
- In order to prevent data loss within the scope of the research and to ensure reliability in the analyzes carried out, the data analyses were carried out simultaneously by the researchers, however, they were repeated four times in different time periods.

# **Implementation Process**

The implementation was carried out in the form of a training program consisting of a total of 25-40-minute lessons in three weeks, outside the course hours of the participants. The implementations were completed in the computer laboratory of Recep Tayyip Erdogan University, Faculty of Education. In the laboratory, there are computers with internet access that students can use individually, as well as an interactive board. In the table below, the activities carried out for practice in each training hour are given.

Activity	Time (Minutes)	Content of the lesson	Detailed Lesson Content
Concept and misconception	40	What is the concept? What are misconceptions? What is the importance of detecting and eliminating misconceptions?	Concept definition, concept development processes, importance of concepts, misconceptions, importance of misconceptions in science teaching.
Web 2.0	40	Web 2.0, The historical process of the web	What is the web? What is Web 2.0? Web (1.0, 2.0, 3.0, 4.0) periods from past to present.
Concept cartoon	40+40	StoryboardThat	Concept cartoon, use of concept cartoon in science courses, concept cartoon development, StoryboardThat application.

 Table 1. Implementation process

Mentimeter	40	Mentimeter	Introducing the Mentimeter application, presenting an example and developing sample
Blendspace	40	Blendspace	Introducing the Blendspace application, presenting an example and developing sample material by the participants.
Phet ve Padlet	40+40	Phet application, POE method and Padlet application	Introducing the Phet simulation application, introducing the POE method, introducing the Padlet application, presenting an example and developing sample material by the participants.
Infogram	40+40	Infogram	Introducing the Infogram application, presenting an example and developing sample material by the participants.
Oppia	40+40	Oppia	Introducing the Oppia application, presenting an example and developing sample material by the participants.
Book Creator	40+40	Book Creator	Introducing the Book Creator application, presenting an example and developing sample material by the participants.
KialoEdu	40+40	KialoEdu	Introducing the KialoEdu application, presenting an example and developing sample material by the participants.
Newspaper, poster preparation	40+40	Canva	Introducing the Canva application, presenting an example and developing sample material by the participants.
Creately	40+40	Mind map and fishbone crafting with Creately	Introducing the Creately application, presenting an example and developing sample material by the participants.
Kahoot!	40+40	Kahoot	Introducing the Kahoot application, presenting an example and developing sample material by the participants.
Course Plan Preparation	40	Course plan development based on the 5E model	Introducing the 5E learning model, and developing course plans according to the 5E model using Web 2.0 tools learned by the participants during the training.
Presentations	60	Presenting the developed course plans to the experts	Presenting the developed course plans to the expert group, including two faculty members from the faculty of education and the researchers themselves, and giving certificates of appreciation to the pre-service science teachersfor their participation.

# Findings

In this section, the findings obtained from the data collection tools are presented under separate headings.

# Teachers' Digital Teaching Material Development Self-Efficacy Scale Pre-Test and Post-Test Findings

Within the scope of the research, the "Digital Teaching Material Development Self-Efficacy Scale of Teachers" was implemented to pre-service science teachers before the training process as a pre-test and then as a post-test. The obtained results were entered into the Microsoft Excel program. SPSS 26 analysis application was used for the analysis of the data. The findings related to the descriptive analyzes are presented in Table 2.

Sample	n	Mean (X)	SD
Pre-test	16	126.12	18.90
Post-test	16	151.00	14.96

When Table 2 is examined, there is a difference between the mean scores of the pre-service teachers in the study group they got from the "Analysis of the Digital Teaching Material Development Self-Efficacy Scale of Teachers" administered before the implementation (X=126.12; SD=18.90) and the scores they got following the implementation (X=151.00; SD=14.96), an increase was observed in favor of the post-test. In order to examine whether this increase was significantly different, Wilcoxon signed-rank test analysis was performed on the scores they received from the questionnaire.

Table 3. Wilcoxon signed rank test

Pre- and post-test	Ν	Mean ranks	Sum ranks	Z	р
Negative ranks	-	.00	.00	-3.409	.001
Pozitive ranks	15	8.00	120.00		
Zero	1				
*n < 0.5					

\*p<.05

According to the Wilcoxon signed rank test, this change in the scores of the pre-service teachers who participated in the implementation they got from the "Analysis of the Digital Teaching Material Development Self-Efficacy Scale of Teachers" is at a significant level (z=-3. 409, p<.05) and is in favor of the post-test.

# Findings of Course Plans

The course plans developed by the pre-service teachers were analyzed with the developed grading scale and a table was created from the data obtained.

Item	Item	Yes	Partially	No
number		f	f	f
1	Appropriate font size is used.	4	1	3
2	Appropriate font is used.	6	1	1
3	Considering the principle of integrity, the related items are placed close	5	1	2
	and the unrelated items are far away.			
4	It is designed in accordance with the developmental characteristics of	8	-	-
	the student.			
5	While preparing the material, attention was paid to color harmony.	5	1	2
6	Appropriate images are used.	5	1	2
7	It is designed using contrasting colors between the background and	5	-	3
	shapes.			
8	While developing the materials, content was developed in a (visually)	1	7	-
	interesting way in terms of density, color and alignment properties.			
9	An appropriate title has been created.	8	-	-

Table 4. Course plans rating scale

10	It is designed in such a way that students can use it individually.	8	-	-
11	Understandable and simple language is used.	6	2	-
12	It is designed by considering the different learning styles of the student.	8	-	-
13	It is designed to develop students' communication skills.	7	1	-
14	It is designed to develop students' critical thinking skills.	7	-	1
15	While preparing the material, teacher needs were taken into account.	8	-	-
16	It is designed to allow students to peer learning (social learning).	7	-	1
17	It is designed in accordance with the objectives and outcomes of the curriculum.	-	-	8
18	The content is designed to reveal possible misconceptions about the determined outcomes.	5	1	2
19	It is designed to be accessible and available for use of every student.	7	-	1
20	It is economical.	8	-	-
21	The content is designed to allow students to associate science concepts with their daily lives.	8	-	-

When the course plans rating scale table is examined, it is seen that the course materials prepared by the pre-service science teachers have deficiencies in terms of design (1, 2, 3, 5, 6, 7, 8, 11). In addition, it was determined that pre-service teachers took into account the students' ability to use them individually, their learning styles and teacher needs while developing their course plans (10, 12, 13, 14, 15, 16). It is also seen in the table that the use of the developed material is functional (19, 20, 21).

The course materials developed by the pre-service science teachers were classified into three thematic areas and analyzed individually. These thematic areas are "Web 2.0 Tools Used in Materials", "Subject Areas Used in Materials" and "Topics Covered in Materials". Tables related to frequency distributions for these are presented below.

Web 2.0 Tools Used in Materials	f
Blendspace	5
Book Creator	8
Canva	3
Crealty	6
İnfogram	2
Kahoot	8
KialoEdu	1
Mentimeter	8
Padlet	7
Phet	6
StoryboardThat	6

**Table 5.** Web 2.0 Tools Used in materials and their frequency distribution.

When Table 5 is examined, the Web 2.0 tools used by the pre-service science teachers in the course materials they developed following the Web 2.0 tools training are mostly Kahoot (f:8), Mentimeter (f:8), Padlet (f:7), Creately (f:6), Phet (f:6) and StoryboardThat (f:6) applications.

Subject Areas Used in Materials	f
Physics	2
Chemistry	3
Biology	1
Astronomy	2

Table 6. Subject areas used in materials and their frequency distribution

When Table 6 is examined, it is determined that pre-service science teachers have chosen the subject areas in the sub-dimension of science in the course materials they have developed.

Table 7. Topics Covered in materials and their frequency distribution

Topics Covered in Materials	f
Acids and Bases	1
Earth, Sun and Moon	1
Electric circuits	1
Solar System and Beyond	1
Conductive and Insulating Materials	1
Heat and temperature	1
States of matter	1
Mitosis and Meiosis	1

When Table 7 is examined, it is seen that pre-service teachers have prepared course plans for different subjects from the subject areas of physics, chemistry, biology and astronomy.

# Findings of Semi-Structured Interviews

In this section, the findings obtained from semi-structured interviews with six pre-service teachers are included to deepen the research results.

The frequency distribution of the opinions of pre-service science teachers regarding their answers to the question "What are Web 2.0 tools?" is given in Table 8.

# Table 8. Web 2.0 tools

Web 2.0 Tools	f
Blendspace	3
Canva	3
Crealty	2
İnfogram	1
Kahoot	6
KialoEdu	1
Mentimeter	4
Oppia	2
Phet	1
StoryboardThat	2

When Table 8 is examined, the answer to the question "What are Web 2.0 Tools?" is mostly seen to be Kahoot (f:6), Mentimeter (f:4), Blendspace and Canva (f:3). T10 also said, "Web 2.0 tools

are a technological tool used in teaching the subject in the education process. For instance; I can give examples of applications such as Mentimeter, Blendspace, Canva, Infogram, Kahoot.".

Their opinions on the question of "For what purposes can web 2.0 tools be used in science lessons?" are given in Table 9.

Table 9. Purposes of using web 2.0 tools

Purposes of Using Web 2.0 Tools	f
Individual Difference	1
Experiment/Simulation	2
Evaluation	2
Permanence	1
Embodying Concepts	2
Misconception Detection	1
Provide Easy Explanation	2
Student Interest and Attention	5
Enabling the student to discover information	1
Identifying preliminary information	2
Creative Thinking	1

When Table 9 is examined, it can be seen that pre-service science teachers use Web 2.0 tools to attract students' interest and attention (f:5), to develop experiments/simulations (f:2), to evaluate (f:2), to embody concepts (f:2) and to determine the students' preliminary information on the subject (f:2). Examples of pre-service teachers' statements; T10: "By appealing to students who have visual, verbal and auditory intelligence types, I increase their permanence on the subject. In addition, after the subject concepts are taught, I use it to determine the prior knowledge of the students in the evaluation of learning." T14: "With the Mentimeter application, I reveal the students' prior knowledge and their thoughts about the concept, I prepare a concept cartoon from the StoryboardThat application and show it to be used in order to determine the misconceptions of the students and to evaluate the lesson process.".

Before participating in this training program, pre-service science teachers were asked whether they had any anxiety, and their opinions are given in Table 10.

Table 10. Anxiety before education

Anxiety Before Education	f
Inability to Integrate into Science Lessons	2
Worry about not being able to	4
No Anxiety	1

When Table 10 is examined, it is seen that pre-service teachers have concerns such as not being able to perform the applications taught during the education process (f: 4) and not being able to integrate the Web 2.0 tools they have learned into science lessons (f: 1). Examples for the statements of pre-service teachers; T10: "Before the training, I had the fear of whether being able to learn Web

Educational Policy Analysis and Strategic Research, V18, N1, 2023  $\ensuremath{\mathbb{C}}$  2022 INASED

2.0 tools.", T5: "Before the training process, I had the fear of learning Web 2.0 tools and the anxiety of failing. ".

The pre-service science teachers were asked whether their concerns were resolved during the training, and if so, the reasons for this were asked and the data obtained are given in Table 11.

Table 11. Reasons for anxiety relief

Reasons for Anxiety Relief	f
Explanation From Simple to Complex	1
Interest and Attitude towards the Course	1
Having Sufficient Knowledge and Equipment of the Researcher Implementing the Program	5
The Positive Attitude of the Teacher	3
Easy access to the teacher	4
Reinforcement (Assignment, Presentation)	2
Positive Classroom Environment	1
Request to Learn New App	1

When Table 11 is examined, pre-service teachers are observed to state that providing access to the teacher whenever requested via Google Classroom, e-mail, Whatsapp, telephone communication in or out of the classroom (f:4), that the teacher has sufficient knowledge and equipment in teaching Web 2.0 tools. (f:5), the teacher's positive attitude in and out of the classroom (f:3), and the reinforcement of Web 2.0 tools (f:2) by giving weekly homework about the practices in the education process are effective in eliminating their anxiety. Examples of pre-service teachers' statements; "Before the training, I had the fear of whether being able to learn Web 2.0 tools. After the training, these concerns were resolved. The reason for relieving my anxiety; the fact that the teacher's style of expression was good during the education process showed us a positive, patient attitude towards us. During the education process, the teacher's mastery of the subject in the Web 2.0 tools described, the teacher's explanation in every level, and the explanation of the applications from simple to complex helped me to overcome my concerns."

The views of pre-service science teachers about the Web 2.0 tools they have found the most difficult with in the education process and the reasons for the difficulties are given in Table 12.

The Web 2.0 Tool Difficult	f	Cause of Difficulty	f
Oppia	2	Foreign language	2
		Adding an Action	1
Phet	2	Lack of Computer Use	2
StoryboardThat	2		2

Table 12. The most difficult web 2.0 tool and cause of difficulty

When Table 12 is examined, it is seen that the pre-service teachers have difficulty adding foreign language (f:2), action to the Web 2.0 tools that they have expressed as Oppia (f:2), Phet (f:2) and Storyboard That (f:2). f:1) and lack of computer use (f:4). Examples from the statements of

teacher candidates; T1: "The web 2.0 tool that I had the most difficulty with during the training was the Storyboard That application because it was very difficult for me to include push-and-hold commands in the application. The reason for this difficulty may be due to my lack of computer use.", S5: "The application language that I had the most difficulty with during the education process was Storyboard That, even though the language of use was Turkish. I think the reason is my lack of computer use in enlarging-reducing, font and font size adjustment processes while preparing speech content."

The views of pre-service science teachers about the Web 2.0 tools they enjoy the most during the education process are given in Table 13.

Enjoyable Web 2.0 Tool	f
Blendspace	1
Kahoot	1
Mentimeter	3
Oppia	1

**Table 13.** Enjoyable web 2.0 tool

When Table 13 is examined, it is seen that the answers of the pre-service science teachers to the question "What is the web 2.0 tool that you enjoyed most during the education process?" were as Mentimeter (f:3), Blendspace (f:1), Kahoot (f:1) and Oppia (f:1). Examples of pre-service teachers' statements; S16: "Oppia was the application that I enjoyed the most during the education process. Because, I liked the fact that it was made up of code blocks and that we determined the feedback to be given by the character in the application.", T10: "The Web 2.0 tool I enjoyed the most during my training was the Blendspace application. Because, it offers features that will meet many needs of the teacher in the application. For example; pictures, videos, writing theoretical information about the subject, preparing evaluation questions.".

# **Discussion and Conclusion**

As a result of the analysis of the "Digital Teaching Material Development Self-Efficacy Scale of Teachers" applied to pre-service science teachersas a pre- and post-test within the scope of the research, it was determined that there was a significant difference in favor of the post-test (Table 3). This result can be considered as an indication that the Web 2.0 tools training carried out positively affects pre-service teachers' digital teaching material development. Onbaşılı (2020) have found similar results in their study. When the answers given by the pre-service teachers to the interviews are examined, it is seen that the education process increases the awareness of the students about the use of Web 2.0 tools in the learning process, and their own practice and material development makes them permanent in using Web 2.0 tools and helps them to see themselves as competent in this regard (Table 9, 11). These statements of the pre-service teachers show that the education applied has positive effects on having the desired features in the science curriculum. Similarly, Isaias, Miranda and Pifano

(2020) and Demirkan (2019) also have stated in their studies that the use of Web 2.0 tools in higher education is effective in factors such as technology selection, user-friendly tools, student participation, high number of active students, access to relevant content and communication.

One of the biggest advantages of using Web 2.0 tools in science courses is that they facilitate concept teaching. As a matter of fact, Can and Usta (2021) have concluded in their study that Web 2.0 supported concept cartoons facilitate student attention and learning in science courses. In their study, Pürbudak (2020) has determined that the use of Web 2.0 tools in science courses is effective in reinforcing the subjects and ensuring that learning is permanent. In the semi-structured interviews conducted in parallel with these results, it is seen that the pre-service science teachers stated that Web 2.0 tools can be used in science lessons to attract students' attention and attention (f:5), to develop experiment/simulation (f:2), for evaluation (f:2), for concretizing concepts (f:2), and determine students' prior knowledge about the subject (f:2) (Table. 9). These answers given by the pre-service teachers can be considered as an indication that they are aware of the importance of using Web 2.0 tools in concept teaching. The fact that pre-service science teachers have this awareness in the first years of their undergraduate education will motivate them to use these tools in their classes in their professional life. In the literature, there are studies showing that web-based education has many positive effects on learning-teaching processes; ; e.g., the use of Web 2.0 tools in physics teaching (Baig, 2011), a science teaching design prepared in the web environment (Bayrak Karadeniz & Bayram, 2012; Karagöz & Korkmaz 2015), science teaching supported by technology (Akgün et al., 2014; Demirkan, 2019), web-based science teaching prepared according to the multimedia design model (Çetin & Günay, 2010), adaptive educational web environments (Güngören Canan, 2019), computer-aided education software (Buluş Kırıkkaya et al., 2016), web-based science education (Can, 2008; Ercan, Bilen, & Bulut, 2013), a problem-based learning method supported by Web 2.0 tools (Hursen, 2020).

Pre-service science teachers claimed that they had difficulties in learning some Web 2.0 tools in Web 2.0 tools training and that the reason for this difficulty (Table. 12) was that the language of use of some of the Web 2.0 tools in the training was not Turkish and they had deficiencies in computer use. They stated that in order to overcome these difficulties, they should eliminate their deficiencies in foreign language and computer usage. Similar results have also been found in the study of Mertoğlu and Öztuna (2004). In this study conducted with pre-service science teachers, pre-service teachers stated that Turkish websites containing technology-supported teaching materials were hesitant to develop technology-assisted materials in the material development process due to insufficient computer usage skills and foreign language knowledge of pre-service teachers.

The greatest responsibility for the success in the teaching process belongs to the teacher. Before the teaching process, the teacher should plan the activities to be presented in the course, effective teaching, effective communication, good classroom management, good guidance, tolerance, patience and understanding, etc. It is expected that the attitudes and behaviors of the students in the classroom will increase positively and their anxiety will decrease (Gültekin, 2020; Gül, 2004). During the education process given to the students within the scope of the research, they were in constant communication with the students. In the course, during the teaching of Web 2.0 tools by the researchers, the opportunity for pre-service teachers to practice was presented after each step of the process of the related web tool was shown. At this point, the researchers ensured progress by helping the pre-service teachers during the practice times provided to them, in the parts where they had difficulties, in the parts they had hesitations, and in the points they did not understand. Apart from the courses, the participation of pre-service science teachers in the class opened via Google Classroom was ensured. In addition, a Whatsapp group has been created. In this way, we were in constant communication with the pre-service science teachers after the courses. Regarding this process, the pre-service science teachers were asked, "What are the reasons for your anxiety following the training?". They stated that their concerns were resolved. They stated that the reason for this was due to the above-mentioned processes, as seen in Table 11. These answers given by the pre-service teachers show that the implementation process went well in their favor. This situation again revealed the importance of the teacher in the classroom, regardless of age group.

In summary, as a result of this research, it was concluded that the training developed for the teaching of Web 2.0 tools positively affected the pre-service teachers' competence in developing digital teaching materials; increased their awareness of the use of Web 2.0 tools in learning processes; their own application and material development work provides permanence in using Web 2.0 tools; it enables them to start to see themselves as sufficient in this regard; and they realized the importance of using Web 2.0 tools in concept teaching.

The aim of the study is to examine the material development status of pre-service science teachers using these tools after the training program developed for teaching Web 2.0 Tools. After the training, they have developed many materials that they can use in science teaching With Web 2.0, individuals can communicate socially, transfer information to each other, the transferred information can be recorded, and information can be accessed more quickly. During the pandemic we have been through, distance education has been started in our country and our teachers, who were not ready for this situation at the beginning, had trouble. At this point, web 2.0 tools will make significant contributions to preparing learning environments suitable for distance education, developing and applying materials. It is very important for pre-service teachers to have these qualifications before they graduate, both in enriching the teaching they will do in their teaching life and in being prepared for extraordinary situations. In this sense, it is thought that the data obtained from the study is

important in terms of being a source for in-service trainings to be given to teachers to use web 2.0 tools and academic studies to be made on this subject.

#### Suggestions

The suggestions made in line with the results obtained in this study, which was carried out to evaluate the effect of this education on pre-service science teachers' material design using Web 2.0 tools by applying a training for pre-service science teachers to use Web 2.0 tools in the teaching process, are presented below:

Elective courses can be given to pre-service science teachers in order to use Web 2.0 tools in undergraduate courses, or the content and course hours of the "Instructional Technologies" course can be increased.

During the applications, pre-service teachers mentioned the inadequacy of Turkish-supported Web 2.0 tools. By sharing the results of this study and similar studies in the relevant literature, it can be reached to authorized persons, and suggestions can be made about the dissemination of Turkish-supported material programs.

Pre-service teachers can be encouraged to develop materials by using Web 2.0 tools regarding the achievements given by the practice teacher during the school practice process and to use the developed materials in their lectures.

After the training developed for the teaching of Web 2.0 tools, it may be suggested to preservice science teachers to plan a new research to examine whether they are used in school applications.

# **Ethical Statement**

In this study, all the rules specified to be followed within the scope of "Higher Education Institutions Scientific Research and Publication Ethics Directive" were complied with. None of the actions specified under the title of "Actions Contrary to Scientific Research and Publication Ethics", which is the second part of the directive, were not carried out. Ethics committee approval dated 10.26.2021 and numbered 2021/226 was obtained from Recep Tayyip Erdoğan University Social and Human Sciences Ethics Committee for this study. The study was produced from the master's thesis named "Examination of the Education Program Developed for the Development of Technology Supported Materials for Science Teacher Candidates: Web 2.0 Tools".

# **Conflicts of Interest**

No potential conflict of interest was declared by the authors.

#### **Credit Author Statement**

This study was taken from the first author's master thesis conducted under the supervision of the second author. In this sense,

Author 1: Investigation, Conceptualization and Methodology, Writing- Original draft preparation.

Author 2 : Supervision, Investigation, Conceptualization and Methodology, Writing- Original draft preparation, Reviewing and Editing

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# Screen Time of Gifted Students During The Pandemic Period: A Mixed Method Research

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#### Abstract

The purpose of this research is to explain the effects of the qualitative results obtained from the data which is gathered from the interviews with gifted students and their parents regarding the screen use of gifted students between the ages of 12-18 on the potential screen addictions of gifted students. This study is mixed methods research. The rationale for choosing mixed methods research is complementarity, based on the fact that results from quantitative and qualitative data clarify and detail each other's results. For the research, explanatory sequential (sequential quantitative  $\rightarrow$  qualitative) mixed methods research design was used. Quantitative data of the study were collected through a questionnaire created by the researcher from a group of 160 gifted students aged 12-18 and 100 parents. The data obtained from the questionnaire were analyzed by ratio and frequency analysis. In the light of the findings obtained from the quantitative results, structured interviews were conducted with 16 gifted students and 17 parents with purposeful sampling from the research group. Content analysis technique was used in the analysis of the data obtained from the interviews. Quantitative and qualitative research results were brought together in the mixed methods study and the results were integrated. The findings of the research were explained under subheadings such as the duration of screen use before and during the pandemic, the number of technological devices used, the time spent in front of the screen, the purpose for which this time was used, and the effects of the time spent in front of the screen on students. With the pandemic, the time spent in front of the screen has increased, the duration of sleep has increased, the purposes of using the screen have changed, and the situation of being uncomfortable and unhappy in case of not being able to reach the screen has increased. As a suggestion to this situation, it is suggested to carry out awareness raising activities for families and children.

**Keywords:** Gifted students, mixed methods research, Covid-19, screen addiction, parents, effects of the pandemic

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#### Introduction

Many epidemics have emerged for years, millions of people die due to these diseases, and the world suffers a great deal of damage. When we look at the past, many epidemic diseases have emerged. Today, the new type of coronavirus, which emerged in Wuhan, China, has affected the world and has taken its place among epidemic diseases (WHO, 2020; cited by Ministry of Health, 2021). The high risk of transmission and its lethal effect on different age groups have made the Covid-19 virus the most important health problem of the 21st century (Üstün and Özçiftçi, 2020). The pandemic has changed many things in the world. In order to reduce the course of the epidemic, measures such as, curfews, suspending face-to-face education and closing cafes, and restaurants have been taken. Many countries have decided to close schools and continue education remotely, in addition to the policy of keeping physical distance in order to slow the rate of transmission of the virus (Van Lancker & Parolin, 2020). According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) (2020) data, as of April 13, 2020, schools were closed in 192 countries due to the new type of coronavirus pandemic. This situation affected 99.4% of students worldwide (Eken, Tosun, & Tuzcu Eken, 2020). This situation has forced the transition to distance education. Distance education has been introduced at all levels, including pre-school, primary education, secondary education, high school and higher education. Although face-to-face education was started in certain periods, most of the education was conducted remotely. As of the beginning of the 2021-2022 academic year, face-to-face education has been introduced at all levels in Türkiye. With the effect of the pandemic, the time spent in front of the screen has increased due to the time spent at home and the transition to distance education. According to researchers; It is appropriate children to use the screen for 30 minutes a day in pre-school period, 45 minutes in primary school, 1 hour in secondary school, and 2 hours in high school age. In the pandemic, these times have increased due to online education. Children spent an average of 2-6 hours a day looking at the screen because of distance education. For this reason, attention should be paid to the screen time outside of online education (Öztürk, 2021).

Today, the Internet is very common and is becoming more and more widespread. This dissemination process naturally brings with it negative consequences. These negative effects also include risks that individuals may encounter. These risks include the easy accessibility of sites that are not suitable for their age, the fact that the individuals they encounter on the internet do not have real identities, the possibility of these people being malicious, and the development of addiction to the screen and the internet (İşçibaşı, 2011).

When we look at the relationship between screen use and generations, the rate of screen use has increased the most in the generation Z. It has been determined that the generation Z communicates through the screen more than the other generations, with a rate of 62%. In the

generation Y, this rate is 45%; It has been observed that it is 40% in the generation X. Since various media alternatives are examined, the increase is in the generation Z (Göker and Turan, 2020). In the studies conducted in Wuhan, where the virus emerged, as a result of the closure of children and adolescents to their homes within the scope of social isolation measures during the pandemic process, both the problem of inactivity (Xiang et al., 2020) and the problematic internet use in terms of coping with the situation and escaping from it (Király et al., 2020). ) were seen to be faced with (as cited in Öztürk, 2021). In the research conducted by Anadolu University Social Media and Digital Security Education Application and Research Center (SODİGEM), It was observed that the time spent by individuals in our country also we have access to computers and internet etc. during the pandemic period has increased. As a result of the survey conducted with 293 participants from 73 provinces, 70% of the individuals' computer usage time and at the same time video conversation and video conferencing and 80% of the mobile phone usage time increased (Öztürk, 2021). The increase in screen usage makes us think and also raises the question, "Can we use technology properly?".

During adolescence, when peer acceptance and belonging are important, the most important people in the lives of adolescents are their peers. Therefore, they want to spend more time with their peers (Özbaş, 2021). Students with special abilities can deal with tasks that will not contribute to their own development when they are faced with boredom in the environment where face-to-face meetings are limited during the pandemic period and in the environments where they receive education with individuals with typical development (Çalıkoğlu, 2021). According to Yang and Tung (2004), addicted individuals use the Internet more frequently for entertainment, interaction, and feelings of contentment. Internet addiction, the individual may lose control of his life and even overuse it at a level that makes him forget his hunger and sleep (Usta, 2016). Choi et al. (2009) state that the internet is widely used among students attending secondary education and that internet addiction is increasing among these students. Internet addiction negatively affects students' academic and personal development (Doğan, Işıklar, & Eroğlu, 2008).

According to Koçak (2019), gifted students mostly use computers, tablets or smartphones for playing games and chat. It can be said that as long as screen use is planned in a way that does not create addiction and does not prevent the physical, social-emotional and academic development of the individual, it can be said that digital games support the development of the imagination of the individual, rather than any expected harm. According to Çalıkoğlu (2021), it is not possible and appropriate to completely keep the child away from the screen. Adolescence is the period in which people's identities are formed. At this point, the parents' observations of the child's behavior and the constructive relationship they establish with them are important. Whether families are democratic or oppressive plays an important role in the formation of an individual's identity (Dutar, Çakır, &

Yeşilkılıç, 2018). If the family is in contact with their children and is away from overprotection; The lack of perfectionism and competition reduces the risk of children developing addiction.

The research is important in terms of contributing to the literature in determining the screen time of gifted students aged 12-18 during the pandemic process and the opinions of parents on this issue. In this context, it is believed that educators and parents will help adolescents to take precautions regarding the effects of screen addiction on their physical, social-emotional and academic development. The mixed research question, which is expressed as the main problem of this research, which is designed as a mixed method research in terms of expressing a research process involving the collection, analysis and integration of different research designs, qualitative and quantitative data: How do the qualitative results obtained from the interview data with gifted students and their parents about the screen use of gifted students aged 12-18 during the pandemic period help explain the effects on potential screen addictions?"

#### Method

In this section information on the study group of the research, the research model, data collection and analysis of the data were presented.

#### **Research Model**

This study is designed as a mixed method research model in which quantitative and qualitative research methods are used together. Mixed methods research is a method that allows to collect and analyze both qualitative and quantitative data to understand research problems, and can simultaneously place these two data types into each other or one after the other, respectively. It can be defined as a research design that can integrate by building on it, using the advantages of integrating these two data types, to obtain comprehensive results, and using special research patterns in planning these operations (Creswell, 2019; Creswell & Plano Clark, 2018). The main reason for using mixed methods research in this study is the complementarity dimension. The purpose of the complementarity dimension in the mixed method study is that one of the results obtained from qualitative or quantitative data is based on clarifying, elaborating and enriching the results obtained from the other (Greene et al., 1989). In this sense, the emphasis on highlighting both methods by addressing the strengths of both qualitative and quantitative data allows researchers to see the general picture of the subject studied and to get answers to different research questions or objectives on complex subjects (Greene et al., 1989; Bryan, 2006). Mixed methods research patterns range from fixed designs to emergent designs. Fixed designs are designs in which decisions about all stages of the research are made and planning is made before starting the study (Creswell & Plano Clark, 2018). This study has a fixed pattern, as the use of mixed methods research was decided before the study started. The explanatory sequential/ (sequential quantitative  $\rightarrow$  qualitative) mixed methods research design used in

this study, which is one of the basic design types, which is one of the categories containing mixed methods research typologies (Creswell & Plano Clark, 2018), is given in Figure 1.



Figure 1. Basic Design: Explanatory sequential/ (sequential quantitative  $\rightarrow$  qualitative) mixed methods research design

Note: Adapted from Toroman (2021) and Creswell and Plano Clark (2018).

The explanatory sequential/ (ordered quantitative  $\rightarrow$  qualitative) mixed methods research design begins with quantitative data collection and analysis that aims to examine trends in a research population or relationships between topics or concepts studied. Subsequently, a connection is made from the quantitative results to the qualitative. As a result of the qualitative data collection carried out, the data are analyzed. Results are explained by qualitative data collection and analysis of the quantitative results obtained. At the point of combining the data, the dialectical pluralism paradigm is used (Creswell & Plano Clark, 2018). Creswell and Plano Clark (2018) suggest that writing details about qualitative and quantitative methods should be compatible with the methodology appropriate to the research design. Since this study was conducted with an explanatory sequential quantitative  $\rightarrow$  qualitative mixed methods research design, the quantitative dimension, method and results of the research were presented first. Then, in the light of the findings obtained from the quantitative results, the qualitative dimension of the research; The determination of the qualitative sample, its method and results are presented. Finally, the quantitative and qualitative results were combined and interpreted.

#### **Quantitative Dimension of the Research**

Different quantitative research designs can be used in social science research. Relational research model, one of the scanning models, was used in the research. In the analysis of this research model, the screen time of the gifted students; before the pandemic and during the pandemic period, the mandatory time spent in front of the screen and the changes in the purposes of screen time were compared. Karasar (2018) describes the research model that aims to detect the existence and degree of change between two and/or more variables; referred to as the relational screening model.

The answers to the following sub-problems were sought with the items in the questionnaires applied separately to the gifted students and their parents in quantitative dimension, according to the procedures of the explanatory design, one of the mixed method researches for the mixed question, which is the main problem of the research.

According to gifted students;

Sub-problem 1S: Have the screen times changed during the pandemic period compared to the time before the pandemic?

Sub-problem 2S: Have the screen time purposes during the pandemic period changed compared to before the pandemic?

Sub-problem 3S: Did the awareness of the negative effects of being in front of the screen during the pandemic period change compared to before the pandemic?

Sub-problem 4S: Have the emotional states changed when connections were cut during the pandemic period compared to before the pandemic?

According to the parents of the gifted students;

Sub-problem 1P: Have the screen times of gifted children changed compared to the time before the pandemic?

Sub-problem 2P: Have the screen time purposes of gifted children during the pandemic period changed compared to before the pandemic?

Sub-problem 3P: Has the awareness of gifted children about the negative effects of being in front of the screen during the pandemic period changed compared to before the pandemic?

Sub-problem 4P: Have the emotional states of gifted children during the pandemic period changed when their screen connections were cut off, compared to before the pandemic?

# Participants of Quantitative Research

The population of the research consists of gifted students between the ages of 12-18, who are educated in Çanakkale and Edirne in the 2021-2022 academic year, and their parents. Appropriate sampling method was used in determining the sample of the study. While creating the working group, social media platforms that are members of gifted children and their families were used. It is stated that the current method of voluntarily or easily sampling and inclusion of participants in the research is the appropriate sampling method (Christensen, Johnson, & Turner, 2015). Families of gifted children were reached through social media.

In the first stage, the prerequisite features that the gifted students and their parents should have, were determined. The prerequisites for gifted students to take part in the study as a participant are a) volunteering to participate in the study, b) being diagnosed with giftedness from the guidance research center, c) being between the ages of 12-18, d) continuing their education online during the COVID-19 pandemic period. e) to have an environment where the research can answer the quantitative questions on the google form platform. Prerequisite features that parents must have in

order to be a participant in the study a) to volunteer to participate in the study, b) to have a child diagnosed as gifted by the guidance and research center, c) to have a gifted child between the ages of 12-18, d) to have an environment where the researcher can answer the quantitative questions on the Google Form platform, e) It has been determined as being in the same house with a gifted child all day during the COVID- 19 pandemic period. Of the 173 forms answered by the students through the Google Form, 160 of them met the prerequisites. 13 students who were diagnosed with giftedness from private centers or private practice and were outside the age range were not included in the sample. Of the 107 forms answered by the parents, 7 did not meet the prerequisites. The sample of the research consists of 160 gifted students aged 12-18, who received online education during the pandemic process, and the parents of 100 of them. This method is important in terms of accessibility and saves time. The distribution of gifted students in the 12-18 age group participating in the research is presented in Table 1. The Sample, their characteristics and their selection methods should be described in detail and justified.

Variables	Level	Frequency (f)	Percent (%)
Gender	Female	105	65.73
	Male	55	34.27
Education Level	Middle School	54	33.75
	High School	106	66.25
Total		160	100

**Table 1.** Distribution of gifted students constituting the sample

As seen in Table 1, 66.3% of the gifted students are at high school level and 33.7% are at secondary school level. 65.73% of these participants are female; 34.27% of them are male students.

<b>Table 2.</b> Distribution of	parents of gifted students	constituting the sample
		$\mathcal{O}$ 1

Variables	Level	Frequency (f)	Percent (%)
Parent Type	Mother	84	84
Education Status			
Employment status during pandemic period	Father	16	16
	Primary	2	2
	Secondary	67	67
	University	27	27
	Master's and PhD	4	4
	Not working before	26	26
	Working from home	67	67
	Fired	17	17
Total		100	100

As seen in Table 2, 84% of the 100 parents included in the study are mothers, and 67% of the parents have secondary education, 27% have a university degree and 4% have a postgraduate degree. In the table, it is stated that while 26% of the parents, only 2 of whom are primary school graduates,

did not work before the pandemic, 17% were dismissed during the pandemic process and 67% of them carried out their work from home.

# Data Collection Tools of Quantitative Research

In the quantitative part of this research, data were collected through the "Personal Information Form" and the "Screen Time Questionnaire" answered by both gifted students and their parents. The data of the research were collected with an online questionnaire. The online survey method has become a method that has increased in recent years and contributed significantly to researchers in the data collection process (Xiao & Lan, 2017). The advantage of the online survey is that it provides immediate access to research questions on digital platforms through technology, which is an important part of people's lives in today's world. Consent form was obtained from the participants regarding their voluntary participation in the study.

**Personal Information Form.** The personal information form applied for gifted students was developed by the researcher in order to obtain information about the demographic characteristics of gifted students. These demographic characteristics are; age, class, gender and educational institution. The personal information form applied to the parents of gifted students was developed by the researcher in order to obtain information about the demographic characteristics of the parents. These demographic characteristics are; age, parent type, employment status, education level, and gender of the gifted child.

Questionnaire on the Effect of The Pandemic on Screen Time in Individuals Aged 12-18 (Student). The questionnaire was prepared by the researcher. The questions of the questionnaire were prepared in line with the symptoms of screen addiction and presented to the expert opinion. As a result of expert opinion, the two-stage survey; It has become to include a total of 24 questions, 12 before the pandemic and 12 during the pandemic process. The purpose of this survey is to determine the effect of the pandemic process on the screen use of gifted students and, finally, to form the basis for the selection of samples for the qualitative part of the research. The survey questions consist of questions about the screen time of individuals, their attitudes towards screen use, the tools they use in screen use, and their awareness of the harms of screen use. Although the answering time of the questionnaire is 15 minutes on average, there is no specific time limit.

**Questionnaire on the Effect of The Pandemic on Screen Time in Individuals Aged 12-18** (**Parents**). The questionnaire was prepared by the researcher. The questions of the questionnaire were prepared in line with the symptoms of screen addiction and presented to the expert opinion. As a result of expert opinion, the two-stage survey; It has become to include a total of 24 questions, 12 before the pandemic and 12 during the pandemic. The purpose of this survey is to determine the perceptions of the parents about the effect of the pandemic process on the screen time of their gifted

children, and finally to form the basis for the selection of the sample for the qualitative part of the research. The survey questions consist of questions about the parents' awareness of their children's screen use, their attitudes towards screen use, the tools they use in screen time, and the harms of screen use. Although the answering time of the questionnaire is 15 minutes on average, there is no specific time limit.

# Data Analysis of Quantitative Research

Percentage frequency analysis calculations were used in the analysis of the data. "Frequency analysis is a statistical analysis technique that shows the observation frequency and percentage distribution of data." Percentage frequency analysis is used in this study to compare the percentages obtained as a result of the pre-pandemic and pandemic process questionnaires and to decide whether the symptoms of screen use increase in individuals.

# Findings of Quantitative Research

In this mixed-methods research, which examines the screen use of gifted students aged 12-18, who are studying at high school and secondary school levels in Çanakkale and Edirne in the 2021-2022 academic year, and the views of their parents on the subject, the findings of the questionnaire items that serve each sub-problem of the quantitative dimension of the research are given in tables.

Sub-problem 1S: According to gifted students, have the screen times changed during the pandemic compared to the time before the pandemic?

Sub-problem 1E: According to the parents of gifted students, did the screen use times of gifted children change compared to the time before the pandemic during the pandemic?

The findings of the questionnaire items that serve the sub-problem regarding the screen time of gifted students before and during the pandemic, and the perceptions of parents towards their children's screen time are presented in Table 3, Table 4 and Table 5.

	1-2 Hours		3-4 H	lours	5-6 H	Iours	7 Hours	7 Hours or more	
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)	
Before Pandemic									
Parent	48	48	37	37	10	10	5	5	
Student	34.4	55	50	80	11.3	18	4.4	7	
During Pandemic									
Parent	4	4	7	7	21	21	68	68	
Student	0	0	10	16	33.8	54	56.3	90	

Table 3. Screen time of gifted students

Before the pandemic, 34.4% of the students, 55 of 160 students, limited the screen time to 1-2 hours, while during the pandemic, 56.3% of the students, 90 out of 160 students, increased this time to 7 hours or more. What is interesting is that 0% of the students, that is, none of the students

in the sample group, used screen less than two hours a day during the pandemic process. All students have more than 2 hours of screen use. Before the pandemic, 48% of parents stated that their children's screen time was limited to 1-2 hours, while only 4% of these parents stated that it was 1-2 hours during the pandemic process. During the pandemic period, 7 hours or more meets the largest part. It reached 68% with an increase of 63%. In general, in terms of both samples, a decrease is observed in those who say 1-2 hours and 3-4 hours, while an increase is observed in 5-6 hours and 7 hours and more. Screen time has increased during the pandemic process.

	1 Hour		2 H	2 Hours		3 Hours		ours
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)
Before Pandemic								
Parent	51	51	27	27	7	7	15	15
Student	58.1	93	25	40	6.3	10	10.6	17
During Pandemic								
Parent	5	5	3	3	18	18	74	74
Student	11.9	19	5,6	9	16.25	26	66.3	106

Table 4. Mandatory screen time of the gifted students (Lesson, homework, online education, etc.)

Before the pandemic, 51% of parents stated the time their children were forced to stay in front of the screen as 1 hour, while those who chose this option during the pandemic period decreased to 5%. The highest increase occurred in 4 or more hours options. While those who chose 1 and 2 hours were 78 parents before the pandemic, this number decreased to 8 parents during the pandemic. The compulsory stay in students before the pandemic is 1 hour at the most. While these people constitute 58.1% of the sample, those who stayed for 1 hour during the pandemic process constitute 11.9% of the sample. While it was preferred for a maximum of 1 hour in both samples before the pandemic process, it was replaced by 4 hours or more during the pandemic process. In other words, the period of mandatory screen time has increased during the pandemic process.

Table 5. Complaining about time spent on screen of gifted students

	Compla	Complainant		Undecided		Not Complainant		No Answer	
	(%)	(f)	(%)	(f)	%)	(f)	(%)	(f)	
Before Pandemic									
Parent	29	29	23	23	47	47	1	1	
Student	25	40	21.9	35	53.1	85	0	0	
During Pandemic									
Parent	56	56	13	13	29	29	2	2	
Student	41.8	77	18.8	30	31.9	51	1.2	2	

Before the pandemic, 29% of parents complained about their children's screen time, while this rate increased to 56% during the pandemic process. Before the pandemic, 25% of the students complained about the time they spent in front of the screen, while this rate increased to 41.8% during the pandemic process. Complaining about screen time has increased during the pandemic process

compared to before the pandemic. 1 of the parents before the pandemic; In the pandemic process, 2 students and 2 parents chose the "no answer" option in the question.

Sub-problem 2S: According to gifted students, have the screen time purposes during the pandemic period changed compared to the pre-pandemic period?

Sub-problem 2P: According to the parents of gifted students, have the screen time purposes of gifted children during the pandemic period changed compared to before the pandemic?

Table 6, Table 7, Table 8 and Table 9 present the findings of the questionnaire items that serve the sub-problem of gifted students' purposes of the screen time before and during the pandemic, and parents' thoughts of children's purposes of the screen time.

**Table 6.** Purpose of screen time of gifted students

	Online Education and		Social	Social Media		Game		Entertainment	
	Resea	arch							
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)	
Before Pandemic									
Parent	62	62	56	56	49	49	52	52	
Student	65	104	78.8	126	44.4	71	61.9	99	
During Pandemic									
Parent	97	97	61	61	49	49	57	57	
Student	93.8	150	78.1	125	50	80	56.3	90	

In this part of the questionnaire, the sample groups were given the opportunity to choose more than one option. Before the pandemic, 62% of parents ticked the online education option, while it increased to 97% during the pandemic. While there was an increase in entertainment and social media options during the pandemic period, the rate of those who chose the game option did not change. While there has been an increase in online education, social media and games among students, there has been a decrease in entertainment options. The highest increase in students has been in the online education option. increased from 65% to 93.8%. According to students and parents, while the time spent on online education increased during the pandemic process, the time allocated for entertainment decreased according to students.

**Table 7.** Number of technological tools used by gifted students

	1			2		3		more
	(%)	( <b>f</b> )	(%)	( <b>f</b> )	(%)	<b>(f)</b>	(%)	( <b>f</b> )
Before Pandemic								
Parent	37	37	43	43	9	9	11	11
Student	34.4	55	45	72	16.2	3	4.4	7
During Pandemic								
Parent	4	4	40	40	36	36	20	20
Student	14.4	23	41.9	67	30.6	49	13.1	21
It is seen that there are 2 most preferred technological tools before and during the pandemic. The biggest increase in student results was determined in the option of owning 3 technological tools. While 3 students with 3 technological devices were 16.2% of the sample before the pandemic, individuals with 3 technological devices during the pandemic period increased by 46 people and reached 30.6%. In the parents' answers, the number of those who said that their children used 1 technological device was 37, while this number decreased to 4 after the pandemic. In parents, there was an increase of 25% in maximum 3 technological device options. There has been an increase in the number of technological tools used during the pandemic process.

	Yes		May	Maybe		lo No A		nswer	
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)	
Before Pandemic									
Parent	50	50	18	18	31	31	1	1	
Student	28.7	46	21.3	34	49.4	79	0.6	1	
During Pandemic									
Parent	40	40	19	19	40	40	1	1	
Student	50	80	18.8	30	30	48	1.2	2	

Table 8. Using screen time as a tool to avoid responsibility

While 50% of parents thought that their children used the screen as a tool to avoid responsibilities before the pandemic, this rate dropped to 40% during the pandemic period. Those who advocate using the screen as a tool have decreased. While 28.7% of the students stated that they used the screen as a tool to avoid responsibilities before the pandemic, this rate was seen as 50% during the pandemic process. There has been an increase in those who argue that use the screen as a tool. 1 person from the parents before the pandemic, 1 person to the pandemic process; Among the students, 1 person before the pandemic and 2 people during the pandemic period give "no answer" to the question. Parents and students have opposite opinions.

Table 9. Social interaction on-screen
---------------------------------------

	Yes		May	Maybe		lo	No Ar	nswer
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)
Before Pandemic								
Parent	60	60	8	8	30	30	2	2
Student	71.3	114	8.8	14	18.1	29	1.9	3
During Pandemic								
Parent	71	71	9	9	19	19	1	1
Student	83.1	133	6.9	11	8.8	14	1.2	2

It is seen that the social interactions of the students increased on the screen during the pandemic (81.3) compared to the pre-pandemic (71.3). According to their parents, their children's social interactions on the screen increased during the pandemic (71%) compared to the pre-pandemic period (60%). Social interaction on the screen has increased during the pandemic period.

Sub-problem 3S: According to gifted students, has their awareness of the negative effects of being in front of the screen during the pandemic period changed compared to before the pandemic?

Sub-problem 3E: According to the parents of gifted students, has the awareness of gifted children about the negative effects of being in front of the screen during the pandemic period changed compared to before the pandemic?

The findings of the questionnaire items that serve the sub-problem regarding the awareness of gifted students and their parents about the negative effects of being in front of a screen before and during the pandemic are presented in Table 10, Table 11 and Table 12.

	Ther	e is	Not	sure	There	is no	No An	swer
	aware	eness			aware	ness		
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)
Before Pandemic								
Parent	50	50	31	31	18	18	1	1
Student	35.6	57	21.9	35	40.6	65	1.9	3
During Pandemic								
Parent	61	61	14	14	23	23	2	2
Student	50	80	18.8	30	30	48	1.2	2

Table 10. Awareness of the negative effects of being in front of a screen

Before the pandemic, 50% of parents stated that they were aware of the negative impact of being in front of the screen of their children, while this rate increased to 61% during the pandemic period. While 35.6% of the students stated that they realized that looking at the screen had a negative effect on them before the pandemic, this rate increased to 50% during the pandemic period.

	Yes		Ma	ybe	No		No Answer	
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)
Before Pandemic								
Parent	24	24	10	10	64	64	2	2
Student	9.4	15	31.3	50	59.4	95	0	0
During Pandemic								
Parent	41	41	19	19	39	39	1	1
Student	41.3	66	21.9	35	36.9	59	0	0

Table 11. The negative effect of screen time on daily work

2 of the parents did not answer this question in the pre-pandemic part and 1 during the pandemic period. All of the students answered this question in both phases of this questionnaire. According to the answers from the parents, the number of those who said "Yes" increased by 17, while the number of those who said "No" decreased by 25. While 9.4% of the students stated that screen use prevented their daily work before the pandemic, 41.3% of the students stated that screen use prevented their daily work during the pandemic period. While the number of people who think

that screen time prevents doing their daily work during the pandemic period has increased, the number of those who say that they do not prevent it has decreased.

	•	Yes	Mayb	Maybe No			No Answer		
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)	
Before Pandemic									
Parent	24	24	10	10	64	64	2	2	
Student	65	104	16.2	26	17.5	28	1.2	2	
During Pandemic									
Parent	42	42	17	17	40	40	1	1	
Student	41.9	67	13.1	21	44.4	71	0.6	1	

Table 12. Sleep deprivation because of screen time

Students stated that they were less sleep deprived because of the screen during the pandemic (41.9%) than before the pandemic (65%). According to parents, their children are more sleep deprived during the pandemic (42%) than before the pandemic (24%).

Sub-problem 4S: According to gifted students, did the emotional states they display during the pandemic period when their screen connections were cut off changed, compared to before the pandemic?

Sub-problem 4P: According to the parents of the gifted students, did the emotional states of the gifted children during the pandemic period when their screen connections were cut off changed, compared to the pre-pandemic period?

Table 13 and Table 14 present the findings of the questionnaire items that serve the subproblem regarding the emotional state of gifted students before and during the pandemic, when the screen connections of the children were cut off.

	Y	Yes		laybe		No		nswer
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)
Before Pandemic								
Parent	21	21	15	15	63	63	1	1
Student	6.3	10	23.1	37	68.8	110	1.9	3
During Pandemic								
Parent	27	27	29	29	42	42	2	2
Student	21.9	35	21.3	34	55.6	89	1.2	2

Table 13. Feelings of unhappiness, restlessness without access to screen

During the pandemic period (21.9%), the rate of feeling unhappy and uneasy when the students were away from the screen increased compared to the pre-pandemic period (6.3%). According to the parents, the rate of feeling unhappy and restless when their children stay away from the screen increased during the pandemic (21%) compared to the pre-pandemic period (27%).

	Ye	Yes		ybe	١	No	lo No A	
	(%)	(f)	(%)	(f)	(%)	(f)	(%)	(f)
Before Pandemic								
Parent	60	60	15	15	23	23	2	2
Student	27.5	44	26.2	42	44.6	71	1.3	9
During Pandemic								
Parent	30	30	46	46	22	22	2	2
Student	32.5	52	18.8	30	46.9	75	1.9	3

Table 14. Negative perspective on life when staying away from social media

Before the pandemic, 27.5% of the students said that they looked at life negatively when they were away from social media, while this rate was 32.5% during the pandemic process. Before the pandemic, 15% of the parents were not clear that their children could look at life negatively if they were away from social media, while the rate of those who are not clear during the pandemic period is 46%. While the rate of those who answered "yes" was 60% before the pandemic, it decreased to 30% during the pandemic period. Parents have less information about their children's perspectives on life during the pandemic than they did before the pandemic.

## **Qualitative Dimension of the Research**

Creswell (2016) likens qualitative research to an intricate fabric formed by a mixture of fabrics of different colors and textures and various materials. The most common patterns used in qualitative research are phenomenological, ethnographic, embedded theory, action, narrative and historical research (Gürbüz & Şahin, 2016). Phenomenology was used in the qualitative dimension of this study, in which the screen use of gifted students aged 12-18 years and the views of their parents on this issue were investigated. In this design, which focuses on facts that individuals are aware of but do not have in-depth and detailed knowledge (Büyüköztürk et al., 2011), it focuses on evaluating the experiences of individuals by highlighting their perceptions and experiences from their own perspectives (Saban & Ersoy, 2019) (Miller & Brewer, 2003). It is to define the essence of experience and to make a universal description based on individuals' expressing "what" and "how" they experience (Creswell, 2016). In this research, it will be described how gifted students experience screen time during the pandemic process.

## Participants of Qualitative Research

Purposive sampling model was used within the scope of the study. With purposeful sampling, researchers aim to work with individuals who have experience or knowledge about the basic phenomenon or key concept they are examining in their studies (Creswell, 2019). Accessibility is important, as well as being willing to participate and the ability to communicate experiences and thoughts in an open, sincere, expressive and reflective way (Bernard, 2002). It is stated that the number of participants in phenomenological studies can vary between 5 and 25 items (Patton, 2002;

Creswell, 2016; Rubin & Babbie, 2016). It was previously stated that 160 gifted students and 100 parents participated in the quantitative phase of this research, which was carried out with a mixed method. In the personal information form, questions were also asked about whether they wanted to take part in the qualitative dimension of the research, whether they wanted to share contact information so that they could be reached, and whether they could spare time to answer the interview questions sincerely. Among the participants in the quantitative dimension of the research, 68 gifted students and 43 parents who answered positively to these questions were contacted via e-mail and their invitations to participate in the structured interview were repeated. As a result of the correspondence, 16 gifted students and 17 parents constitute the research group of the qualitative stage.

During the interview, the students were addressed by their names, but during the reporting phase, a coding was made as S1, S2.... Information about the students is shared in Table 15. 11 of the 10 high school and 6 secondary school students in the study group consisting of 9 female and 7 male gifted students are students of BİLSEM (Science, Art and Education Center).

Student	Gender	Education Level	BİLSEM student status
S1	Female	Middle-School	Yes
S2	Female	High School	Yes
<b>S</b> 3	Female	Middle-School	Yes
<b>S</b> 4	Female	High School	Yes
S5	Male	Middle-School	Yes
<b>S</b> 6	Male	Middle-School	Yes
<b>S</b> 7	Female	High School	No
S8	Male	Middle-School	Yes
S9	Female	High School	No
S10	Male	Middle-School	Yes
S11	Female	High School	Yes
S12	Male	High School	No
S13	Female	Middle-School	Yes
S14	Female	Middle-School	Yes
S15	Male	Middle-School	No
S16	Male	Middle-School	No

Table 15. Demographics of the gifted students that are in the study group

During the interview, parents were addressed by their names, but at the reporting stage, P1, P2 .... coding was done. 10 of the parents are the parents of the gifted students in the study group. Information about the parents is shared in Table 16. In the group consisting of 11 mothers (1 single-10 married) and 6 fathers (2 single-4 married), 6 of the parents have secondary education, 8 have a university degree, 2 have a master's degree and 1 have a doctorate degree.

Parent	Parent	Age	Marital	Education	Work Status During	Child's	Child's
	Type		Status		Pandemic	Gender	Education
							Status
P1	Mother	46	Single	University	Worked from home	Male	High School
P2	Mother	37	Married	Middle School	Didn't work before	Female	Middle School
P3	Mother	39	Married	Middle School	Worked from home	Female	Middle School
P4	Mother	33	Married	Middle School	Didn't work before	Male	Middle School
P5	Father	41	Married	Master's	Worked from home	Female	Middle School
				Degree			
P6	Mother	39	Married	PhD	Worked from home	Male	High School
P7	Father	47	Single	University	Laid Off	Female	High School
P8	Mother	36	Married	Middle School	Didn't work before	Male	Middle School
P9	Father	42	Single	University	Worked from home	Female	Middle School
P10	Mother	33	Married	Middle School	Laid Off	Male	Middle School
P11	Father	39	Married	University	Worked from home	Male	High School
P12	Mother	40	Married	University	Worked from home	Male	Middle School
P13	Mother	34	Married	Middle School	Laid Off	Female	Middle School
P14	Mother	42	Married	Master's	Worked from home	Male	Middle School
				Degree			
P15	Father	43	Married	University	Worked from home	Female	Middle School
P16	Mother	38	Married	University	Worked from home	Female	Middle School
P17	Father	47	Married	University	Worked from home	Female	High School

**Table 16.** Demographics of the parent that are in the study group

#### Data Collection Tool and Data Collection Process of Qualitative Research

In the qualitative aspect of the research, structured interviews were conducted with the participants by using the structured form and interview technique. The structured interview includes a predetermined set of questions. In the interview technique, which aims to determine the parallelism and difference between the information given by the interviewed participants (Yıldırım & Şimşek, 2016), questions are asked to each participant in the same way and with the same words (Karagöz, 2017). In order to test the clarity of the interview questions, a pilot study was conducted with two gifted students and two parents. Pilot study is the process of testing the planned research and revising it according to the results obtained (Gall, Gall, & Borg, 2007). As a result of the pilot interviews with parents and students, no changes were made to the interview questions. The data obtained from the pilot interview study were not included in the research findings.

All interviews during the data collection process were conducted via the online platform "Zoom". Before the interview, the accessibility of all participants to the "Zoom" program was checked. The interviews were conducted on a standard questionnaire in order to reduce bias and avoid guiding questions. Interviews started after the participant parents and all the parents of the participating gifted students allowed the interviews to be recorded and their consent was obtained. It was ensured that every positive and negative statement was recorded. In the interviews made over Zoom, the participant's state, movements and emotions were noted by the researcher. During the

interviews, the researcher asked the participant after the interview question, and after the answer sentence given when she deems necessary, in order to reach the main meaning and deeper answers, the researcher asked "What exactly do you mean by this?", "What does this mean?", "Can you explain a little more?", "Can you give an example?" questions such as While the longest interview within the scope of the related interviews lasted 54 minutes; The shortest interview lasted 37 minutes.

The audio recordings obtained were transcribed by the researcher by hiding the names, and content analysis processes were carried out by taking the opinions of field experts in line with these transcripts. In the analyzes obtained, the condition of the researcher to report the findings honestly was fulfilled by directly transferring the statements of the participants (Creswell, 2016). The interview questions of this study, which examines the effect of the pandemic on screen time in individuals aged 12-18, are presented in Table 17.

Table	17.	Interview	questions
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Applied Group	Questions
Gifted student group	<ul> <li>What are your thoughts on your screen time during the pandemic period?</li> <li>What do you think about the effects of being on the screen for a long time during the pandemic period?</li> <li>How do you think the pandemic period affects your screen time purpose?</li> <li>How do you behave when you are disconnected from the screen?</li> </ul>
Parent Group	<ul> <li>What are your thoughts on the screen use time of your gifted child during the pandemic period?</li> <li>What do you think about the effects of your gifted child being on the screen for a long time during the pandemic period?</li> <li>How do you think the pandemic process affects your gifted child's screen time?</li> <li>How does your gifted child behave when the screen is disconnected?</li> </ul>

## Validity and Reliability of Qualitative Research

The concepts of credibility, transferability, objectivity and consistency are used for validity and reliability in qualitative research (Merriam, 2009; Yıldırım & Şimşek, 2016). Mertens (2019) states that for the credibility of a qualitative research, strategies such as long-term interaction, peer review, participant confirmation and variation should be used, and the researcher can summarize what the participant said at the end of an interview and ask whether the notes reflect what the person wants to express. The actions that support the validity and reliability of the qualitative dimension of this research are given in Table 18.

Concept	Action				
Credibility	Communication was established with the participants.				
	The rationale and purpose of the research are explained.				
	In the interviews, the sincere interaction was ensured as much as possible.				
	Expert opinion was taken in the preparation of the interview questions.				
	A pilot study was conducted.				
	At the end of the interview, the participant's thoughts were summarized, and his				
	confirmation was obtained.				
	Attention was paid to the collection of qualitative data to support the quantitative data.				
	Direct quotations reflecting the views of the participants were mostly included.				
Transferability	Purposeful sampling was chosen. The research process is described in detail.				
Objectivity	Acted diligently to reach the results objectively.				
(confirmability)	An environment has been created where the participants can express themselves easily.				
	Records are reported in accordance with codes and themes.				
	Opinion was obtained from another expert.				
Consistency	The researcher has a PhD in the field of gifted people.				
(reliability)	During the research, the researcher paid attention to the conceptual framework of the				
	findings.				

Table 18. Actions that support the concepts of validity and reliability of qualitative research

## Data Analysis of Qualitative Research

Content analysis method was used in the analysis of the data obtained from the interviews. In the content analysis process, similar data are brought together around certain concepts and themes (Yıldırım & Şimşek, 2016). In this process, the following steps were carried out. The recordings of interviews with gifted students and parents were converted into written form without any changes. The written data, the answers given by the gifted students and parents to each question were coded by the researcher according to the most prominent themes. In the theme determination study, another expert working in the field independently of the researcher read the written data and created the categories. The researcher and the expert came together, and the categories gathered under four themes were determined from the interviews held with the gifted students and parents, and a consensus was reached on the themes and categories.

## Findings of Qualitative Research

The findings of the qualitative research consist of the themes under the headings of screen time, the effects of being in front of the screen for a long time, the purpose of screen time, and the mood when they have no screen time.

**Findings on Screen Time**. In the interviews, in order to examine the screen time of gifted students during the pandemic period, the gifted students and their parents answered the question to determine what their thoughts were about the screen time during the pandemic period. The findings are presented in Table 19 and Table 20, respectively.

Themes	Categories	Codes	Expression samples from Documents
	Opinions of gifted students	Optimum duration of use (4)	<i>"Before Corona, I only played with my tablet for as long as my family allowed." (S5)</i>
	on screen use time before the pandemic.		"I used my computer for two hours on weekends." (T7)
		Long term use (7)	"Before pandemic, I was on my smartphone for more than three hours a day." (S12)
	Opinions of gifted students	Long term use (10)	"Because the classes were online, I was in front of the computer for almost 8 hours a day." (S16)
Screen time considerations	during the pandemic		"Just like everyone else during the pandemic, I was stuck on the computer or tablet a lot, except for the lessons." (S8)
		Obligation (4)	"During the pandemic, I entered EBA and listened to lectures. The teachers made it compulsory for us to attend the classes. On the other hand, the teachers at BİLSEM also gave online lessons. I wish they didn't make it compulsory." (S10)
		Discontent (2)	"During the pandemic, I had to attend all of the classes. I had to stay in front of the screen for almost 7 hours a day. For someone like me who doesn't even like to use a smart phone, it is very boring to listen to lectures and do homework on the screen." (S13)
		Wasted time (2)	"Teachers who were not very proficient in technology, trying to make the lessons online, took too long to process and connect to the lessons. I was working by myself in front of the screen much more than necessary for me to learn my lessons well. While my ostensibly screen time was very long, it was also a lot of time wasted." (S4)

Table 19. Gifted students' own thoughts on screen time

Table 20. Parents' thoughts on screen use time of gifted students

Themes	Categories	Codes	Expression samples from Documents
erations	Parents' thoughts on screen time of gifted students before the	Optimum duration of use (4)	"Before the pandemic, we only allowed my son to use his computer for gaming on weekends." (P8)
	pandemic		"Before the pandemic, my daughter was using a certain time a day to do her homework and research." (P16)
en time consid		Long term use (6)	"Before the pandemic, we couldn't take her smartphone away from her. She was hanging out on social media or playing games on the computer for a long time." (P1)
Scre	Parents' thoughts on screen time of gifted students during the pandemic	Long term use (10)	"Before the pandemic, my son was spending a lot of time on computer games. During the pandemic, he also spent more than half of the day in front of a computer or tablet because he was doing their classes online." (P11)

Obligation (6)	"He used to use his tablet while researching something. During the pandemic process, he was forced to go to the computer and stayed on screen for a long time because he had to listen to lectures and do his homework." (P15)
Discontent (3)	"I'm worried about my child spending so much time in front of a screen. The psychologist we went to said that he was a young person at risk of becoming a technology addict. I think this process made him more screen addicted." (P6)

**Findings on the effects of prolonged screen time.** In the interviews, in order to examine the screen time of gifted students during the pandemic period, gifted students and their parents answered the question to determine their thoughts on the effects of being in front of the screen for a long time during the pandemic period on gifted students. The findings are given in Table 21 and Table 22, respectively.

Table 21. Opinions of gifted students about the effects of being in front of the screen for a long time

Themes	Categories	Codes	Expression samples from Documents
	Opinions of gifted students on their awareness of the negative effects of being in front of the screen for a long time	Awareness (8)	"Tve never been in front of a screen for this long before. In the short or long term, I think staying in front of the screen for a long time will cause us negativity." (S9) "Maybe we don't see the negative impact right now, or we think so. However, I think we will get the result of this in the following years." (S3)
long time	Opinions of gifted students on the negative effects of being in front	Health (5)	"Because of screen time my eyesight has gotte worse." (S2)
of being in front of the screen for a	of the screen for a long time		"I have scoliosis. I don't like online classes at all. We listened to the lecture with our camera on. We used the computer to do our homework. No matter how much I wear my corset, I attribute the increase in my pain to my constant sitting during the pandemic." (S16)
			"Being in front of the screen for a long time makes me unhappy." (S1)
			"My sleeping pattern has changed. I think I am not getting enough sleep. I guess this makes me more aggressive." (S11)
Effect		Daily routines (2)	"I think that I don't take the time I need for my self-care, and I don't take care of myself because I stay in front of the screen for that long." (S7)
			"Both my mother and father were doing their work from the screen. The fact that we all had to be in front of the screen for a long time during the pandemic process caused us to have task sharing problems in our family from time to time." (S4)

Themes	Categories	Codes	Expression samples from Documents
Effects of being in front of the screen for a long time	Opinions of parents about the negative effects of being in front of the screen for a long time in gifted students	Awareness (7)	"Unfortunately, we cannot control computer use outside of lessons. Family friends we interviewed say the same about their children. Will this process we live through make our children addicted to technology?" (P4)
			"Schools being closed, and lessons being held remotely will cause them to continue with very incomplete information in the later stages of their education life. Moreover, staying in front of the screen for such a long time will cause dissatisfaction with the usual learning environments and the school environments they will demand in the future will also change." (P14)
	Parents' thoughts on the negative effects of being in front of the screen for a long time in gifted students	Health (11)	"My son has attention deficit hyperactivity disorder. Having to stay in front of a screen for a long time for lessons and homework was very difficult for a distracted child like him. We had to readjust the doses of his medication." (P6)
			"The fact that his father could not come home from the hospital during the pandemic had disrupted our family order. The fact that I work from home on the screen and my daughter's screen time for a long time has affected the way we eat. We mostly ordered take- out food. In this process, we both gained a lot of weight." (P3)
			"Exposure to screen light for a long time caused sleep problems in my daughter. That's what the psychologist said. He has just started to establish his new sleep pattern." (P13)
		Daily Routines (4)	"Sometimes, even if she didn't have a lesson, she stayed in front of the screen for a long time, I think, to escape from her responsibilities." (P7)

**Table 22.** Parents' thoughts on the effects of being in front of the screen for a long time in gifted students

**Findings on Screen Usage Purpose.** In the interviews, in order to examine the screen time of gifted students during the pandemic process, gifted students and their parents answered the question to determine what their thoughts were about the purpose of screen time during the pandemic period. The findings are given in Table 23 and Table 24, respectively.

Themes	Categories	Codes	Expression Samples from Documents
	Opinions of gifted students on screen usage purposes before the pandemic	Social Media (6)	"Before Corona, I used to hang out more on social media sites from my smartphone. During the pandemic period, I could not even follow the posts of the people I loved very much on social media." (S3)
	pandenne	Entertainment (9)	"At first, I thought I would play more computer games since we were staying at home during this period. I was wrong. Before the pandemic, I used to spend my weekends playing computer games." (S11)
		Doing Homework (3)	"I used to research the homework given by our teachers on the internet." $(S14)$
r screen time			"They still haven't bought me a smartphone. My connection with the screen was while I was doing homework from my sister's tablet or the laptop used by everyone in the house." (S8)
Considerations fo	Opinions of gifted students on screen time purposes during the	Social Media (8)	"In the process, I also added a tik tok to my social media accounts. I was bored of doing classes online. It's not for me at all." (S16)
	pandemic process		"While using my smartphone primarily to follow my friends' posts on Facebook and Instagram, I used my father's laptop to attend classes." (S4)
		Entertainment (3)	"My family could not control my computer use because we spent the whole day at home and the lessons were online. I used the opportunity and played a lot of games." (S12)
		Doing Homework (7)	"It was very practical to do and send our homework over the internet." (S9)
		Having Lessons (10)	"Of course, we didn't do online classes before. I used the computer mostly to attend the lesson and then I played games if our parents allowed it." (S15)

Table 23. Thoughts of gifted students on screen usage purposes

Table 24. Parents' thoughts on scree	en time purposes of gifted students
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Themes	Categories	Codes	Expression Samples from Documents
ime	Parents' thoughts on screen use purposes of gifted students	Social Media (4)	"He hasn't been on social media since the day we bought the smartphone." (P5)
rreen t	before the pandemic		"I think he is mostly on social media." (P10)
tions for sc		Entertainment (8)	"He was passing his time with computer games because we only allowed him to turn on his computer on the weekends." (P4)
Considera	Parents' thoughts on screen use purposes of gifted students during the pandemic process	Social Media (4)	"When he wasn't attending classes, he was making videos on Instagram the most." (P3)

Entertainment (7)	"Although he told us that he was studying, I could not control what he was doing because the lessons were on the internet. I think you spend a lot of time playing games." (P12)
Doing Homework (12)	"He was a responsible kid ever since he was little. In addition to his lessons, he used the computer a lot so that his homework was researched and there was no lack of knowledge." (P7)
Having Lessons (13)	"He wanted to learn his lessons very well because he was going to take the university exam next year. He used to attend classes and study. He was watching a video on You Tube when it got too narrow." (P6)

**Findings on Mood Swings During Screen Connection is Cut.** In the interviews, in order to examine the screen time of gifted students during the pandemic process, the gifted students and their parents answered the question to determine what their thoughts were about the mood change when the screen connection was cut during the pandemic process. The findings are given in Table 25 and Table 26, respectively.

Table 25. Thoughts of gifted students on mood changes when the screen connection is cut

Themes	Categories	Codes	Expression Samples from Documents
	The thoughts of gifted students about the emotional state they display, when the	Bad Temper (8)	"The sudden disconnection of the internet in the middle of the lesson was driving me crazy." (S9)
	screen is connection is cut.		off. I was very angry when the internet was disconnected during the game." (S12)
onnection is cut		Anxiety (5)	"At times, the modem in our house could not handle 3 connections at the same time, slowing down or breaking down. I was very worried, especially when it was in mathematics lessons, that I would not be able to connect." (S2)
ges during screen cc		Moodiness (5)	"During the pandemic days, we could only meet with my friends on social media. Even though I wanted to connect to the internet on my phone when there was a connection problem in the home internet, I used to spend the night in a state of embarrassment when I finished it in a short time before." (S14)
Mood char	Thoughts of gifted students about their behaviors when screen connection is cut	Damaging technological devices (9)	"When my phone is out of charge, if the electricity is also cut off, I sometimes have to throw it because I can't charge it." (S5)
		Trying to come up with solution (2)	"If the internet connection problem was from our house, I was going to my uncle's house downstairs." (S15) "I would definitely check their charge overnight in case my smartphone or tablet ran out of charge. If the internet went out while on the computer, I was connecting from my smartphone" (S4)

Themes	Categories	Codes	Expression Samples from Documents
	Parents' thoughts	Bad Temper (10)	"Some days it took a long time for the teachers to login
	on the emotional		to class. Also, my daughter got very angry when the
	state of gifted		internet was cut off in the middle of the lesson." (E4)
	students when they		
	are disconnected		"He didn't care much when his connection was lost
	from the screen		during the lesson, but he got very angry if the internet connection was lost while playing." (E12)
uo			
connecti		Unhappiness (3)	"He is using a smartphone. If the internet package runs out while surfing on social media, he will give a hard time to us." (E1)
dis			"The disconnection of the internet makes him yery
screen			unhappy. He once said that he becomes very miserable (E7).
ring	Demonstration	T. i.e. (	
ges du	on the behavior of	up with solution	on and off." (E8)
Jan	when the screen is	(2)	"W/h the interment is and all he immediately trian to be
Mood cł	disconnected		in from my or his father's mobile phone because he usually ends his internet before the end of the month." (E3)
		Damaging	"Once, his teacher was going to tell a very important
		technological devices (9)	subject, and that day he could not turn on the computer screen. His computer was old, it turns out the screen card was burned. He was so angry that he closed the lid
			(E9) $(E9)$

Table 26. Parents' thoughts on mood changes when gifted students are disconnected from the screen

#### **Discussion, Conclusion and Recommendations**

The mixed research question, which is expressed as the main problem of this research, which is designed as a mixed method research: "How do the qualitative results obtained from the interview data with gifted students and their parents about the screen use of gifted students aged 12-18 during the pandemic period help explain the effects on potential screen addictions?" The quantitative and qualitative results of this study, which was conducted with the descriptive sequential (quantitative  $\rightarrow$  qualitative) mixed methods research design, were combined.

As a result of the research, it was determined that the time of the individuals to look at the screen and the situations in which the individuals are pessimistic and unhappy in the absence of access to the screen increase, the use of the screen negatively affects their sleeping patterns and doing their daily work, and the number of devices with a screen increase. This situation increases the complaints about screen time in individuals and prevents individuals from doing their daily work and fulfilling their responsibilities. While individuals' purposes of using the screen during the pandemic period have shifted to the field of education, the number of people using the screen as a means of

entertainment has decreased. In addition, the number of people who received complaints about screen time from the environment has increased. In terms of sleep, individuals stated that they did not experience insomnia due to screen time during the pandemic period. On the contrary, the number of people who declared this opinion during the pandemic process has decreased.

The results of this research and the results of the few pandemic screen addiction studies in the literature overlap with each other. In Öztürk's research in 2021, it was determined that physiological, sociological, mental and psychological changes occur in individuals with social isolation during the pandemic process, and one of the psychological changes is information technologies and screen addiction. It has been determined that these addictions also affect the sleep quality of individuals. These results are in agreement with our research. The reason for this addiction has been determined as the restriction of activities in social life and the alternative of social media to this situation. In our research, it was observed that it was mostly due to online education.

In the research conducted by Göker and Turan in 2020, it was stated that together with social isolation, individuals see social media, technological devices and screens as saviors. Individuals stated that they use them as a tool to reduce the stress and anxiety brought about by social isolation. It has been stated that this situation may cause individuals to develop addiction to these tools. This research also showed that the majority of individuals (50%) use screen time to avoid responsibilities. The two studies support each other.

In the qualitative research conducted by Erol and Erol (2020), the views of parents on their children's screen use during the pandemic process were taken. Most of the parents stated that when their children are bored at home, they give them technological devices (tablets, phones, televisions, etc.). The reason for this behavior is to prevent their children from exhibiting behavioral problems at home. Some of these parents are worried that this will turn into screen addiction. When the statement of one of the parents is examined, this concern appears more clearly. This statement was "Already, televisions were empty, people had to turn to things like social media tablets, I think this increased this screen addiction." is the expression. In this study, 68% of the parents stated that their children's screen time is 7 hours or more and the number of technological devices used is excessive. The results of the two studies show similarity.

In the study conducted by Sülün, Yayan, and Düken (2021), 56.8% of the youth in the sample group stated that they slept more than eight hours a day and 40% stated that they used smartphones all day. Looking at the results of this study, 65% of the youth stated that screen time does not affect their sleep. Before the pandemic, 41.9% argued that screen time affected their sleep. In other words, the pandemic process had a positive effect on students' sleep.

In Aboud's research in 2021, results indicated that school closures and isolation have led parents of gifted children to experience a higher psychological burden and more family conflict than normal. In their self-regulated learning, gifted have experienced changes. Covid-19 has also disrupted their daily activities and prevented their free movement, making them feel like they are not doing something important, resulting in adverse effects such as sleep disorders, depression, isolation, frustration, and loss of motivation. Most gifted students often have negative online learning perspectives, indicating it as inefficient and lacking in effectiveness and connections.

Most of the studies have mentioned the benefits of online education via screen. While we are asked to continue the education, we can benefit from the positive aspects of it, as it is mentioned in the literature, if trainings on addiction are also provided. While taking advantage of this positive aspect of the screen, it is extremely important to pay attention to the screen addiction, which is the negative aspect of it. It has been mentioned that in the pandemic, online education covers the entire education system. In this process, the fact that we are constantly in front of the screen due to education increases the risk of addiction.

Based on the results obtained from the research, suggestions are presented under two headings. In the first title; While suggestions for the participants were presented based on the findings obtained as a result of the research, under the second heading; Suggestions for researchers who will study the effect of the pandemic on screen addiction in the coming years are included.

## **Suggestions for Participants Based on Research Findings:**

• Individuals should be made aware of the negative effects of screen time and control should be provided.

• Individuals should be supported to turn to sports or art branches or activities that will increase physical activity in order to get away from the screen and to develop both their physical and social aspects.

• Addictive use of social media, internet, mobile phone and computer should be limited, and the specified period of use should not be exceeded.

• Parents should also be made aware of screen time, and they should behave in a way that will be a role model for their children.

• An order should be established in the use of the screen time and the harmony of the whole family should be ensured.

# Recommendations for Researchers Working on the Effects of the Pandemic on Screen Addiction

• This study was conducted with gifted students aged 12-18 and their parents. Similar studies can be conducted with other age groups.

124

• In this study, gifted students between the ages of 12-18 were discussed. In similar studies to be conducted, the issue of screen addiction in parents can be addressed.

• Learning difficulties and screen addiction in students with ADHD can be addressed in similar studies.

• The number of people in the sample group of this research can be increased.

## **Conflict of Interest**

No potential conflict of interest was declared by the author.

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#### **Credit Author Statement**

The author confirms that he had all responsibilities for the following: conceptualization of the study and design, data collection, data analysis and interpretation of the findings, and preparation of the manuscript.

## **Ethical Statement**

Ethics committee approval within the scope of the research has been obtained from the Çanakkale Onsekiz Mart University ethics committee of scientific research with the decision numbered 22/17 on 15.12.2022.

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Investigation of the Relationship between Individual Innovation Profiles of Special Education Teacher Candidates and Their Tendency towards the Use of Technology in Class<sup>1</sup>

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#### Abstract

The purpose of this research is to examine the relationship between the individual innovativeness profiles of special education teacher candidates and their tendencies towards technology use in the lesson. The study group of the research designed in the survey model consists of 194 special education teacher candidates. Research data were obtained with "Personal Information Form", "Individual Innovativeness Scale", and "Scale of Tendency towards the Use of Technology in Class". Descriptive statistics, t-test, one-way analysis of variance, and Pearson correlation analysis were used to analyze the data. The research will contribute to the literature by revealing the relationship between the individual innovativeness profiles of special education teacher candidates and their tendencies towards the use of technology in the course, and the findings will be guiding for relevant individuals and institutions in terms of both research to be made in the field of innovation and professional development of special education teachers in terms of their professional development is considered.

Keywords: Individual innovation, special education, technology integration

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#### Introduction

Large human societies, too much movement, dynamism, rapid change, scientific and advanced technology are the qualities that represent the age we live in. Developing and changing information technologies have reshaped individuals' perceptions of themselves and their environment and have made it inevitable that change and development take place at the same pace in the field of education. It is not possible to keep the rapidly increasing student population within the boundaries of the traditional education system, and education and technology emerge as the main elements with significant power in the process of making human life more effective (Alkan, 2005). While the knowledge economy surrounding the 21<sup>st</sup> century necessitates innovative and qualified manpower, integrating rapidly occurring technological developments with education requires having an innovative vision. While education and innovation affect each other mutually, education contributes to the development of innovation, and innovation increases the quality of education (Kılıçer, 2011). Innovation is one of the most important factors in the progress of the society and the ability to improve themselves necessitate and innovative education approach. In this context, creating innovative and qualified manpower becomes the main duty of the education system (İlhan-Fındıkoğlu, 2019).

With the transition from the industrial society to the information society, the industrial economy based on production has left its place to the service economy based on knowledge, creativity, and innovation. While expectations from individuals change with this transformation process and the increasing importance of 21st century skills, innovation is seen as the basis of development in our age (Korucu & Olpak, 2015). Innovativeness refers to the degree to which individuals or institutions who are at the centre of innovations and their state of accepting it are defined as individual innovativeness, and individuals are considered in five different categories in terms of their characteristics: innovators, pioneers, questioners, sceptics, and traditionalists (Rogers, 2003). Depending on the needs of individuals and societies for change, educational institutions should offer opportunities to respond to these needs. With the technological developments being an inseparable part of educational activities, the role of teachers, who are the shapers of the system, has also changed, and accessing different information, having an innovative understanding, adopting, and applying new approaches in education have become extremely important. The development of teachers' individual innovativeness is the basis for all these to happen. Cuhadar, Bülbül, and Ilgaz (2013) emphasized that there is a need to train innovative teachers and pre-service teachers when technology applications in education are considered, and that teachers and pre-service teachers should be individuals who lead the society with their innovative perspectives. Individual innovativeness emerges as a concept that is examined in the context of individuals and the differences in their reactions to trying innovations. Possession of the characteristics necessary to be innovative appears as

one of the most important factors affecting teachers' adoption of technology and its use in an educational context (Özbek, 2014). In the existing research, it is stated that individuals having the characteristics required by innovativeness have a more positive attitude towards the acceptance and use of current technologies (Akgün, 2017; Kim & Chai, 2017). The increasing importance of innovativeness and changing social structures have made innovativeness a subject that needs to be studied and emphasized in terms of education.

Individual innovativeness is closely related to the application of new developments and ideas in education, and it is thought that teachers having the characteristics required by innovativeness will be more willing to use educational technologies. Therefore, one of the most important features of innovative teachers is to integrate information and communication technologies into educational environments and to use them correctly (Kocasaraç & Karataş, 2018). The fact that technology has experienced new transformations, both in terms of support and education, also offers great opportunities for the field of special education. As in the education of all individuals, individuals with special needs also have the basic rights that their peers have, and technology can be used effectively in the process of arranging learning environments to address the individual needs of these learners. Technology has an important role in the process of increasing the learning capacity and independence of individuals with special needs and facilitating their communication (Hammond, Whatley, Ayres, & Gast, 2010; Sula & Spaho, 2014; Zisimopoulos, Sigafoos, & Koutromonos, 2011). Teachers should be able to use these technologies effectively in the education of individuals with different characteristics, skills, and special needs by following technological developments closely. In this context, technologies that can be employed affect the ability of learners with special needs to learn many skills, as well as their self-confidence, quality of life and ability to live as independent individuals. Effective use of technology in special education teachers and when the relevant literature is reviewed, it is seen that the number of studies on technology acceptance and use and related innovations is limited (Alhossein & Aldawood, 2017; Aslan, 2018; Deniz & Demirkıran, 2006; Kışla, 2008; Kutlu, Schreglmann, & Cinisli, 2017; Ogirima, Emilia, & Juliana, 2017; Sakallı, Demirok, Haksız, & Nuri, 2019; Sola-Özgüç & Cavkaytar, 2014). No study has been found investigating the attitudes of pre-service special education teachers towards the use of technology in class and their individual innovativeness characteristics together. Thus, the current study aimed to examine the relationship between the individual innovativeness profiles of pre-service special education teachers and their tendency towards the use of technology in class. To this end, answers to the following research questions are sought:

1. What is the distribution of the individual innovativeness profiles of pre-service special education teachers?

- 2. Do the individual innovativeness profiles of pre-service special education teachers vary significantly depending on their
  - 2.1. gender
  - 2.2. level of technology use
  - 2.3. self-efficacy perception of individual innovativeness?
- 3. What is pre-service special education teachers' level of tendency towards the use of technology in education?
- 4. Does pre-service special education teachers' level of tendency towards the use of technology vary significantly depending on their
  - 4.1. gender
  - 4.2. level of technology use
  - 4.3. self-efficacy perception of individual innovativeness?
- 5. Is there a significant correlation between pre-service special education teachers' individual innovativeness profiles and tendency towards the use of technology in class?

## Method

## **Research Model**

The current study, which aimed to determine the relationship between the individual innovativeness profiles of pre-service special education teachers and their tendency towards the use of technology in class, was carried out in compliance with the relational survey model. The purpose of survey research, which is carried out on relatively larger samples, is to describe the current state of the subject or event being studied (Fraenkel & Wallen, 2006). The relational survey model on the other hand is used to reveal the relationship between two or more variables (Büyüköztürk et al., 2013).

## **Study Group**

In the selection of the participants of the study, the convenience sampling method was used and in this way a total of 194 pre-service special education teachers accepting to participate on a volunteer basis constituted the study group. The demographic features of the study group are presented in Table 1.

Table 1. Demographic features of the participants

Variable		f	%
Condor	Female	140	72.2
Gender	Male	54	27.8
Total		194	100.0

#### **Data Collection Tools**

#### **Personal Information Form**

With the prepared personal information form, information was obtained about the participants' gender, level of technology use, and self-efficacy perception of individual innovativeness.

## Individual Innovativeness Scale

To determine the individual innovativeness profiles of the participants, the "Individual Innovativeness Scale" developed by Hurt, Joseph, and Cook (1977) and adapted into Turkish by Kılıçer and Odabaşı (2010) was used. The five-point likert-type scale consists of four dimensions and 20 items. The Cronbach alpha internal consistency coefficient of scale was reported as .82.

## Scale of Tendency towards the Use of Technology in Class

To determine the tendency of the participants towards the use of technology in class, the "Scale of Tendency towards the Use of Technology in Class" developed by Günüç and Kuzu (2014) was used. The five-point likert-type scale consists of two dimensions and 16 items. The cronbach alpha internal consistency coefficient of the scale was reported as .95.

#### **Data Analysis and Interpretation**

The data collected in the current study were analysed using the SPSS program, and the assumption of normal distribution was checked for each of the variables. For this purpose, skewness and kurtosis coefficient were examined. If the skewness and kurtosis coefficients are between -1 and +1, it can be interpreted that the scores do not show a significant deviation from the normal distribution (George & Mallery, 2010). In this context, it is possible to say that all the variables used in the study are within the recommended ranges and show a normal distribution. Since the assumption of normal distribution was satisfied, two parametric tests; independent samples t-test and one-way analysis of variance, were used in data analysis. On the other hand, Pearson correlation analysis was used to determine the relationships between the variables (individual innovativeness profile, tendency towards the use of technology in class).

To determine the status of the participants according to their answers to the scale items, descriptive statistics were examined by calculating the mean scores and standard deviation values. To determine the reliability of the data collection tools used in the study, the cronbach alpha value was calculated and it was found to be .74 for the "Individual Innovativeness Scale" and .94 for the "Scale of Tendency towards the Use of Technology in Class". A Cronbach alpha value of .70 and above is an indicator of reliability for the measurement tool (Büyüköztürk et al., 2013).

#### Results

#### **Pre-service Special Education Teachers' Individual Innovativeness Profiles**

Individual innovativeness profiles of the pre-service special education teachers were determined based on the mean scores taken from the sub-dimensions of resistance to change, opinion leadership, openness to experience and risk-taking and the whole measurement tool. The descriptive findings regarding the individual innovativeness profiles of the participants are given in Table 2.

Table 2. Descriptive findings regarding the participants' individual innovativeness profiles

Sub-dimensions	N	x	Sd
Resistance to Change	194	3.38	.51
Opinion Leadership	194	3.82	.81
Openness to Experience	194	4.25	.59
Risk-taking	194	3.62	.99
Whole Scale	194	3.71	1.26

# Correlation between the Pre-service Special Education Teachers' Individual Innovativeness and Gender

To determine whether the individual innovativeness profiles of the pre-service special education teachers vary significantly depending on gender, independent samples t-test was used. The results obtained from this analysis are presented in Table 3.

**Table 3.** Results of the independent samples t-test conducted to determine whether individual innovativeness profiles vary significantly depending on gender

Group	Ν	$\overline{\mathbf{X}}$	Sd	df	t	р
Female	140	3.43	.53	102	1 922	042
Male	54	3.28	.44	192	1.032	.045

As can be seen in Table 3, the participants' individual innovativeness profiles vary significantly depending on gender ( $t_{(192)}=1.832$ , p<.05). In this regard, the individual innovativeness profile of the female participants ( $\overline{x}=3.43$ ) is higher than that of the male participants ( $\overline{x}=3.28$ ).

# Correlation between the Pre-service Special Education Teachers' Individual Innovativeness and Level of Using Technology

To determine whether the individual innovativeness profiles of the pre-service special education teachers vary significantly depending on their level of using technology, one-way variance analysis was used. The results obtained from this analysis are presented in Table 4.

**Table 4.** Results of ANOVA conducted to determine whether individual innovativeness profiles vary significantly depending on level of using technology

Source of the Variance	Sum of Squares	df	Mean Square	F	р
Between Groups	2.096	2	1.048	1 151	017
Within Groups	48.217	191	48.217	4.131	.017
Total	50.313	193			

As can be seen in Table 4, the participants' individual innovativeness profiles vary significantly depending on their level of using technology and this difference is in favor of the participants having the adequate level of technology use ( $F_{(2, 191)}$ =4.151, p<.05).

# Correlation between the Pre-service Special Education Teachers' Individual Innovativeness and Self-efficacy Perceptions of Individual Innovativeness

To determine whether the individual innovativeness profiles of the pre-service special education teachers vary significantly depending on their self-efficacy perception of individual innovativeness, independent samples t-test was used. The results obtained from this analysis are presented in Table 5.

**Table 5.** Results of the independent samples t-test conducted to determine whether individual innovativeness profiles vary significantly depending on self-efficacy perception of individual innovativeness

Group	Ν	x	Sd	df	t	р
Traditional	27	3.44	.55	102	(29)	7(0*
Innovative	167	3.38	.51	192	.628	./69*

\**p*>.05

As can be seen in Table 5, the participants' individual innovativeness profiles do not vary significantly depending on their self-efficacy perception of individual innovativeness ( $t_{(192)}$ = .628, p>.05).

# Pre-service Special Education Teachers' Tendency towards the Use of Technology in Class

Based on the mean scores taken by the pre-service special education teachers from the subdimensions of affective and behavioural tendencies and the whole scale, the pre-service special education teachers' tendency towards the use of technology in class was determined. The descriptive findings regarding the tendency of the participants towards the use of technology in class are given in Table 6.

**Table 6.** Descriptive findings regarding the tendency of the participants towards the use of technology in class

Sub-dimensions	Ν	x	Sd
Affective Tendency	194	3.96	.79
Innovative	194	3.50	1.21
Whole Scale	194	3.82	.87

# Correlation between the Pre-service Special Education Teachers' Tendency towards the Use of Technology in Class and Gender

Independent samples t-test was used to determine whether the pre-service special education teachers' tendency towards the use of technology in class varies significantly depending on gender. Findings obtained from the analysis are presented in Table 7.

**Table 7.** Results of the independent samples t-test conducted to determine whether the pre-service special education teachers' tendency towards the use of technology in class varies significantly depending on gender

Group	Ν	x	Sd	df	t	р
Female	140	3.86	.91	102	1 1 47	
Male	54	3.70	.76	192	1.147	.094*
*n> 05						

\**p*>.05

As can be seen in Table 7, the pre-service special education teachers' tendency towards the use of technology in class does not vary significantly depending on gender ( $t_{(192)}=1.147$ , p>.05).

# Correlation between the Pre-service Special Education Teachers' Tendency towards the Use of Technology in Class and Level of Using Technology

One-way variance of analysis was used to determine whether the pre-service special education teachers' tendency towards the use of technology in class varies significantly depending on their level of using technology. Findings obtained from the analysis are presented in Table 8.

**Table 8.** Results of ANOVA conducted to determine whether the pre-service special education teachers' tendency the use of technology in class varies significantly depending on their level of using technology

Source of the Variance	Sum of Squares	df	Mean Square	F	р
Between Groups	10.662	2	5.331	7.5(1	001
Within Groups	134.663	191	.705	/.501	.001
Total	145.325	193			

As can be seen in Table 8, the participants' tendency towards the use of technology varies significantly depending on their level of using technology and this difference is in favour of the participants having the adequate level of technology use ( $F_{(2, 191)}=7.561$ , p<.05).

# Correlation between the Pre-service Special Education Teachers' Tendency towards the Use of Technology in Class and Self-efficacy Perception of Individual Innovativeness

To determine whether the pre-service special education teachers' tendency towards the use of technology in class varies significantly depending on their self-efficacy perception of individual innovativeness, independent samples t-test was used. The results obtained from this analysis are presented in Table 9.

**Table 9.** Results of the independent samples t-test conducted to determine whether the pre-service special education teachers' tendency towards the use of technology in class varies significantly depending on self-efficacy perception of individual innovativeness

Group	Ν	$\overline{\mathbf{x}}$	Sd	df	t	р
Traditional	27	3.36	.83	102	2 009	
Innovative	167	3.89	.85	192	-2.998	.366*

\**p*>.05

As can be seen in Table 9, the participants' tendency towards the use of technology in class does vary significantly depending on their self-efficacy perception of individual innovativeness ( $t_{(192)}$ = -2.998, p>.05).

# Findings Related to the Relationship between the Pre-service Special Education Teachers' Individual Innovativeness Profiles and Tendency towards the Use of Technology in Class

Pearson correlation analysis was conducted to determine the relationship between the individual innovativeness profiles of the pre-service special education teachers and their tendency towards the use of technology in class. The obtained findings are presented in Table 10.

**Table 10.** Results of the Pearson correlation analysis conducted to determine the relationship between the individual innovativeness profiles of the pre-service special education teachers and their tendency towards the use of technology in class

	Individual Innovativeness Profile	Tendency towards of the Use of Technology in Class
Individual Innovativeness Profile	-	.227**

\*\*Correlation is significant at the level of .01

As can be seen in Table 10, there is a positive and significant correlation between the individual innovativeness profiles of the pre-service special education teachers and their tendency towards the use of technology in class (r=.227; p<.01). While interpreting the r values, Cohen (1988) states that values between .10 and .29 are low, values between .30 and .49 are medium, and values between .50 and 1.0 are high correlation values. In this context, it can be said that there is a low correlation between the individual innovativeness profiles of the pre-service special education teachers and their tendency towards the use of technology in class.

## **Discussion, Conclusion, and Recommendations**

The current study was conducted on 194 volunteer pre-service special education teachers to determine their individual innovativeness profiles and their tendency towards the use of technology in class and to examine their relationship both with each other and with different variables (gender, level of using technology, self-efficacy perception of individual innovativeness).

In this connection, first, the individual innovativeness profiles of the pre-service special education teachers were examined, and it was concluded that the individual innovativeness levels of

the participants were high and the sub-dimensions of openness to experience and opinion leadership came to the fore. Parallel to this finding of the current study, Atl1 (2019), investigated the relationship between individual innovativeness characteristics of primary teachers and their tendency towards the use of technology in class in terms of different variables and concluded that the individual innovativeness levels of the participants were high. Similarly, there are studies conducted with the participation of teachers and pre-service teachers in the literature, revealing a high level of individual innovativeness (Bahceci, 2019; Yıldırım, 2021). On the other hand, there are also studies that reveal a medium and low level of individual innovativeness (Kılıç, 2015; Şahin, 2016). When it was examined whether the innovativeness profiles of the pre-service special education teachers vary significantly depending on the variables of gender, level of using technology and self-efficacy perception of individual innovativeness, a significant difference was obtained in favour of the female participants and participants with an adequate level of technology use, while no statistically significant difference was found in terms of self-efficacy perception. When the literature is examined in this context, it is seen that there are different opinions. According to the findings of the study conducted by Korucu and Olpak (2015) to investigate different variables that affect the individual innovativeness levels of preservice information technology teachers, "gender" was found to be a factor not affecting the individual innovativeness level. Similarly, there are studies showing that there is no significant difference between individual innovativeness and gender (Atlı, 2019; Başaran & Keleş, 2015; Demir-Başaran & Keleş, 2015; Kılıç & Ayvaz-Tuncel, 2014; Özgür, 2013; Yavuz-Konokman, Yokuş, & Yanpar-Yelken, 2016).

Another variable addressed in the current study is the tendency towards the use of technology, and it was concluded that the pre-service special education teachers have a high tendency towards the use of technology in class. In this context, when the relevant literature is reviewed, it is seen that the findings obtained in many studies support this result of the current study (Atlı, 2019; Bahceci, 2019; Güneş & Buluç, 2017; Yılmaz, Üredi, & Akbaşlı, 2015). When it was examined whether the preservice special education teachers' tendency towards the use of technology varies significantly depending on the variables of gender, level of using technology and self-efficacy perception of individual innovativeness, a significant difference was obtained in favour of the participants having an adequate level of technology use, while no statistically significant difference was found in terms of gender and self-efficacy perception. However, when the literature is examined, it is seen that there are also studies emphasizing the significant relationship between self-efficacy perception and attitude towards using technology (Köroğlu, 2014).

In the current study, which was conducted to determine the relationship between individual innovativeness and the tendency towards the use of technology in class, it was concluded that there was a positive low-level significant relationship between individual innovativeness and the tendency

towards the use of technology in class. In a study confirming these results, Bahceci (2019) examined the attitudes of teachers working in the field of special education towards assistive technologies and their individual innovativeness levels and concluded that there is a moderately significant positive relationship between individual innovativeness and attitudes towards assistive technologies. Teachers with innovative characteristics are more willing to use educational technologies (Kim & Chai, 2017; Kocasaraç & Karataş, 2018). Similarly, there are studies in the literature that show that teachers and pre-service teachers with high levels of individual innovativeness have a more positive tendency towards the use of technology in class (Akgün, 2017; Atlı, 2019; Kartal, 2018; Örün, Orhan, Dönmez, & Kurt, 2015; Solmaz, 2019; Şahin, 2016; Yılmaz & Bayraktar, 2014).

As a result, the importance of technology integration into education in the process of increasing the quality of educational activities and training individuals with high technology selfefficacy is apparent. In this process, teachers play a key role as the direct implementers of the developing and changing technologies. The effective use of information and communication technologies in the classroom is directly related to teachers' positive attitudes towards these technologies. Innovative teachers are more willing to use educational technologies. In future studies, a holistic view of individual innovativeness profiles can be put forward by collecting data from larger participant groups through multivariate statistical methods. In this context, it may be possible to conduct more in-depth studies through qualitative studies to be carried out. It is thought that new studies to be conducted based on individual innovativeness profile and various variables such as grade level, 21st century skills such as problem-solving skills and creativity and lifelong learning which may have an impact on the tendency towards the use of technology in class, will also contribute to the literature.

#### **Policy Implications**

Developing and changing information technologies have reshaped individuals' perceptions of themselves and their environment and have made it inevitable that change and development take place at the same pace in the field of education. It is not possible to keep the rapidly increasing student population within the boundaries of the traditional education system, and education and technology emerge as the main elements with significant power in the process of making human life more effective (Alkan, 2005). Innovation is one of the most important factors in the progress of the society and the increase of the welfare level, and the adaptation of individuals to the technology age and the ability to improve themselves necessitate and innovative education approach. In this context, creating innovative and qualified manpower becomes the main duty of the education system (İlhan-Fındıkoğlu, 2019). With the technological developments being an inseparable part of educational acitivities, the role of teachers, who are the shapers of the system, has also changed, and accessing different information, having an innovative understanding, adopting and applying new approaches in

education has become extremely important. The importance of innovation and changing social structures have made innovation a subject that needs to be studied and emphasized in terms of educational policies.

#### **Conflict of Interest**

There is no conflict of interest between the authors of the article.

#### **Credit Author Statement**

Author 1: Conceptualization, Investigation, Project Administration, Writing

Author 2: Data Curation, Formal Analysis, Methodology, Project Administration, Writing

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# **Evaluation of Educational Games Prepared by Mathematics Teacher Candidates According to Game Design Key Model**

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#### Abstract

If chosen carefully according to teaching purposes and incorporated into the curriculum, games can enhance teaching and learning. The use of didactic games while teaching maths can support students' motivation and performance during the lesson. Therefore, educational games should be preferred in maths classes as an alternative teaching method. In this study, math teacher candidates' processes of developing educational games were observed, and the aim was to determine their opinions about the process. 52 teacher candidates form the participants of this research, which was conducted as a case study. Teacher candidates were informed about the properties of educational games, and they were asked to develop a mathematical game according to the Game Design Key Model developed by Özkan (2018). The research data was obtained using Game Design Key Model, structured interview forms, and daily plans. The obtained data was analyzed with descriptive and content analysis techniques. The games developed for the study were categorized according to their grade level, design purpose, learning area, game type, the way the game was developed, goal, the obstacle of the game, basic mechanics, feedback, and the number of players. Teacher candidates' views on the process were categorized as factors that make the process difficult and easier, and things that are enjoyed and disliked during the process.

Keywords: Educational Games, Game Design Key Model, Mathematics Teacher Candidates

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#### Introduction

When mathematics is taught as memorized rules and manipulation of symbols with no meaning, it causes the child to fail in mathematics (Battista, 1986). This causes the child to learn mathematics, which is an intellectual subject, as a collection of symbols, signs, and formulas, and develop a fear and hatred towards the subject (Orim & Ekwueme, 2011). When mathematics is taught through memorization and algorithms mechanically within the "explain-apply-memorize" cycle, rather than understanding and reasoning, it also leads to the development of mathematics anxiety in students (Newstead, 1998). Teaching with traditional methods meets neither the expectations nor needs of the contemporary education system. Therefore, there are studies conducted concerning the re-structuring of learning environments. In this context, it is emphasized that education should be fun. Because when playing, the child is present both physically and mentally (Dienes, 1960). In the educational environment, children should be encouraged to learn by having fun, and such activities should be presented. Educational games serving this purpose make learning more interesting and attract the attention of the educators (Jong, Shang, Lee & Lee, 2008).

Games are closely related to people's desire for entertainment. As an innate personality trait, this element of entertainment may suggest that people have an instinct to "play." As a primordial human activity from childhood to adulthood, play is an integral aspect of life and culture (Campos & Moreira, 2016). Recently, it has been stated that entertainment and enjoyment are important in the learning process and should be included in the learning environment(Russo, Russo, & Bragg, 2018). Because learners are more comfortable, motivated, and willing to learn once the learning environment is rendered in an entertaining manner. Therefore, it is stated that we should consciously plan for "fun" in the classroom. In this way, the opportunity to learn through the pedagogical benefits of entertaining and adventurous experiences can be provided to students (Bisson & Luckner, 1996).

Mathematics and its learning should be designed as fun. This situation makes itself visible in many country's education policies. These countries emphasize attracting the attention of the child and creating positive emotions (MEB, 2018). Then, adding fun to the teaching of mathematics is not only a pleasant teaching method but also a way of achieving mathematical empowerment (Sumpter, 2015). Educational games are used to introduce new concepts in mathematics, reinforce mathematical ideas, solve problems in practice, and create an enthusiastic and avid classroom environment (Orim & Ekwueme, 2011). Putting a math skill into play helps students acquire it in a way better and faster than the traditional way they're accustomed to. It is remarked that in mathematics, most students are willing to learn the mathematical knowledge contained in a game through playing the game over the traditional method (Nejem & Muhanna, 2013). Children like playing games as playing games are fun.

that would motivate children to learn. A well-designed math game can have both affective and cognitive effects on math learning (Lee, 1996).

The first and most striking advantage of supporting mathematics teaching with games is that it provides motivation (Ernest, 1986; Lee, 1996). Thanks to the game, students become motivated, and after a while they develop their attitudes as they immerse themselves in the game. In addition to being motivating, games add variety to the general mathematics curriculum by bringing a different approach to teaching the subject (Ernest, 1986). In some cases, classroom practices can remain insufficient. Thus, the mathematical concepts that students learn can sometimes hang in the air. Children who have the opportunity to practice with games can develop a deep understanding of concepts (Orim & Ekwueme, 2011). While children play, opportunities to develop mathematical skills arise, including attention, concentration, perception, memory, problem solving and strategy seeking, as well as having fun (Campos & Moreira, 2016). The students, who have the opportunity to apply formulas and rules, can enhance their understanding to a further level while solving problems. As they use their imaginations while playing, children who are given the chance to play can think of different ways of solving a problem. This improves their creativity and causes them to be more flexible in problem solving (Ompok, Teng & Sapirai, 2021). Additionally, they are suggested as a way for attaining such mathematical goals as acquiring and developing new concepts or practicing and reinforcing skills (Ernest, 1986; Jong, Shang, Lee & Lee, 2008; Orim& Ekwueme, 2011; Russo, Russo, & Bragg, 2018). The best part, on the other hand, is that the student experiences them through a very fun way, by playing games (Orim& Ekwueme, 2011)

There are many studies evaluating the effectiveness of using games in the mathematics learning environments. These studies concluded that the inclusion of games in the mathematics teaching environment increased achievement in mathematics (Başün & Doğan, 2020; Boz, 2018; Dinçer, 2008; Divjak & Tomic, 2011; Köroğlu & Yeşildere, 2002; Tural, 2005), impacted positively the attitudes, motivations and interest (Afari, Aldridge & Fraser, 2012; Çankaya & Karamete, 2009; Dele-Ajayı, Strachan, Pıckard & Sanderson, 2019; Dinçer, 2008; Divjak & Tomic, 2011; Köroğlu & Yeşildere, 2002; Tural, 2005; Tüzün, Arkün, Bayırtepe, Kurt, & Yermeydan Uğur, 2006), and induced learners to teamwork and cooperation (Campos & Moreira, 2016; Dele-Ajayı, Strachan, Pıckard & Sanderson, 2019; Tüzün et al., 2006). There are also studies showing that using games in other lessons have positive effects for the students. With these studies, it was stated that the success, interest and motivation of the students increased with the use of games in the learning environment in the science course (Gürpınar, 2017; Yeşilyurt, 2004), social studies course (Altınbulak, Emir & Avcı, 2006; Savaş and Gülüm, 2014; Somen&Metin Göksu, 2020), Turkish course (Babayiğit & Gültekin, 2019; Boz, 2018). According to the results of all these studies, the use of games in the teaching environment increases the attitude towards the lesson, success, motivation, and interest. That is why

teachers are advised to use games in their lessons to create an interesting learning environment. There are also studies researching the opinions of teachers about the necessity of using games in the teaching environment (Ateş & Bozkurt, 2021; Doğan & Sönmez, 2019; Gürbüz, Gülburnu & Şahin 2017; Özata & Coşkuntuncel, 2019). In these studies, teachers stated that the games facilitated the learning and made it more permanent since they also made mathematics more concrete and comprehensible, that the fear of the mathematics lesson could be reduced thanks to an enjoyable learning environment, and that friendships would improve and team spirit would be supported. Therefore, a learning environment supported by games can enable students to associate mathematical concepts and applications more easily. In that case, games fill the gap between practical and theoretical knowledge. In this context, it is thought that it is crucial for teacher candidates, who will become the teachers of the future, to experience educational game design and that it is important to determine the reflections of this process. There are studies aiming to have teacher candidates design educational games and research their opinions about the process (Aykaç &Köğçe, 2019; Baran Kaya & Gökçek, 2021; Önen, Demir & Şahin, 2012; Saygı & Alkaş Ulusoy, 2019; Seçkin Kapucu & Çağlak, 2018; Usta, Işık, Şahan, Genç, Taş, Gülay, Diril, Demir & Küçük, 2017). Baran Kaya and Gökçek (2021) classified the types of the games designed by primary school mathematics teacher candidates in terms of the place where the game is played, class level, learning area, purpose, and number of players. Different from this study, the current study asked mathematics teacher candidates were asked to develop a mathematical game according to the Game Design Key Model developed by Özkan (2018) and determined their opinions about the process. For this purpose, answers to the subproblems below were searched.

- 1. How are the educational games prepared by the teacher candidates evaluated according to the grade level, purpose of the design, learning area, game type, way the game is developed, goal, obstacles of the game, game's basic mechanics, feedbacks of the game, and number of players?
- 2. What are the opinions of the teacher candidates about the game design process?

# Method

# **Research design**

This study used case study as one of the qualitative research designs. In-depth analysis of the process is conducted during case studies, in which the factors related to a certain situation are evaluated with a holistic approach (Yıldırım & Şimşek, 2005). In the study, on the other hand, the aim was to evaluate the educational games developed by teacher candidates in mathematics and determine their opinions about the process.

#### **Determination of the participants**

The participants of the research consist of 52 teacher candidates who study at a primary school mathematics teaching program at a state university in the Central Anatolia Region. These students are in their their year and take the course Teaching Mathematics with Games 38 of the participants were female and 14 were male teacher candidates. The teacher candidates were briefed that the information and visuals of the games they designed would be shared as part of the study, and all of them volunteered to participate in it.

# **Data Collection Tool**

The data used in the research was obtained through the game design key model about the games developed by the students, a structured interview form in which students' opinions were taken at the end of the design process, and a lesson plan in which they could use the game they developed.

#### **Game Design Key Model**

Game design key model was developed by Özkan (2018) for teachers who want to prepare educational games. The game design key model consists of two main parts as the general features of the game and the selection of game mechanics and elements. The game elements and mechanics, which are described as the building block of the game design, were determined as the character, rule, target, obstacle, feedback, environment, and story of the game (Özkan, 2018). The elements and mechanics that are mentioned as part of this research are explained below.

Purpose of the game: It is defined as the performance standard, task, and problem and that the players have to perform, which can be grasped by the players as tangible, accessible, and appropriate for their level.

The rule of the game: The rules of the game are the most basic elements that make the game a game, and they define what the player can and cannot do.

The obstacle in the game: It is defined as the physical elements included in the game that prevents the player through rules or procedures, does not allow her to achieve her goals, makes the progress and development of the game difficult, and limits or brings it to a halt.

The game feedback: They can be defined as the rewards, punishment, badge, or success status suitable for the purpose, which enable the player to remain in the game flow.

The game environment: The game environment, which is determined by the game location, time, purpose, and the player's duty, can also be determined according to the game type.

Game mechanics: They are the elements that make the game entertaining and match the players' abilities so that the players eagerly continue playing the game.

Within the study's scope, the teacher candidates are separated into groups. Thus, 12 games developed by 12 groups were examined within this study's scope. The game design key model filled by the teacher candidates about the 12 games form the data in this study.

### Structured interview form

From the questions used by Özkan (2018) to evaluate the educational game development processes of the teacher candidates and obtain their opinions, in accordance with this study, they were asked to express the challenges encountered in the process and the factors that facilitated the process, as well as the points they enjoyed or disliked in the game development process. Each teacher candidate responded to the structured interview forms individually. Therefore, 52 structured interview forms were used as a data collection tool as part of this study.

# **Daily Plans**

Teacher candidates were asked to plan a lesson environment in which they could use the educational game they developed. Thus, the 12-day plan, which was prepared as a group, is the data of this research. The reason for the preparation of these plans is to determine whether the educational game is prepared according to the game design purpose specified in the game design key model. Once the specified game design purpose and daily plans were evaluated together, it was determined that all of the games developed were designed according to the design purpose.

# **Data Collection Process**

This study was carried out during spring semester of 2021-2022 academic year as part of the course Teaching Mathematics with Games for 3rd grade students by primary school mathematics teaching. The content of the course was planned to inform about games and their types, mathematical games, the significance of games in teaching mathematics, and theoretical approaches to games. As this content was completed, information about the game design key model was delivered for 2 weeks, game mechanics and elements were introduced, and the points that should be considered while developing the game according to this model were highlighted. In the class, 12 groups were formed, and each group was asked to develop an educational game according to the model. Then they were asked to prepare as a form the information about the game they developed and found in the game design key. Thus, 12 forms were obtained. Following the preparation of the games, structured forms in which the teacher candidates were asked about their opinions about the process were administered individually. Additionally, the teacher candidates were asked to plan and execute a lesson environment in which they could use the educational game that they developed. Thus, for 6 weeks, each group introduced the game they developed and presented it to the class with a lesson plan. At the

end of each presentation, the whole class and the lecturer assessed the game and expressed their opinions about it. The study was thus completed in 14 weeks.

# Data analysis

Descriptive analysis was used for analyzing the game design keys of the educational games developed by the teacher candidates, and the structured forms in which the opinions about the process were determined were analyzed via content analysis technique. The teacher candidates were asked to create lesson plans in order to determine the suitability of the game they developed for the game design purpose. It was found that all the educational games presented by the teacher candidates according to their lesson plans were suitable for the game design purpose specified in the key.

# Findings

The findings regarding the evaluation of the games developed in the study according to the game design model and the opinions of the teacher candidates about the game development process are considered.

How are the educational games prepared by the teacher candidates evaluated according to the grade level, purpose of the design, learning area, game type, way the game is developed, goal, obstacles of the game, game's basic mechanics, feedbacks of the game, and number of players?

The analysis of the developed games according to grade levels can be seen in the table.

 Table 1. Analysis of the developed games according to the grade level

Grade level	n
5th grade	2
6th grade	4
7th grade	3
8th grade	3

As it can be seen, two of the games were on the 5th grade level, 4 of them on the 6th grade level, and 3 of them are 7th and 8th grade level. One of the games designed for 8th grade is seen below.



Figure 1. A Game Sample Designed For the 8th Grade

Played by the whole class, the game aims to reinforce the factorization of algebraic expressions. Students line up before a racetrack and jump to the question's correct answer. The next player has to jump to the card her previous friend has jumped, and then she jumps to the answer of her own question. The team that reaches to the end of the racetrack will be the game's winner.

The developed game's analysis according to the design purpose can be seen.

Table 2. Analysis of the developed game according to the design purpose

Design Purpose	n
To enhance operations skill	6
Reinforcement	5
To determine preparedness	1
To eliminate misconceptions	1
To use it for evaluation	1

In the majority of the games developed (n=6), it was aimed to improve the students' operation skills and to consolidate the knowledge (n=5). In addition, determining the students' preparedness, eliminating misconceptions, and using the game for course evaluation is among other purposes. In the game Guess What, which was developed for 5th grade students, the aim was to improve the students' skills in operations.





Figure 2. Visual From The Game Guess What

The class separates into groups of 4. The presenter asks the questions written on the question cards to the players. Players solve the question on the answer sheets, and the first one to solve says the answer after pressing the button. Then the next player takes the turn.

The analysis of the developed games according to learning and sub-learning areas is seen.

Learning area	Sub-learning area	n
Numbers and operations	Natural numbers	
	Operations with natural numbers	
	Fractions	
	Operations with fractions	
	Exponential Expressions	
	Square-root expressions	
	Multipliers and Multiples	
Algebra	Algebraic Expressions	5
	Equality and Equation	
	Linear Equations	
Geometry and measurement	Polygons	1

Table 3. The analysis of the developed games according to learning and sub-learning areas

As it is seen, games were developed in the learning areas of numbers and operations (n=6), algebra (n=5), and geometry and measurement (n=1). In the field of numbers and operations, games on natural numbers, operations with natural numbers, fractions, operations with fractions, exponential expressions, square root expressions, multipliers and multiples sublearning areas have been developed. On the other hand, while algebraic expressions, equality and equations, and linear equations were central in the area of algebra learning, the only game in the field of geometry and measurement learning was developed on polygons. The visual of the Find Polygon game can be seen, which is a game aiming students to find the polygon suitable for the given property and reach the correct polygon as soon as possible.



Figure 3. Visual From The Game Find The Polygon

In this game, the class is divided into groups. For each question, a different member is selected from the groups in turn. The selected students go to the center of the game carpet. The teacher asks a question to the students, and the students are expected to go within the given time to the polygon containing the answer. Each student plays in turn, and the group scores are determined according to the correct/wrong answers. The group with the highest score wins the game.

The analysis of the developed games according their type can be seen.

Game type	n
Card game	7
Racetrack	5
Material-supported game	2
Digital	1
Board game	1

Table 4. The analysis of the developed games according to game types

While only one of the developed games was digital, all of the remaining games were physical games. It was seen that the games coded as physical were card games (n=7), racetrack games (n=5), material-supported games (n=2) and board games (n=1) according to the material used in the game. When the game types are evaluated, it is seen that some games consist of stages.

From these games developed as a card game, in Unomath, 8 cards are distributed to each person. After each player receives their cards, a person selected randomly starts the game throwing a question card. If the player does not have a question card in her hand at the beginning, he/she draws a card from the card deck in the middle a question comes, and then throws the question card. It is now the player in the right's turn and he/she tries to throw the answer. The game continues in this manner. The game also includes handover, joker, direction change, pass, and ban cards. In this way, the game enhances the student's mathematical skills.



Figure 4. A Visual From The Game Unomath

One of the developed games has a digital dimension as well as a racetrack. Designed for 7th grade students, the students must complete the ground racetrack in the first place. The questions about equality and equations with answers either 1,2, or 3 are directed to the students. Students act as pawns on the ground racetrack; they first say the answer to the question and then proceed as far as the

answer they say. The one who complete the racetrack first wins. Then they move on to the Fish Grabber game, which was developed using the Scratch program. The game begins with the instruction to start. The crab character informs about the game. When the game starts, a shark waiting for small fish appears. The small fish asks questions and expect their answers. These questions must be answered until they go near the shark. The groups receive points according to their correct/wrong answers, and the group with the highest score wins the game.



Figure 5. A Game Sample Designed For 7th Grade

The distribution of the games according to the way they are developed can be seen.

**Table 5.** The analysis of the way the game is developed

The way the game is developed	n
Original	8
Adaptation	4

8 of the developed games are original, while 4 of them are adaptations. Ludo, which is an adapted game, was developed for the 6th grade level.



Figure 6. A Visual From Ludo Game

Each player or group is represented by a pawn in the game that can be played individually or in groups. The dice is thrown to decide which pawn will begin. The pawn moves forward as the dice shows, and does the operation in the square it arrived. The turn is in the next pawn, and so the game continues. The one who completes the game first wins. The distribution of the games according to purposes can be seen.

Table 6.	The analy	vsis of the	developed	games	according t	o their	purposes
				( <b>7</b>			

Purpose	n
Duty (answering the right answer, memorizing the previous friend's answer, reaching the	12
target first, writing the answer on the board, finishing the cards, modeling, matching)	
Passing stages	4

While in 12 of the developed games the student is expected to fulfill a task (giving the correct answer, remembering the answer of the previous player, being the first to reach a target, writing the answer on board, finishing the cards, modeling, matching), in 4 games the aim was to pass the stages. A game designed to reinforce the topic of operations with fractions is composed of two stages as matching cards and a Tarsia puzzle.



Figure 7. Visual From The Game Matching Cards And Tarsia Puzzle

In the card-matching game, the prepared cards are placed as their upward-facing side is closed. Then the group members randomly open the cards. Those cards whose fraction and modeled state correspond are left out. It continues until the cards are finished in this way. The first group to finish the cards start the Tarsia puzzle completion task. At this stage, the groups fit the triangular cards and the questions and answers given in a scattered manner into the puzzle, and as a group they try to complete the puzzle, the outline of which they already know. The first group to finish wins the contest.

The student is required to both take quick action and model it in a game that is developed for reinforcing the subjects of equality and equations and that consists of stages.



Figure 8. Visual From A Game Developed For Reinforcing The Topic Of Equality And Equation

In this game played as groups, 2 students draw cards and try to solve the question on the solution board while 2 other students try to model this question on a weighing scale. Therefore, the aim is the active participation of all group members. Among the groups that are scored separately for the problem solving and modeling on the weighing scales, the group with the highest score wins the game.

The distribution of the games according to their obstacles can be seen.

**Table 7**. Analysis of the games according to their obstacles

The obstacle of the game	n
Time	8
Rival	6
Tasks becoming more difficult	3
Individual game	2
Group game	1

As it can be seen, the players will compete against time (n=8), against a rival (n=6), against tasks becoming more difficult (n=3), against individual player obstacle (n=2), and against group game obstacle (n=1).

The distribution of the developed games according to their basic mechanics can be seen.

 Table 8. Analysis of the developed games according their basic mechanics

Basic mechanics	n	
Knowledge	7	
Running	5	
Pressing a button/bell	4	
Speech	4	
Matching	3	
Selecting card	3	
Progress	3	
Carrying a bottle	2	
Jumping	2	

Educational Policy Analysis and Strategic Research, V18, N1, 2023  $\ensuremath{\mathbb{C}}$  2022 INASED

Finishing the cards at hand	2
Toppling glasses	1
Finishing the puzzle	1
Modeling	1
Entering the right answer on keyboard	1
Reading	1
Writing the answer on board	1
Rolling a dice	1

The basic mechanics of the developed games were determined as knowledge, running, pressing a button/bell, telling, matching, selecting a card, moving forward, carrying a bottle, jumping, finishing the cards in one's hand, tipping the glasses, completing a puzzle, modeling, entering the correct answer on the keyboard, reading, writing the answer on board and rolling dice. The basic mechanics of a game developed for 7th grade level were determined as knowledge speech, choosing cards, writing the answer on board.



Figure 9. A Game Sample Designed For the 7th Grade

As the visual explains, the game is composed of cards and joker cards. The questions, determined as easy, normal, and difficult, are arranged according to colors. 3 questions must be correctly answered to pass to the next level. Afterwards, it proceeds to the next level once the critical question on the gray card is solved. The group that accomplishes all the stages win the game.

The distribution of the developed games according to their feedbacks can be seen.

Table 9. T	he analysis of th	e developed games	according to their	feedbacks.
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Feedback	n
Progress/No Progress	4
Win/lose points	3
Eliminate/Level up	3
Award/penalty	2
Winning jokers/losing hearts	2
Increasing/decreasing the card at hand	2

It is seen that the feedback type most preferred by the teacher candidates is progress/fail to progress, gain/lose points, eliminate/level up, win a prize/penalty, gain a joker/lose lives, and increase or decrease the card in their hand.

The distribution of the developed games according to the number of player can be seen.

Number of players	n
As a team	7
The whole class as a team	5
Individual	4

# Table 10. The analysis of the developed games according to the number of player

It is seen that the games developed are played as a team (n=7), as a team with the participation of the whole class (n=5), and individually (n=4).

# What are the opinions of teacher candidates about the game design process?

This section gives the views of teacher candidates about the game development process. The answers given by the teacher candidates about the process were categorized as factors that make the process difficult or easier and things that are enjoyed or disliked in the process. In the game development process, the most challenging factors for prospective teachers were determined as difficulties about the game properties, about the game preparation stage, and about working as a group. Prospective teachers stated that they had difficulty in developing original and instructive games in which the whole class would participate, that must be fun, and that are suitable for all levels. At the same time, they had difficulty in developing a game that is up to standards, that the game is in accordance with ethical values, that the chance factor is low, that it must be popularize mathematics and include. Some student statements mentioning these difficulties are presented below.

"We tried to design a game ensuring that the student does not get bored and the game also provides complete learning. As we progressed in this direction, factors such as enabling the participation of whole class was a little challenging for us."

"It was trying to include the whole class in the game. Since there will be students from all levels in a classroom, considering this situation and preparing questions for all their levels and designing a game that would include the whole class was truly a thought-provoking and challenging process."

Table 11. Students	' views on the	factors that	make the gam	e development	process cha	llenging
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Category	Theme
Challenges related to game properties	Fun
	Attendance of the entire class
	Original
	Suitable for all levels
	Educative
	Low luck factor
	Suitable to ethical values
	Competitive
	Making mathematics more lovable

Challenges related to the game preparation phase	Deciding the game
	Designing the game
	Determining the rules
	Working with game material
	Determining the questions
Difficulty of working as a group	Communication with group friends
	Arranging a suitable time
	Consensus on a common idea

The challenges encountered by the teacher candidates during the game preparation stage were found as deciding on the game, designing the game, determining the rules, working with game material, and determining the questions. Some expressions in this category were determined as follows:

"We had some concerns about out imagined game's adaptability to real life."

"The most difficult part of the game design process was determining the suitability of the game to the class level. On the other hand, another issue that I was challenged with was preparing the question cards. While preparing these question cards, it was necessary to pay attention to details such as them being suitable for the learning outcomes, for the level of the student, for the topic, and for modeling on a weighing scale."

"It was challenging to cut the cartons we used because they were rather hard"

Teacher candidates, who talked about the difficulty of working as a group, remarked that they had difficulty in communicating with their group friends, arranging a suitable time, and building consensus around a common idea. The expressions evaluated in this category are as follows.

"The game design process was actually fun, but it was also rather tiring. The most tiring part was coordination with group friends."

"Preparing as a group and gathering during the school process pushed us a little. I mean, we had difficulty in coming together with our group friends."

The student opinions regarding the factors that facilitated the game development process are categorized as the characteristics of group members, individual, and design process. It can be stated that the group members being individuals who do division of labor, are at work, are in solidarity, respect different ideas, make an effort, and exchange ideas facilitates the game development process. The evaluated answers from the students in this context are as follows:

"Sharing tasks in the game design process made it easier for all of us. After sharing tasks, we helped each other in cases where we couldn't make on our own. And while designing the game, we all researched what kind of game it should be; so it became easier for me to come up with new ideas for the game."

"It made our task easier for us that we were in constant communication about the game and everyone had logical ideas. In addition, that my group friends truly put an effort for the assignment made the task easier."

Characteristics of group members	Does division of labor
	Groups at work
	Groups in solidarity
	Respectful of different ideas
	Making an effort
	Exchanging ideas
Individualistic	Having field and field education knowledge
	Observing secondary school youth
	Researching
	Loving mathematics
Design process	Expert guidance
	Conducting research on the subject
	Being inspired by similar games

Table 12. Students' views on the factors that make the game development process facilitated

The students stated that the game development process was easy due to their individual characteristics. The evaluated answers in this context were gathered under the themes of having field and field education knowledge, conducting research, observing secondary school youth, and loving mathematics. The evaluated statements in this context are given as follows:

"Designing a structure and a game on my favorite subject was very enjoyable process... In addition, since we know the outcomes, we did not have difficulty in question preparation."

"The point that made my job easier in game design is that I examined the secondary school youth around me in the past and recently. In addition, I have seen after some research online that there are many studies about the topics we want."

The points that facilitated the students' work during the game design process are determined as expert guidance, research on the subject, and inspiration from similar games. The evaluated statements in this context are as follows:

"The point that contributed to us was that we designed a new game by combining some other games. The games helped us a lot."

"The things that facilitated and contributed to my progress in the game design process are my love for mathematics, collective action with group friends, the information given by our teacher about this course, and other articles and theses on this subject in the literature."

During the game development process, the things that teacher candidates enjoyed were categorized as group work, game determination stage, and design stage. Working in harmony within groups, collective decision-making and exchanging ideas, and increasing intimacy with friends were determined as the things they liked the most. The statements evaluated in this context are as follows:

"The place I enjoyed about the game design process was my research on the specification of the materials and presenting my findings to my group friends. Besides, what I liked the most is that the developing friendships in the group were new, and the teammates supported each other in communication."

"Although the work of preparing the materials and the game seemed challenging, it enabled us to act as a team, and I understood the value of the saying that two heads are better than one. Once the thrill of designing a new game was added to it, happiness hormones were released. "

Working with the group	Making decisions together
	Working in harmony
	Exchanging ideas
	Increased sincerity with friends
The stage of determining the game	Conducting research
	Associating with mathematics
	Determining the rules
	Writing the questions
Game design phase	Preparing the material
	Painting, cutting, folding, gluing
	Being able to design digital games
	Producing a new game
	Playing

Table 13. Students' opinions about the points they enjoyed during the game development process

During determining the game phase, the most enjoyable points for the teacher candidates were determined as doing research, associating with mathematics, determining the rules, and writing the questions. The statements of the teacher candidates in this regard are as follows:

"Following the preparation of the game, the best part was determining the rules. Because we usually play a game with certain rules. This time, we were the ones who made the rules. I enjoyed determining the rules of the game and them being unique to us."

"It was very fun to prepare questions, arrange cards, and define the rules of the game by discussing with friends. My favorite part was to associate the game with the mathematics lesson after determining the game."

During the game design phase, the most enjoyed things were found as preparing the material, painting, cutting, folding, pasting, being able to design a digital game, producing a new game, and playing. The student responses evaluated in this context are as follows:

"After designing the game, I enjoyed handling cardboards in the process of designing materials. Preparing colorful materials was fun."

"The part I liked doing during the game design process was to be able to design Scratch Fish Snatching game. It was a very fun and enjoyable process." "During the game design process, I liked the point when we prepared materials with our group friends using objects such as cardboard, scissors, or glue. After preparing the game, I also liked that we presented and played it in the class."

The points that the students did not like about the game development process were categorized as the preparation for the game stage and the game preparation stage. Regarding the preparation for the game stage, they stated that they did not like being affiliated with the group and determining the game. The students expressed this situation as follows:

"Thinking about what the game will be during the design process has put me under a lot of stress. In other words, the process of deciding what the game would be was the most troubling part for me."

"There was no part that I did not enjoy except that I could not make completely autonomous and original decisions, since the task was accomplished with the group."

Table 14. Stud	ents' opinions	about the points	they did not li	ke during the gam	e development process
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Preparation for the game stage	Being bound by the group
	Determining the game
Preparing the game stage	Editing document
	Preparing question
	Working with the computer
	Not enjoying drawing and cutting

The things they disliked about the game preparation phase were expressed as document editing, question preparation, working with the computer, and not liking drawing and cutting. The evaluated responses in this context are as the following:

"What I did not like about the game design process was that I could not perform my duties on time due to the lack of important materials such as computers and thus my participation remained weak."

"What I did not like doing was to write questions with similar answers (such as 4a, 4x). To ensure competition, we had to choose questions that students could answer incorrectly."

*"What I didn't like doing during the game design process was to fill out forms. Because it was a long and difficult process."* 

# **Discussion Conclusion and Recommendations**

Learning mathematics is one of the most difficult lessons for many children due to its difficult and abstract nature. Thanks to educational games, mathematics learning and attitudes are positively affected by minimizing these difficulties (Afari, Aldridge & Fraser, 2012). Educational game is understood as a student and teacher activity that pursues certain instructional goals. In this process, students usually engage in such activities as the motivation and joy of playing the game, competitiveness, the opportunity to work as a team, and self-actualization. Therefore, they do not become aware of learning goals. The educational game also has rules that regulate student activities and help achieve the game's educational goals. Thanks to an educational game, students enjoy having accomplished an activity with high participation, motivation, and fun(Vankúš, 2008). The games can be used as an icebreaker to create a positive and enthusiastic atmosphere. It is also used to introduce new concepts and reinforce ideas (Orim & Ekwueme, 2011). Students learn mathematics for outcomes such as enjoyment or encouraging cooperation and discussion, besides achieving the specified mathematical goals. These mathematical goals were determined as acquiring and developing new concepts, applying and reinforcing skills, and developing a problem-solving strategy (Ernest, 1986). Within this study's scope, the aim to improve the processing skills of secondary school students and consolidate their knowledge through games developed by teacher candidates. In addition, determining preparedness, eliminating misconceptions, and usage of the game in lesson evaluation are among other purposes. Baran Kaya and Gökçek (2021) stated that the games developed by teacher candidates were for reinforcement purposes, and only one game was for teaching the subject.

While the developed games are mostly in the areas of learning numbers and operations and algebra, only 1 game is in the area of learning geometry and measurement. Along with this, no game was developed in the areas of data processing and probability. Mathematics, which is generally described as unpopular, is one of the subjects that students fail the most due to its abstract and unrelated nature. Among mathematics topics, the learning areas with which the students say to have the most difficulty with are numbers and algebra (Baki & Kutluca, 2009). Therefore, this may be the reason why teacher candidates also turn to numbers and algebra and develop more games in these learning areas. In the field of numbers and operations, games on natural numbers, operations with natural numbers, fractions, operations with fractions, exponential expressions, square root expressions, multipliers and multiples sublearning areas have been developed. In algebra learning, algebraic expressions, equality and equations, and linear equations were central while the only game in geometry was developed on polygons. Ates and Bozkurt (2021) determined in their study that primary school teachers mostly need to teach with games about four operations and fractions in mathematics. Additionally, they expressed that they need teaching with games in the topics on measurement. Similarly, Baran Kaya and Gökçek (2021) stated that while the games developed by teacher candidates in mathematics were mostly in the fields of numbers and operations learning, they also developed games in the fields of geometry and measurement, algebra and data processing, but no games in probabilities. No additional game about data processing has been developed in this study. Although probability, permutation, and combination are very critical in mathematics and in daily life, they are among the subjects that students have the most difficulty in understanding. Therefore, it is possible for students to learn these concepts, which they have difficulty in learning, by making them more fun thanks to the game (Celikler, Demir Kaçan&Yenikalaycı, 2021; Gün, Işık & Şahin, 2021).

From this perspective, that teacher candidates do not think about developing games in this learning area is an interesting result.

The physical games developed within the scope of this study were determined as card game, racetrack game, material supported game, and board game. When the game types are evaluated, it is seen that some of the games are composed of stages. Games and activities are expressed as special educational structures in which diverse teaching methods, techniques, and tools can be applied in various combinations. Knowledge of different game types and properties can be beneficial for teachers in mathematics teaching planning, game development and application (Demir, 2016). The types of educational games that can be used in the lessons can be categorized as card games, racetrack games, material-supported games, and board games. Which game type is more effective in maths classes varies depending on the purpose of using the game (Lee, 1996). Additionally, the class level to be taught with the game and the characteristics of the students are also important in determining the game. The important thing is that these games are presented to students according to the purpose of teaching. It is stated that the educational games used in teaching should be determined according to the objectives and should be prepared with concrete materials by addressing the students' age groups (Usta et al., 2017). Baran Kaya and Gökcek (2021) stated that the majority of teacher candidates in mathematics preferred using board/card games in their lessons. Some of them have preferred to adapt well-known board/card games for the mathematics lesson. On the other hand, some of the developed games are original. Within the scope of this study, while most of the games developed by teacher candidates in mathematics are original games, some are adaptations.

With the contemporary developments in mathematics teaching, integration of technology into mathematics teaching increases day by day. The rapid development of technology also elicits new opportunities for meaningful and permanent teaching in mathematics (MEB, 2018). Computer use in teaching mathematics enables students to acquire high-level mathematical skills and allows them to create their own knowledge (Cengiz, 2017). Educational math games in which computers are deployed are reported to have positive effect on students' achievement, motivation, and attitudes (Korkmaz, 2018; Uğurel & Moralı, 2008). In this context, it is remarked that educational computer games, in addition to being motivating and entertaining, can be used as a complementary and supplementary activity (Çankaya & Karamete, 2008). Within this study's scope, only one of the games developed by the candidate mathematics teachers is determined as a digital game, while the others are considered as physical games. This situation is interesting. Because the computer games started to supersede the traditional to digital in games as well (Taylan, Kara & Durğun, 2017) However, that only one group developed a digital game can be explained by the fact that teacher candidates do not have sufficient knowledge to design a computer game. Sarıgöz (2019) determined that teacher

candidates avoided playing digital games, hesitated. They also feared that if they face with a problem when using digital games, they would not solve it. A similar condition is seen in the study by Baran Kaya and Gökçek (2021), and the candidate teachers' lack of computer knowledge is given as the reason.

We see that education and competition have been employed together since the past. Some researchers believe that competition should be included in education for students to get accustomed to it for their later lives. The aim of these competitions is for students to compete successfully without appearing to be competing (Verhoeff, 1997). This situation can be provided through games. Hence, it can be seen that the types of feedback preferred by teacher candidates in the games they developed are progress/no progress, gaining/losing points, elimination/level up, reward/penalty, winning joker/losing lives, and increasing /decreasing the card in the player's hand. The aim with these types of feedback is that the students succeed in a given task and get ahead of their competitors. However, in order to prevent the negative feelings and tension that this competitive environment will create on children, measures should be produced and the teacher should manage the process (Tural, 2005). From this perspective, it should be secured that students focus on the game rather than focusing merely on winning or losing. Therefore, mathematical games are meaningful learning tasks in which the aim is to achieve certain mechanics and dynamics that require contending with a task or an opponent. It was determined in Özkan's (2018) study that the objectives of the games developed was to accomplish the tasks, and the obstacle of that game was various elements such as playing individually or as a team, playing against time, non-player characters, and levels in increasing difficulty. The goal of the games developed in this study can be explained as giving the right answer, being the first to reach a target, modeling, matching, or passing the stages in some other games. Additionally, players in these games will compete against time, an opponent, tasks that become more difficult, the obstacle of playing individually or in groups. It is seen that these games are played as a team, with the whole class as a team, and individually. Similarly, Baran Kaya and Gökçek (2021) stated that the games developed by the teacher candidates were designed as games for the whole class, for a few people, or for a single person.

Working as a group and division of labor during the game development process made the teacher candidates' work easier. When working as a group, individuals support each other because they feel that they are on the same side. This enables the development of the skills of being a part of a group, which is a function of social skills (Johnson & Johnson, 1999). Emotional and social development of children should be supported as well as their relationships with others (Aksoy, 2020). In this study, too, teacher candidates stated that the solidarity of the group members and division of labor in a way that respects different ideas facilitated the game development process. Working as a group and sharing responsibilities were also determined as conditions that teacher candidates liked

most about the game development process. About the design process, they remarked that receiving expert guidance when needed and being inspired by similar games facilitated the process.

The success of teaching maths is primarily dependent on the student's active participation. Children learn mathematics by practice and forming mathematical concepts and skills themselves. Therefore, the child has to be active during the process of knowledge-formation. Similarly, the child is physically and mentally active as she plays a game. Therefore, games encourage children's active participation, make them open to learning, and increase their motivation (Ernest, 1986). When involved in an entertaining situation, the child learns the logical structure of the game while at the same time assimilating the existing mathematical structure (Campos & Moreira, 2016). It is also stated that the attitudes of the students towards the lesson improve as the use of games in the learning environment increases the motivation. Considering that attitudes activate the mental activities essential for learning, educational games also help develop attitudes towards mathematics and its teaching (Vankúš, 2008). Therefore, games add variety to the standard mathematics curriculum by bringing a different approach to teaching the subject (Ernest, 1986). Therefore, teachers should try to include games in their mathematics lessons (Lee, 1996). Opinions of the teacher candidates about the game development process were categorized as factors that make the process difficult or easier and things that are enjoyed or disliked in the process. Prospective teachers stated that they had difficulty in developing original and instructive games in which the whole class would participate, that must be fun, and that are suitable for all levels. At the same time, they had difficulty in developing a game that is up to standards, that the game is in accordance with ethical values, that the chance factor is low, that it must be popularize mathematics and include. Onen, Demir, and Sahin (2012) also stated that teacher candidates in sciences should use games in the learning environment as they make the lesson fun and contribute to the subject's learning. However, regarding the game development process, they also stated that they had difficulty in preparing questions suitable for the grade level. Similarly, Usta et al. (2017) also found in their study that teacher candidates thought that using games in mathematics lessons was necessary and beneficial, that the fear of mathematics could be reduced in a fun learning environment, thus making mathematics more concrete and comprehensible. However, teacher candidates expressed that they had difficulty in preparing games suitable for the subject and grade level. The game that will be used in the learning environment should be suitable for the age, interests, and abilities of the students. This game should have content that matches the educational learning outcomes. Only a game with these properties can actually lead to more effective teaching and the elimination of some learning barriers (Tüzün et al., 2006; Vankúš, 2005). The difficulties in the game preparation phase are deciding on the game, designing the game, determining the rules, working with the game material and determining the questions. Similar challenges are remarked in other studies as well (Seckin Kapucu & Çağlak, 2018; Usta et al., 2017). These challenges experienced by the teacher candidates can be explained by their lack of experience in game development. Therefore, support can

be provided to the environments where teacher candidates can practice educational game development.

Teacher candidates stated that they enjoyed producing mathematical games in which they determined the rules themselves while designing the game. Producing a new game is a situation about which teacher candidates are happy both in this study and in the study of Özkan (2018). During the game preparation stage, producing a new game by dealing with the material is a situation that some students enjoyed and some students disliked. In addition, preparing the design key about the game they developed and a lesson plan were determined as the points they did not like. A similar result was concluded in Özkan's study (2018). In this study, teacher candidates stated that writing the details and preparing a lesson plan while designing the game was a waste of time. As technology has recently been taking a large space in our lives, the work of writing has been replaced by such devices as computers or smartphones. For this reason, in Özkan (2018), teacher candidates proposed to digitize the documents and prepare the documents about the game with the aid of computers and phones.

In this study, teacher candidates in mathematics designed educational games using the game design key. This study revealed that the key developed by Özkan (2018) is suitable for developing a mathematical game. Similar game design processes can be carried out for different courses with the help of this key. In addition, the developed games can be applied to the target audience and improvements can be made in the game. Thus, these games can be created as resources that teachers, who are the practitioners of the course, can benefit from. Mathematics teaching can be enriched by applying to the students the games developed within the scope of the study. It was observed that only one of the developed games was digital. Considering that its reason may be the teacher candidates' lacking computer use, it can be recommended to increase the knowledge and experience of teacher candidates in using computers during their undergraduate courses.

#### **Policy Implications**

When games are carefully selected on the basis of instructional objectives and incorporated into the curriculum, they enhance teaching and learning. The use of didactic games during the teaching of mathematics supports the motivation and performance of the students during the lesson. For this reason, educational games should be preferred in mathematics classes as an alternative teaching method. When mathematics is traditionally taught with an understanding that is far from reasoning, a meaningful understanding does not occur for students. It is also known that traditional teaching methods develop anxiety and fear towards mathematics in students. Therefore, teaching with traditional methods does not meet the expectations and needs of the education system today. In order to meet these expectations, studies are carried out on the restructuring of learning environments. In the educational environment, children should be encouraged to learn by having fun and such activities should be offered. Mathematics and its teaching should be designed as fun. For this reason, it is important to include educational games in learning environments. This situation shows itself in the education policy of most countries. From this point of view, it can be suggested that the program makers make arrangements in the teaching environment by taking into account the "ice breaker" effect of the games. Because, studies show that teachers and teacher candidates also think that using games in teaching environments contributes to students. In their undergraduate education, prospective mathematics teachers take the course of Teaching Mathematics with Games. This course should also be offered to prospective teachers studying in other departments. Thus, pre-service teachers are informed and experienced about teaching with games as an alternative teaching method.

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# Is Self-Criticism Really a Trigger of Psychological Problems? An Analysis of Self-Criticism in the Context of Turkish University Students

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#### Abstract

This study aims to examine the concept of self-criticism in the context of Western and Eastern cultures and to examine graduate students' perceptions regarding this concept. When reviewing the Western literature, researchers have generally associated the idea of self-criticism with psychopathology, while researchers in Eastern cultures typically interpret the notion of self-criticism positively. This qualitative study consists of three stages and uses open-ended questions to measure the perceptions of students from different graduate programs with regard to self-criticism. The researcher asked the students about their perceptions toward self-criticism in the first stage, questions about the concepts they'd associated with self-criticism in the second stage, and questions involving metaphors about what students liken to self-criticism in the third stage. Within the scope of the research, the researcher accessed 41 students for the first stage, 52 students for the second stage, and 32 students for the third stage. In all three studies conducted within the scope of this research, it was concluded that self-criticism is not perceived negatively in Turkish culture but rather evaluated as positive. Although there have been a few negative themes, self-criticism is generally perceived as a concept that brings people well. The most crucial aspect that makes this research valuable is that it provides a critical perspective on the pairing of self-criticism with psychological problems in the psychology literature. It is understood that self-criticism is seen as an essential source of individual development in Turkish culture rather than being the source of psychological problems. When the psychology literature is examined, it is seen that self-criticism is generally considered the trigger of psychological problems. Self-criticism is regarded as a situation that harms self-esteem. However, in eastern cultures, self-criticism is accepted as a prerequisite for a healthy identity. In this study, this conclusion was reached in three stages.

Keywords: Self-Criticism, Interview, Metaphor, Qualitative Research, Experience

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#### Introduction

Churchill said the following about self-criticism, "Criticism may not be agreeable, but it is necessary. It fulfills the same function as pain in the human body. It calls attention to an unhealthy state of things." The main thing that is meant by self-criticism as a word is that criticizing oneself disturbs people at some point, but this disturbance also indicates a problem that other people have. The Turkish Language Association (TDK, 2020) defines self-criticism as "the judgment one makes about one's own behavior." In a way, self-criticism is a search for the reasons behind the negative situations a person experiences in the face of daily events. It can also be expressed as the ability a person has to judge themself, to take on the problems they encounter without blaming others, and to direct the necessary criticisms regarding these problems. Undoubtedly, seeing one's own mistakes and learning from them is a positive critical situation for human maturity. However, when considering the limits of self-criticism under three categories will facilitate how to understand and use self-criticism, and the third is constructive self-criticism. These three categories also constitute the primary purpose of the study.

#### The Three Dimensions of Self-Criticism

Although self-criticism is a prevalent concept, defining and understanding it correctly are imperative because defining a concept accurately allows every relevant segment to be handled and analyzed correctly. In this context, the correct approach would be to consider the idea of self-criticism in three ways and to explain all three points in detail, because examining and analyzing only one aspect of self-criticism makes seeing its other dimensions impossible. As a result, Figure 1 shows the different consequences each of the three dimensions of self-criticism has.



Figure 1. The dimensions of self-criticism. (Okan, 2021).

As a result, how the concept of self-criticism is handled in the literature needs to be examined in these three contexts.

#### Excessive Self-Criticism (Psychopathology)

A person who can learn from their mistakes through self-criticism undoubtedly reveals their maturity and is a critical condition. However, sometimes people can blame themselves excessively even when they are not at fault. The literature has shown that certain psychopathological conditions may occur as a result of this. Thompson and Zuroff (2004) revealed self-criticism to give rise to psychopathology, expressing self-criticism as one having hard-to-achieve expectations while simultaneously constantly feeling the fear of not being approved by others. Put more clearly, selfcriticism that leads to pathology involves a situation where individuals themselves are overburdened and have unrealistic expectations that are difficult or impossible to achieve. Doğan and Sapmaz (2013) found individuals with high levels of self-criticism to have high personal standards, to overvalue themselves, and as a result to excessively focus on themselves. As a result, they experience extreme stress. Excessive self-criticism, a feeling of loss, and worthlessness may form alongside the failures that accompany the stress (Bergner, 1995; Blatt, 2004). Likewise, Blatt (2004) stated the main reasons behind why individuals who criticize themselves excessively are in this situation as: having parents who inhibit and control their children, restrict them from moving freely, and reject them. They stated that this situation prevents the formation of self-perception in these individuals. Some researchers have also discussed this situation with regard to early childhood experiences (Blatt, 1974; Blatt & Homann, 1992). Namely, the feeling of exclusion, excessive pressure, and worthlessness an individual is exposed to in early childhood may cause that person to blame themself at a high level and therefore fall into pathological situations by placing excessive burdens on their self-acceptance. Blatt (1974) touched upon two fundamental problems in individuals with autonomy problems, stating the first to be dependence and the second to be self-criticism. Mendelson et al. (2002) emphasized that individuals who have experienced negative experiences in their childhood have excessive selfcriticism in their attempts to become autonomous, and this situation causes extreme pressure on the self. Murphy and Bates (1997) conceptualized the attempts individuals in this situation make to become self-reliant as occurring in two ways: excessive self-criticism and attempts to be overly independent, both of which hurt the self, due to the extreme effort required. Cantazaro (2007) stated excessive self-criticism and perfectionism to make the individual vulnerable to depression. Hence, the differences between constructive self-criticism and excessive self-criticism essentially reflect two sides of the same coin.

Some empirical studies have shown anxiety to play a vital role in how individuals with excessive self-criticism tendencies use their daily energy. In a survey conducted with volunteers, Mongrain and Zuroff (1995) found excessive self-criticism to be related to self-preservation.

Likewise, overly self-critical people were observed to report more goal-setting anxiety with regard to achievement. This finding supports people's excessive self-criticism being an excessive reflection of the attempt to become autonomous. Just as with depression and anxiety, Bowbly's (1969, 1973, 1980) attachment theory essentially provides a theoretical framework for addiction and excessive self-criticism. As mentioned before, individuals with problematic attachment orientation have been stated to possess different internal working models regarding themselves and others. Notably, individuals with attachment anxiety tend to feel unworthy of attention and have a negative model of internal functioning. This situation paves the way for an individual's fear of abandonment and dependent behaviors. Therefore, an individual's attachment anxiety will contribute to nurturing an overly self-critical personality style, as identified by Blatt (1974). Murphy and Bates (1997) as well as Zuroff and Fitzpatrick (1995) also stated a positive and moderate relationship among attachment anxiety, addiction, and self-criticism. In a sense, excessive self-criticism appears to be directly related to attachment anxiety. Yamaguchi and Kim (2013) stated excessive self-criticism to be a concept that has attracted the attention of some researchers because it leaves adolescents and adults vulnerable to depression and psychological disorders.

### Lack of Self-Criticism

The situation opposite excessive self-criticism involves individuals who apply no selfcriticism but instead blames others for adverse conditions. Çam and Akgün (2007) made a classification for this by considering the accusation in two ways: self-blame and blame of others. They stated that by condemning others, a person tries to avoid taking responsibility by putting it on someone else. When one blames themself, they create excessive self-criticism by taking all responsibility. A person who blames others results in conflicts, and a person who blames themself prevents disputes. However, this will also cause the person to experience internal conflicts. Excessive self-criticism has been stated above to lead to psychopathologies. However, if a person constantly criticizes others or blames others without criticizing themself, this is not a conscious or voluntary situation. It is instead generally viewed as hiding, suppressing, reflecting, or manifesting emotional reactions subconsciously. Therefore, the person is often unaware of their responses, cannot determine their reactions, and has difficulty expressing themself properly (Çam & Akgün, 2007). Or instead of self-criticizing, one tries to justify themself by directing the criticisms they should direct to themselves to others.

In some cases, criticizing or blaming others may be overt; sometimes a person seeks to make others feel guilty by exploiting emotions. Bertram et al. (2011) stated a moral side to blaming others without criticizing them. In this case, they emphasized that individuals who want to cover up their problems by blaming others should focus on their cognitive structures first. Based on this case, Bertram et al. (2011) developed a mental model to determine the underlying reasons why people

blame others without self-criticizing. According to this model, individuals generally use blame more to avoid situations that hurt them.

Meanwhile, Lozano and Laurent (2019) stated that people blame others rather than selfcriticize. People are seen to prefer to blame others in order to save their damaged image (Fein et al., 2003; Greenberg & Pyszczynsk, 1985) and to appear stronger in the environment (Synder, 1987). Individuals who have not developed the skill of constructive self-criticism in particular are observed to exhibit behaviors such as criticizing others to avoid negative social evaluations (Leary, 2007). For this reason, such individuals blame others in order to protect themselves and divert attention (Peterson & Baret, 1987). The main reason for this is that these individuals lack the courage to face themself. Individuals who were constantly blamed in their childhood are more likely to show such tendencies. Lozano and Laurent (2019) found several reasons to underly an individual's tendency to blame others rather than admit their mistakes. They expressed these as exclusion and learning in social settings. Likewise, individuals who do not self-criticize but instead blame others noteworthily say that doing what others do regularly would be wrong if they did it. This situation can be interpreted as the manifestation of a moral contradiction and inconsistency. Therefore, talking about a constructive self and personality structure in situations of excessive self-criticism or of no self-criticism is incorrect, because in one case, the person invites psychopathological situations by placing extreme burdens on themself, while in the other case, they prefer to blame others by redirecting the self-criticism they should place on themself. Both situations negatively affect the individual's psychological health and formation of a healthy ego structure and cause the individual to misrepresent themself.

# Constructive Self-Criticism (Self-Knowledge)

Constructive self-criticism is undoubtedly an indication of a very healthy maturity and high virtue, unlike cases where people self-criticize to much or not at all. At some point, the most important thing that stands out is awareness of one's reactions, recognizing and trying to correct one's mistakes, self-criticizing without blaming others, and, more importantly, knowing oneself. The person who knows others and themself is both aware of the events occurring in the external world as well as those taking place in the inner world. When examining the literature on psychology, a negative perception is generally seen to exist regarding self-criticism, and studies have been conducted to reduce the effects of this negative perception.

Scientists with a cognitive and analytical perspective have argued individuals to exhibit symptoms of depression due to a perceived threat to the self as a result of excessive self-criticism (Beck, 1983; Blatt & Zuroff, 1992). The common point of these studies is that people with depression exert excessive self-criticism; at the same time, excessive self-criticism is also an essential factor in the development and emergence of depression (Campos et al., 2010; Lerman et al., 2012; Ehret et al.,

2015; Joeng & Turner, 2015). The dominant viewpoint in Western studies in particular being toward the psychopathological consequences of self-criticism has already been stated. However, Seligman and Csikszentmihalyi (2000), the theorists of positive psychology, conducted studies to alleviate the harmful effects of self-criticism on depression. They presented the positive contributions both healthy family support and support related to self-esteem have in reducing a person's symptoms of depression (Abela et al., 2012). However, another concept that positive psychology has presented as an important factor against excessive self-criticism is self-compassion (Terry, Leary, & Mehta, 2013). Self-compassion has been argued to effectively reduces symptoms in individuals with depression (Baer et al., 2012). Self-compassion and compassion are essential in establishing a positive relationship with oneself emotionally, being sincere with oneself, and accepting oneself without being judgmental (Zhang et al., 2013). Concepts and suggestions about self-compassion are seen to have occurred in many studies. Neff (2003) stated a person who forms their own self-wellbeing to be able develop love and empathy toward themself and therefore be gentler toward themself.

#### **Present Study**

Whether expressed with regard to self-compassion, self-wellbeing, or other ways, researchers are seen to be looking for a more positive foundation for self-criticism. The concepts of empathy, awareness, compassion, and self-knowledge are seen to be used in particular with self-criticism. Suppose every individual self-criticism is considered harmful. In this case, people will not be able to develop self-awareness, self-recognition, become aware of their shortcomings, or learn from their mistakes and move toward something better. Therefore, modeling constructive concepts will allow one to see the positive points of self-criticism more clearly and thus enable these positive points to be correctly positioned in social and academic life as well as in the context of psychology. Determining the position of self-criticism and gaining new information about it are imperative. Therefore, the primary purpose of this study is to determine how self-criticism is perceived in Turkish culture, because such a study will also provide an opportunity for comparing with studies that have been conducted so far.

#### Method

#### Stage 1

The first stage of the study examines and identifies the perceptions and experiences regarding self-criticism for individuals studying at the postgraduate level. In this context, these graduate students have been asked semi-structured questions based on their experiences with self-criticism.
## Model

This stage of the research involves a qualitative study conducted to reveal the perceptions and experiences graduate students have regarding self-criticism. Due to the survey asking about graduate students' experiences, this part of the study was designed using the phenomenological study design. Özet (2014) stated phenomenological studies to examine different people's experiences about the same phenomenon. Likewise, Creswell (2007) expressed the aim of phenomenological studies to be to reveal the ordinary experiences different people have with regard to a phenomenon.

#### **Participants**

Students studying at the postgraduate level in different universities of Istanbul represent the universe of this research. From this universe, 41 students studying at the postgraduate level have been reached. The attempt was made to call students from different departments as much as possible, and interviews were conducted with the students on a voluntary basis. Before the interviews, the students were informed that the study was about self-criticism, and care was taken to select students who had something to say about this subject. The purposeful sampling method has been used in this case. Patton (2014) allowed situations to be selected that are rich in the required information. Therefore, graduate students have been preferred as they are thought to have good knowledge about self-criticism. Within the scope of the research, data were collected from a total of 41 participants (25 females, 16 males). Of the participants, 32 are at the master's level, and nine are at the doctorate level. Their age range between 24 and 40.

# **Data Collection Tool**

Semi-structured open-ended questions developed by the researcher were used as data collection tools in the scope of the research. At the same time, a demographic information form was also added by the researcher and used. Each participant was asked five questions to reveal their experiences with self-criticism.

#### Data Analysis

The data obtained from the research were audio recorded. Next, the audio files were converted to text. The transcribed files were subjected to content analysis with the help of the package program Maxqda 20, and the main themes and sub-themes were formed.

#### **Stage 1 Findings**

The themes and sub-themes related to the concept of self-criticism as a result of the interviews are shown in Figure 2.



Figure 2. Self-criticism and its sub-themes after the interviews.

According to these results, the participants mainly emphasized the positive and constructive aspects of self-criticism. However, some participants rarely emphasized the negative aspects of self-criticism. As seen in Figure 2, the themes of self-anger and self-punishment were obtained in this context. When looking at the positive themes, these are seen to be self-acceptance, self-awareness, self-knowledge, and self-reasoning. Some of the expressions the participants used while obtaining these themes are as follows:

- Self-criticism skills may also be a prerequisite for self-knowledge/self-actualization. (P1)
- Self-recognition means identifying the things within oneself, thinking these are incomplete and wrong, and acting toward improving them. (P3)
- Self-criticism reminds me of self-knowing. Unless a person knows oneself, they cannot even self-criticize. (P7)
- When I self-criticize, I can see my shortcomings and the aspects I need to constructively correct. (P9)
- For example, I know my shortcomings and limitations when I self-criticize in addition to what I can do. (P11)

- In my opinion, self-criticism is the ability of an individual to judge their behaviors and thoughts. (P12)
- Self-criticism means evaluating oneself with an external eye. For example, I look at what I do with an external eye when I go through hard times and can distinguish between right and wrong. (P13)
- Self-criticism involves positive and negative self-evaluations. It should be positive because one should know the good aspects and appreciate them and see the harmful aspects and repair the situations they cause. (P17)
- Self-criticism means being able to act in terms of one's capacities and being aware of one's shortcomings and abilities. (P19)
- Self-criticism means awareness of one's right and wrongs, deficiencies, and excesses. (P22)
- I think self-criticism means being aware of our mistakes and deficiencies and acting honestly with ourselves. (P23)
- I believe self-criticism is one of the most extraordinary good things one can do for oneself. Sometimes even those closest to us do not tell us the truth. (P27)
- Self-criticism is the ability to evaluate what the self does with high awareness. (P33)
- While self-criticism may be positive, it is something I always do negatively where I punish myself. (P39)

# Stage 1 Conclusion and Discussion

Themes were formed as a result of the phenomenological interviews about how university students perceive the concept of self-criticism. The obtained themes reveal that some inferences need to be made psychologically. The study data show self-criticism to consist of six themes. While four of these themes are positive concepts, two consist of negative ideas. The following positive themes have been arrived at: self-acceptance, self-awareness, self-judgment, and self-knowledge. The negative themes are self-anger and self-punishment. Although negative themes did form, most of the participants were observed to generally associate self-criticism with positive concepts. For selfcriticism in particular, sub-themes were obtained that involve important skills such as seeing one's deficiencies, making constructive evaluation, and correcting one's deficiencies. Meanwhile, some researchers who are particularly interested in the psychopathological dimension of self-criticism (Bowbly, 1969, 1973, 1980; Blatt & Homann, 1992; Bergner, 1995; Murphy & Bates, 1997; Thompson & Zuroff, 2004; Blatt, 2004; Cantazaro, 2007; Yamaguchi & Kim, 2013) have found university students to generally consider self-criticism as a positive concept. Therefore, researchers who constantly focus on the negative aspects of self-criticism should also focus on the positive aspects. Of course, looking at the results obtained from the interviews, some negative aspects of selfcriticism were also seen to have been emphasized. However, this should not bring self-criticism to an

utterly negative point. On the contrary, knowing that too much of anything can be harmful, excessive self-criticism can also be said to includes various adverse situations.

# Stage 2

Stage 2 of this study asked graduate students to say the first five concepts that come to mind regarding self-criticism. This study aims to compare their responses with the data obtained from the first stage in order to place the idea of self-criticism on a more solid foundation. The students were limited to five answers in this context. However, they were free to say whatever they wished within these five answers.

# Model

The model for this stage of the research has been determined as the scanning model. This stage attempts to conceptualize graduate students' thoughts regarding the concept of self-criticism.

## **Participants**

The universe of the second study is again graduate students. Because collecting data from postgraduate students was thought to be more appropriate for making a better comparison of the data obtained in the first stage, an online question was prepared for the second stage, and the graduate students were asked to write the first five concepts that come to mind in terms of self-criticism. This stage uses simple random sampling as the sampling method as the students who'd filled out the questionnaire are accessed at random. Within the scope of this stage of the research, a total of 52 students were accessed (36 females, 16 males).

# **Data Collection Tool**

The following question was asked along with the questions containing demographic information as a data collection tool, "What are the top five concepts that come to mind in terms of self-criticism?"

## Data Analysis

The data obtained from the graduate students were first entered into a word file for processability. Next, this file was transferred to Maxqda 20. In vivo coding was done first here. Afterward, the concepts were gathered under various themes and the final pieces obtained.



*Figure 3.* Self-criticism and its sub-themes according to the conceptual answers.

This stage of the study was conducted to determine the concepts related to self-criticism. Figure shows the names of the discovered themes. According to the answers given, themes such as self-acceptance, awareness, empathy, will, reasoning, and self-acceptance emerged.

When examining Figure 3, some of the obtained themes are seen to have sub-themes. Accordingly, the sub-themes for the theme of self-awareness are foresight, clairvoyance, and learn lessons from mistakes. The subthemes for the theme of self-acceptance are authenticity, self-esteem, and honesty. The subthemes for the theme of self-reasoning are self-reckoning, self-judgment, self-assessment, conscience, self-regulation, and self-assessment. The subthemes for the theme of self-knowledge are seeing what's lacking, fixing deficiencies, self-interpretation, resilience, identity, and self-confidence.

#### Stage 2 Conclusion and Discussion

The second stage of the study was conducted to determine which concepts self-criticism is related to in the minds of university students and obtained some results. Students were asked to write the first five concepts that come to mind in terms of self-criticism. When categorizing the given answers, the responses are seen to be grouped under six different themes: self-awareness, selfacceptance, empathy, self-knowledge, self-reasoning, and willpower. Various sub-themes related to these were also reached at the same time. When examining both themes and sub-themes, no student was seen to express any negative concepts among the first five concepts that come to mind in terms of self-criticism. All students only had positive ideas come to mind regarding self-criticism. Therefore, this result shows a similar effect as that in the first stage. It also presents data that contrasts with the findings of researchers who've dealt with self-criticism only from a psychopathological perspective (Bowbly, 1969, 1973, 1980; Blatt & Homann, 1992; Zuroff, 2004; Blatt, 2004). This situation indicates that self-criticism should be viewed from different perspectives.

## Stage 3

The third stage of the study is a metaphor study with graduate students that aims to reveal the metaphors students associate with self-criticism and the characteristics from which these result. As in the second stage, this stage seeks to compare the results obtained from phenomenological interviews in order to obtain the most accurate data and results regarding self-criticism.

# Model

This stage is a metaphor study. Rich findings are obtained about concepts through metaphors, which count as qualitative data collection tools (Patton, 2002; Yıldırım & Şimşek, 2013). Metaphors can be used both as descriptive and comparative tools in understanding social phenomena (Silman & Şimşek, 2006).

## **Participants**

The population of this study is graduate students in Istanbul. With the help of the online data collection tool created within the scope of the research, a total of 32 students (18 females, 14 males) were reached. Due to random participation being provided in this study, simple random sampling has again been the sampling method.

## **Data Collection Tool**

The following fill-in-the-blank statement was used to reveal metaphors about self-criticism and was prepared online as a data collection tool:

## • ..... resembles self-criticism because .....

In addition to this statement, a form regarding various demographic information was also included.

#### Data Analysis

Content analysis was performed on the data obtained within the scope of this stage. The primary purpose here is to arrive at themes based on the obtained data (Yıldırım & Şimşek, 2013).

Accordingly, the responses acquired from the students were grouped under similar metaphors. Both the creatures to be likened to and why they were associated with have been divided into separate categories. Likewise, some students' metaphors have been provided in quotations. Accordingly, the participant responses have been identified under four categories: 1) Coding data, 2) Finding themes, 3) Organizing the data according to codes and pieces, and 4) Interpreting the findings (Ekiz, 2009; Yıldırım & Şimşek, 2013).

# **Stage 3 Findings**

Figure 4 shows the tabulated form of the findings obtained within the scope of this stage of the research. According to this, the themes of self-awareness, empathy, self-acceptance, willpower, self-reasoning, self-knowledge, and difficulty have been obtained.





Table 1 shows the results obtained upon examining what was obtained from the metaphor stage of the study.

Frequency	Resemblance	Feature	
1	Whale	Awareness	
2	Child	Questioning/Self-knowledge	
1	Scorpion	Self-questioning	
3	Dog	Precision Scales/Reasoning	
1	Crow	Intelligence	
1	Hedgehog	Self-acceptance	
2	Sunflower	Self-knowledge/Self-knowledge	
1	Leaf	Turning green Again	
1	Panda	Rarely questions	
3	Lion	Self-acceptance/knowing/ willpower	
4	Cat	Not caring / positive and negative situations / logical	
1	Animals	Withdrawal (Accounting)	
2	Plant	Knowing your limits / Awareness	
1	Lizard	Reform	
1	Rabbit	Awareness	
1	Human	Being tough	
2	Ant	Sure/determined	
1	Mirror	Awareness	
2	That	Be your own	
1	Bamboo tree	Patience, perseverance	
32	Total	-	

**Table 1.** Results regarding metaphors

Some of the answers from this stage's participants are presented below:

- Self-criticism is like a whale because people are not very aware of its size as it doesn't surface often. Everyone would be aware of how big it was if it constantly surfaced.
- Self-criticism is like a 3-5 yr. old child in my opinion because they require questioning and learning with reasons. These children also want to question and find out the reason for everything and take steps accordingly.
- Self-criticism is like a scorpion because it's an animal that can show its venom to itself when necessary.
- Self-criticism is like dogs maybe because dogs show us things we can't see through their sense of smell. Self-criticism is like putting ourselves on a delicate scale and being an honest trader.
- Self-criticism is like a hedgehog because it has thorns as one of its features. They accepted themselves with their thorns and live with them. Although everybody criticizes them for this, that's how it is.
- I guess self-criticism is like a sunflower because if we accept the sun as its self-criticism that provides the inner control of the sunflower; the sunflower changes its direction depending on the movements of the sun and its position; It can be interpreted as changing the behaviors constructively based on one's self-criticism.

- Self-criticism is like a tree leaf because just as leaves fall from time to time, they come back to the tree branches; self-criticism is also necessary from time to time.
- Self-criticism could be like a panda because self-critical people, like the panda, are also going extinct. It decreases daily.
- Self-criticism is like a cat because it is cute and beautiful, often peaceful, but at some moments, some words and behaviors make you so angry that that cat can scratch and leave yourself wounded.
- Self-criticism is like a poppy flower. When the poppy flower begins to grow, it grows from one side and starts to tilt its head slowly, neither too much nor too upright. Self-criticism is such a thing: You are neither too upright nor tilt your head too high; you're fair to yourself.
- Self-criticism is like water, because self-criticism is as important and valuable as water and a great blessing for a person. Of course, for those who know the value of water ...
- I compare it to a bamboo tree because not everyone can easily self-criticize. But if he continues patiently, he can see his shortcomings and reach the highest part of his potential. *Stage 3 Conclusion and Discussion*

# **Summative Assessment**

This study was conducted to reveal how university students perceive self-criticism and formed by combining three different stages; it is seen to have also arrived at some significant results. In particular, self-criticism has often been viewed negatively in psychology literature. However, when looking at the answers the participants gave, self-criticism is seen to mostly be perceived as a positive situation. Due to doing the modeling based on the data obtained being thought to be correct, the results obtained from all three stages are gathered under a single roof in Figure 5.



**Figure 5.** The self-criticism model based on the three stages (S1 = Stage 1, S2 = Stage 2, S3 = Stage 3).

The similar results from all three stages make this study very important. The theme and subthemes obtained from all three stages can be seen by examining Figure 5. Only two sub-themes are seen to occur under the theme of negative effects: self-anger and self-punishment. These negative subthemes occurred only in Stage 1. No negative themes or sub-themes were obtained in Stages 2 or 3. This result shows reflecting on self-criticism, which is often viewed negatively, to be necessary.

Meanwhile, when examining the sub-themes for the theme of the positive effects of selfcriticism, similar results are seen to have been obtained in practically all three stages. The selfawareness theme is one of the common themes in all three studies. Several sub-themes belonging to this theme were arrived at in Stage 2: foresight, clairvoyance, learn lessons from mistakes, and intelligence. Again, three more themes were found to have been obtained from all three stages: self-knowledge, self-acceptance, and self-reasoning. The sub-themes for the theme of self-knowledge are: seeing what's missing, fixing deficiencies, self-interpretation, resilience, and self-confidence. The sub-themes for the theme of self-acceptance are: identity, authenticity, honesty, and self-esteem. Another common theme was the theme of self-reasoning, and its sub-themes have been found as: self-assessment, justness, constructiveness, self-judgment, self-reckoning, self-regulation, and conscience. The theme of empathy is reform. Willpower's subthemes consist of perseverance and patience. The theme of difficulty was only obtained in Stage 3. These results show self-criticism to have gained a more positive place in the minds of university students. Therefore, instead of looking at self-criticism as a negative concept, its positive aspects need to be looked at. In the research conducted by Yaylak (2020) with students, it was concluded that self-criticism is also an important value. In a study on school principals, it was stated that constructive self-criticism is important (Özcan, 2020).

#### Conclusion

This research differs from studies on self-criticism because it deals with self-criticism multidimensionally. As is known, the Western literature on psychology often associates self-criticism with negative psychological experiences. However, when looking at Eastern societies, self-criticism is known to be perceived as a favorable situation rather than a negative one. Therefore, the aim of this research is to reveal how the concept of self-criticism is perceived in Eastern society by combining the data obtained from three different stages. When considering the research results, although a few participants associated self-criticism with negative experiences, most emphasized the constructive aspect of self-criticism. Therefore, this study will contribute to researchers working in psychology in terms of examining constructive self-criticism.

#### **Limitations, Future Research Directions and Policy Implications**

Researchers continue their studies knowing some limitations exist. This study should be noted to have several limitations. It was conducted with accessible students; therefore, it was not conducted directly with people who have psychological problems and who self-critique. This situation may have caused self-criticism to appear different compared to studies describing it psycho-pathologically. However, the primary purpose of this study has been to show that self-criticism is not completely psychopathological. Another limitation is that all three stages were conducted with university students. Different results would have been obtained in this study had self-criticism been studied over a variety of sample groups. Therefore, to verify this study, similar studies with diverse populations and samples are needed. Another limitation is that the researcher also considers self-criticism to not

be a negative situation as it is commonly thought. Therefore, the researcher asked another researcher to analyze the data to eliminate this bias.

This study is thought to be able to be a guide for future studies. In particular, researchers working in psychology should also consider and examine self-criticism from this aspect. Conducting studies that will be handled positively will allow discussing the concept of self-criticism on the proper foundation. Therefore, the door to having researchers look at self-criticism from a new perspective is thought to have been opened through this research. This study is thought to be able to be a guide for future studies. In particular, researchers working in psychology should also consider and examine self-criticism from this aspect. Conducting studies that will be handled positively will allow discussing the concept of self-criticism on the proper foundation. Therefore, the door to having researchers have been opened through this research.

# **Conflict of interest**

No potential conflict of interest was declared by the authors.

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Author 1: Conceptualization and Methodology, Writing- Original draft preparation, Visualization, Investigation, Data Curation, Formal Analysis, Writing – Review & Editing.

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# Teaching the 21st Century Learning Skills with the Critical Thinking Technique Based on the Argumentation Method

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#### Abstract

In today's world, rather than students who memorize information and only perform assigned tasks, education is more oriented towards raising inquisitive individuals with a strong consciousness. Contemporary education, thus, seeks to provide students with the abilities to think critically and analytically, to question or prove with arguments, and to build causal relationships between subjects in order to use the knowledge learned when needed. Taking all these expectations into account, teaching critical thinking skills and techniques based on the argumentation method can help students progress both cognitively and behaviorally. To this end, the goal of this qualitative case study is to provide students with the 21st century learning skills using the critical thinking technique on the basis of argumentation-based learning. The research group comprises of 40 students from Hatay Mustafa Kemal University's Faculty of Education. In the study, a semi-structured interview form was employed to gather data. As a result of the research, two main conclusions were made. Firstly, subjects can be better comprehended through classes that incorporate the use of ideas, views, proof, or evidence. Such classes can be taught in greater depth and without much difficulty. Furthermore, students' speaking and oral abilities, as well as comprehension skills, increase in sessions taught using the argumentation method and critical thinking strategies. Yet, it should be noted that in order to attain these results, lessons should be planned in accordance with the mentioned methods.

Keywords: Argumentation Method, Critical Thinking, The 21st Century Learning Skills, Proving

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#### Introduction

The twenty-first century is a transformational one with a surge in scientific studies in a range of areas, such as economy and professions, sociocultural research, industrial and technical field, and politics, so with this quick development and transmission of knowledge, both individual attributes and the qualities and expectations placed on people change at a rapid pace (Uyar-Çiçek, 2021). In this regard, research shows that the one of the most important competencies of this century is self-development not only in but also outside of school within all domains of learning, which are cognitive, emotional, and psychomotor (Aydın & Tan-Şişman, 2021; Beers, 2011; Cansoy, 2018; Kylonen, 2012).

From their first breath to the last, people utilize the 21st century skills in their whole lives, particularly in their careers after graduating school (Aydın-Ceran, 2021). These skills are predicated on the reality that people have a profession, they develop themselves in that field, and they raise their success in a progressive manner by continuously improving in their career throughout their life.

The primary goal of 21st century life skills is to provide individuals with fundamental skills that have been determined or reported by various institutions and organizations, such as the Partnership for 21<sup>st</sup> Century Skills (P21), the Assessment and Teaching of 21<sup>st</sup> Century Skills (ATCS21), North Central Regional Educational Laboratory (NCREL), National Educational Technology Standards (NETS/ISTE), American Association of Colleges and Universities (AACU), Organization for Economic Cooperation and Development (OECD) and National Research Council NRC (Kalemkuş, 2021). These skills and the organizations that report on them are addressed and explained in detail in the paragraphs that follow.

*Partnership for 21<sup>st</sup> Century Skills (P21):* The P21 is a reference framework for assuring quality in vocational schools that strives to provide students with literacy skills in real-life areas so that they can develop themselves after graduation. The initiative, designed to teach 21st-century life skills, is now being implemented in 21 states throughout the United States and is partnered by 33 institutions (Gelen, 2017). The partnership encapsulates three different categories of skills, which are learning and renewal skills, life and career skills, and information, media, and technology skills (Voogt & Roblin, 2010). Firstly, learning and renewal include all aspects of interaction, cooperation, creative problem-solving, and critical thinking. Secondly, professional qualities including adaptability and resilience, self-management and entrepreneurship, social and intercultural competence, and leadership are included in career and life skills. Lastly, information, media, and technological literacy are recognized as the final classification of skills. The P21 main topics on which the 21st century skills are based were identified language-related subjects, positive and social sciences, and civics (Kylonen, 2012; Partnership for 21st Century Learning, 2007; Trilling & Fadel, 2009). To further elucidate the first two, language-related subjects include reading, language arts, acquiring other

languages, and knowing the English language, whereas the aforementioned sciences include mathematics, economics, geography, and history.

The Assessment and Teaching of the 21<sup>st</sup> Century Skills (ATCS21): Developed by the Assessment and Teaching of the 21st Century Skills group in 2009, the project divides the 21st century skills into four subskills as *ways of thinking, ways of working, tools for working,* and *life on earth.* First, skills labeled as ways of thinking include creativity and innovation, critical thinking, problem solving and decision making along with metacognition or learning to learn, whereas skills described as ways of working include communication and cooperation or teamwork in short (Griffin et al., 2012). Information literacy and information and communication technology (ICT) literacy are tools for work, and life on earth is the last subskill group, which covers citizenship, life and career skills, and personal and social responsibility (Binkley et al., 2010). The ATCS21 initiative, differing slightly from the others, also placed some emphasis on students while assessing the 21st century skills and concentrating on the importance of schools to education. In order for learners to successfully navigate the modern world and the workplace after graduation, the project contends that schools' incentives need to be raised.

North Central Regional Educational Laboratory (NCREL): With the slogan of "no child left behind", the 21st century skills framework was jointly developed by NCREL and Metiri Group in 2003 as a result of two years of meticulous and effective work, which is intended to examine previously published projects and reports, frameworks required or established at national and international levels, and research done in the area of education (NCREL & The Metiri Group, 2003). The skills of the 21st century include a variety of properties, such as literacy in a wide range of fields like digital technology, ideation, critical and creative thinking, problem solving, effective communication, management, and effective use of mass media (NCREL & The Metiri Group, 2003). One of the NCREL skills is digital age literacy, which includes visual, mother tongue, and information literacy, basic mathematics, science, economic, and technological literacy, use of it for communication and learning, global awareness and multicultural literacy, and the ability to understand global events and problems. The capacity to manage complicated thoughts and solve challenges that individuals cannot overcome is referred to as *creative thinking*, which focuses on the goal of adapting and coping with complex events and self-management, to make new productions out of curiosity, creativity and risk taking with the properties of high-level thinking and reasoning. Moreover, individuals' ability to work as a group or as a team, cooperation and interpersonal adaptation skills, learning together, establishing positive relationships or communication, using technology consciously and responsibly, and personal, social, and social responsibility skills are all components of effective communication. Lastly, high efficiency is characterized by the ability to plan and execute a project, prioritize outcomes, effectively use technology in problem solving, organize

and deal with problems, effectively employ real-world tools, and generate informative, intelligent, and high-quality goods in accord (NCREL & The Metiri Group, 2003).

National Educational Technology Standards (NETS/ISTE): The National Educational Technology Standards (NETS) and the International Society for Technology in Education (ISTE) have devised these skills to help students, instructors, and administrators use technology more successfully and efficiently in their personal and professional lives. These competencies indicate that communication-related technologies should unquestionably be the focal point of teaching in all educational institutions (Partnership for 21st Century Skills, 2009). NETS/ISTE established student standards in 2007 as creativity and innovation, critical thinking, problem solving and decision making, communication and teamwork, digital citizenship, technology applications and ideas, research and knowledge fluency (ISTE, 2007). Then, in 2016, NETS/ISTE modified the predefined competencies and the seven key skills, emphasizing that education for students should make their life simpler and that acquiring 21st century skills should be student-centered. As the revised ISTE (2016) 21st century skills report is analyzed, it is clear that the document puts more of an emphasis on students as empowered learners and views them as technological or digital information producers, innovative designers, effective communicators, and computational logic thinkers. In line with these, empowered learners are those who possess the knowledge and abilities to design their own learning settings, employ technology in those areas, and establish their own learning goals (ISTE, 2016). Digital citizenship, secondly, is the recognition of one's rights, obligations, and chances to exist, study, and work in a connected digital environment while also acting in a safe, ethical, and legal manner, whereas thirdly, a knowledge constructor is someone with the capacity to develop original works, the ability to use digital technologies to create worthwhile learning experiences for others and oneself, and the capacity for critical thought (ISTE, 2016). Furthermore, an innovative designer is someone who uses a variety of technologies to pinpoint issues and find solutions by coming up with original, innovative, or practical ideas during the design process, and the goal of being a computational thinker is to raise people who can devise strategies, solve issues, and take advantage of technology (ISTE, 2016). Sixthly, raising people who express themselves creatively via a variety of materials and digital media is the goal of becoming a creative communicator, and lastly, training for using digital technologies to enhance learning while cooperating with local and international teams is known as being a global collaborator (ISTE, 2016).

When the 21st century skills report, updated by ISTE (2016), is examined, it can be seen that the report focuses more on students and they are updated as technological or digital information producers, innovative designers, effective communicators and individuals who think with computational logic.

*American Association of Colleges and Universities (AACU):* It is the framework in which the skills required by the graduates of a higher education institution are determined by the American association of Colleges and Universities. According to the report, individuals generally start a career in their field after graduating from a higher education institution. However, it may be possible for an individual to succeed in a profession primarily by acquiring a sustainable and lifelong understanding (AACU, 2007). These skills, which are determined by the Association of American Colleges and Universities, must be sustainable for life. They are the skills of individuals who have responsibilities for nature or natural life, socio-cultural structure, certain basic knowledge-practices-social responsibilities and have adopted the principle of progressivism. At the heart of these skills, which are required to be found in higher education graduates, there are firstly knowledge, then skills, experience and solving problems by being aware of them, having and using science and technology as well as literacy related to all values and branches of science that may be necessary in life. In the report, while higher education graduates are required to be successful at the highest level in their fields of expertise, they are also required to be literate at the least basic level of knowledge in related fields other than their fields of expertise and in other fields that may be necessary for them.

Organization for Economic Cooperation and Development (OECD): The OECD and the Portuguese government jointly held a summit on the future of education called 'Skills for a Digital World' in Porto on June 28-29, 2018. The aim of this summit was to develop the imagination of students in education, to enable them to participate in today's digital education world, and to seek answers to how the knowledge, attitudes, values and behaviors that students need can be developed in today's education system. At the OECD (2018) summit, the skills that students should have in the 2030s were tried to be estimated and three categories were determined to increase the skills of students in digital and social fields in those years. The first of these categories is to take responsibility by dealing with difficulties and problems. The second is that students can learn and apply ideas such as being open to innovations in all areas of life, creating innovative applications, coping with problems or difficulties. The third is to enable students to make self-assessment by improving their skills such as self-control, self-efficacy, taking responsibility and problem solving. The OECD 2030 learning framework, jointly prepared by a community of government representatives, researchers, thought leaders, academics, educators and experts in various fields, determined by leaders, administrators, teachers, students, parents, universities and local organizations, aims to understand how students should guide their lives and futures and it is a guide that determines the knowledge, behavior, values and attitudes that may be necessary for the development of the world, the welfare and future of societies. This guide presents not only individual requirements or competencies, but also some of the must-haves that may be necessary for the education of the future (OECD, 2018).

The most important of these essential requirements is that the individual should not only work in one specific field, but should have a multidisciplinary education understanding. In other words, they should both know their own area of expertise and have literacy specific to other areas. Thus, the individual should be able to look at subjects or events through the eyes of researchers in different fields.

National Research Council (NRC): NRC is a framework developed by combining the initials of Science, Technology, Engineering, Mathematics (STEM) fields. NRC is a comprehensive research prepared by NRC officials by holding symposiums, congresses, workshops and scientific meetings between 2005-2009 on what the necessary skills should be for individuals' working life. In the research, it was tried to determine what the skills and characteristics should be in the STEM education in the 21st century information society. In the research, it has been determined that there are three types of skills that may be required or should be found in the individual. The first of these skills is *cognitive skills* such as critical thinking, analytical thinking, problem solving, reasoning, creativity, the second is interpersonal skills such as personal and social communication skills, social skills, teamwork, problem solving, coping with difficulties and the third is intrapersonal skills such as selfmanagement, self-regulation, personal development, responsibility, lifelong learning, and adaptation (Soland et al., 2013). According to the NRC skills framework, reasoning, analytical thinking, judgment and decision making are at the center of cognitive skills, listening, persuasion, selfexpression, effective use of gestures and facial expressions, respecting the opinions of individual are at the center of interpersonal skills, self-development, planning, effective use of time, self-regulation and self-control are at the center of intrapersonal skills (National Research Council, 2011). It is also stated that with the combination of the skills in these three dimensions determined in the research, there will be a permanent and deep learning in the mind.

## **Argumentation-Based Learning**

Argumentation is a process in which reasons and evidence are used to support or refute a claim that has been put forward (Toulmin, 2003). Its foundation dates back to Aristotle's rhetorical art 2500 years ago (Freeley & Steinberg, 2013). The method gained popularity and started to be used as a method after Toulmin's work titled 'The Uses of Argument' published in 1958 (Driver et al., 2000; Erduran, Simon & Osborne, 2004). The model developed by Toulmin includes a claim about a topic or opinion, grounds supporting this claim with various evidence, reasons for linking the claim with the grounds, supports to make the arguments stronger, and finally, rebuttals used to indicate the situations in which the claims cannot be realized (Erduran et al., 2004).

As a concept or definition, argumentation is a reasoning process in which claims, grounds and warrant components are used and arguments are created with these components (Toulmin, 2003), an individual activity through thinking and writing, or a social activity within a group (Driver et al.,

2000), and reasoning that aims to increase the acceptability of the ideas by the audience or readers before making a logical judgment (Van Eemeren et al., 1996). The argument that we encounter a lot in the argumentation process can be expressed as the series of speeches made to explain the opposition between two opposing situations or the activities performed to reach logical and coherent decisions (Kaya & Kılıç, 2008), or the structures that individuals create to express and justify the claims put forward (Sampson & Clark, 2008).

Toulmin's Argumentation Model is powerful in terms of evaluating arguments and consists of six variables: claim, grounds, warrant, qualifier, rebuttal and backing (Jimenez-Aleixandre et al., 2000; Bell & Linn, 2000). The order of the argument structures according to Toulmin's model:

*Grounds:* Statements that help reach the claim. Grounds are evidence used to show facts about an event and to support a claim.

*Claim:* Claims that contain reasons to justify the grounds. The argument consists of at least two components, the claim and grounds. Arguments are used to persuade the other party.

*Warrant:* It provides justification for the relationship between the grounds and the claim. Claim, grounds and warrant are the basic building blocks of these components that make up Toulmin's model.

*Backing:* Backing ensures the accuracy and credibility of the grounds. It is used when grounds are not accepted.

*Rebuttal:* It refers to situations where the claim is not valid. It includes exceptions.

*Qualifier:* It specifies the conditions under which the claim can be accepted. Except as specified by the qualifier, the claim is not valid.

It can be said that there is a spiral relationship between Tolmin's argument structures. Grounds support claim, warrant provides a link between the grounds and the claim, backing strengthens the warrant, and qualifier indicates the situations where the claim is not true, and creates the limits of the claim (Toulmin, 1958; Osborne et al., 2004).

In classroom environments where argumentation-based learning technique is used, students use scientific theories, grounds and evidence to defend their claims about the subject or refute other claims (Simon et al., 2006). With the argumentation-based learning approach, individuals question the ideas or information they have previously developed in their minds. Individuals find the grounds required for this technique by reasoning or critical thinking in accordance with the academic mindset. At the end of learning, conceptual changes occur in individuals as a result of both defending and refuting ideas.

When the literature is examined, it has been determined that the researches on argumentationbased learning are mostly limited in number and mostly focused on numerical/computational courses or subjects, while the studies on verbal fields are almost nonexistent. For this reason, the main purpose of this research is to create a resource for the field and to provide students with critical thinking skills in the argumentation-based teaching principles and methods course of 21st century learning skills that have not been studied before, and to contribute to the field in this regard. With the research, it is planned that the 21st century skills of teachers, academicians or trainers will provide students with critical thinking skills on the basis of argumentation.

## **Critical Thinking**

Critical thinking is the process of understanding, observing or making sense of events based on evidence (Sarıgöz & Özkara, 2015; Sarıgöz, 2014). According to Paul (1984), it is a disciplined and self-controlled way of thinking that reveals perfect thinking about a particular field or form of thinking. According to Scheffer & Rubenfeld (2000), it is the art of thinking about what you are thinking while you are thinking about improving your way of thinking. In this regard, critical thinking is a high-level thinking skill on subjects such as realizing, analyzing, developing realistic criteria about the subject or subjects, questioning the accuracy of the subjects. In order for the individual to make the right decisions in life, it is necessary to have critical thinking skills (Sarıgöz & Bolat, 2018).

The common ground of the methods to be used in critical thinking teaching is to enable students to be active in their own learning, to look at an event or phenomenon from more than one perspective, and to be participative in group work that supports cooperation (Mastrian & McGonigle, 1999). There are 5 basic methods scientifically proven to provide effective and efficient results in teaching critical thinking (Şenşekerci & Bilgin, 2008). These are the Six Thinking Hats Method, the Brainstorming Method, the Questioning Method, the Intellectual Norms Activity and the Critical Media Literacy Training Method (Baştopçu, 2018; Şenşekerci & Bilgin, 2008).

# Method

#### **Purpose and Model of the Research**

The aim of this research is to enable students to gain the 21st century learning skills with critical thinking method based on argumentation-based learning. In the research, the "case study" method, one of the qualitative research methods, was used in order to determine and analyze the opinions of prospective teachers studying in different departments about what the 21<sup>st</sup> century learning skills are. Case study is a research method that is used to reveal the existing situation as it is, based on "how" and "why" questions, which allows the researcher to examine a phenomenon or event in depth (Yıldırım & Şimşek, 2021).

## **Study Group of the Research**

The study group of the research consists of 40 students studying in different departments and taking the Adult Education and Lifelong Learning course taught as an elective course in Hatay Mustafa Kemal University Faculty of Education.

## **Data Collection Tool**

Before collecting the data required for the research, that is, before starting the study, the necessary permission for the research (E-30013534-302.08.02-107341) was obtained from the Dean of the Faculty of Education, Hatay Mustafa Kemal University. Afterwards, in the research, the teacher candidates were taught 21<sup>st</sup> century learning skills for 6 weeks, two hours a week, and they were provided with information about 21st century learning skills with critical thinking methods (brainstorming method, questioning method, 6 hats thinking method, intellectual norms activity method, media literacy training method) based on argumentation method. Then, the opinions of the candidates about the subject were received using the interview approach method. In the research, the interview form was used while receiving the opinions of the teacher candidates. The interview form approach is a type of approach that provides time flexibility to the researcher and the interviewer, and in which the interviewer has the freedom to both ask pre-prepared questions and ask additional questions in order to get more detailed information about these questions, while remaining loyal to the subject or areas for which they have prepared beforehand (Karasar, 2016; Yıldırım & Simsek, 2021). In this study, a semi-structured interview form was used. In semi-structured interviews, although the interview questions are prepared in advance by the researcher, it may be necessary to think and ask new questions according to the progress in the interview (Yıldız-Bıçakçı et al., 2017). Semi-structured interviews also allow the participants to reorganize and discuss the questions created by providing partial flexibility during the interview (Ekiz, 2003).

Descriptive analysis and content analysis were used in the analysis of the research data collected through the interview form. With the descriptive analysis, the necessary concepts in the answers were placed under the determined themes, the concepts were ordered by coding and taking their frequencies, and the sub-themes were determined with the content analysis. In descriptive analysis, the data are placed under predetermined themes, while in content analysis, sub-themes and themes belonging to the codes are extracted from the data (Yıldırım & Şimşek, 2021).

Theme	21st Century Learning Skills Expressions	F
	Digital technologies, use of technology	31
	Technology literacy	29
Education and training	STEM	17
	Nature, natural life	10
	Sociocultural structure	6
	Guidance	3
	Creativity, innovation	28
	Social responsibility	19
	Self-Sufficiency	16
Understanding and	Qualified personnel, workforce	12
comprehension	Coping with difficulties and problems	10
	Self-control	8
	Graduation from a school, a program	7
	Being information literate	4
	Motivation	32
	Increasing success	23
	The desire to achieve	12
Motivation	Activating requests, hobbies	8
	Concentration	5
	Willingness to improve and evolve	2
	Critical thinking	27
Reinforcement and forgetfulness	Following the technology	25
	Learning to learn, knowing how to learn	17
	Collaboration, sharing	9
	Trying to be successful all the time	5

# Table 1. Teacher candidates' views on 21st century learning skills

Table 1 includes the themes and expressions related to the opinions of the teacher candidates on 21<sup>st</sup> century learning skills. Based on these themes and expressions, a semi-structured draft interview form consisting of 4 questions was created. Hereupon, the form was revised with the help of faculty members in educational sciences who do research on teaching, method and technique, and the semi-structured interview form was finalized after necessary corrections were made.

The questions in the semi-structured interview form were determined as follows.

- 1. What do you think about teaching 21<sup>st</sup> century learning skills with critical thinking skills based on the argumentation method?
- 2. What do you think about the effect of teaching 21<sup>st</sup> century learning skills with critical thinking skills based on the argumentation method on understanding and comprehension?
- 3. What do you think about the effect of teaching 21<sup>st</sup> century learning skills with critical thinking skills based on the argumentation method on increasing student motivation?
- 4. What do you think about the effect of teaching 21<sup>st</sup> century learning skills with critical thinking skills based on the argumentation method on reinforcement and forgetfulness?

## Findings

The findings regarding the questions in the semi-structured interview form asked to the teacher candidates in the study were evaluated and interpreted in this section. The interview forms obtained from the opinions of the teacher candidates participating in the research were listed and named as (T1, T2, T3, T4, ...).

*Question 1. What do you think about teaching*  $21^{st}$  *century learning skills with critical thinking skills based on the argumentation method?* 

Most of the teacher candidates stated that especially the events with documents, films, photographs or evidence can be better understood with critical thinking skills and can give a different perspective to the event or subjects than expected. They also stated that individuals who are critical of events and try to prove events in scientific ways can make more stable decisions by thinking more logically over time. Some of the teacher candidates argued that it would be more logical to use evidence-based learning in numerical/computational lessons, while some teacher candidates are of the opinion that critical thinking skills can be used in all areas of education, yet it would be more logical to use the argumentation method only in subjects that can be documented or proven.

"...the events that can be proven in the social sciences are usually events related to geography or documents in the field of history. Therefore, since the lessons taught with the argumentation method and critical thinking method require high intellectual skills, students can gain a different perspective especially on historical events." (T17).

"...I think individuals who do research or make decisions by combining the argumentation method with critical thinking skills begin to think more logically and scientifically over time." (T8).

"...argumentation method is a method based on proof or evidence. It can also be used easily in many fields of social sciences. However, it would be more appropriate to use it not in social sciences, but in science courses with proof in numerical/computational departments or in different areas of provable positive sciences." (T21).

"...especially for subjects that will be handled by the argumentation method, it is necessary to redesign classes or rearrange methods according to their properties. If the deficiencies of the classes are completed and the method is made available for use, the argumentation method can be easily used in all areas by combining it with other methods." (T37).

"...21st century skills can be acquired by students using the argumentation method. However, I believe that as a second method, it will contribute more to the student if it is taught through discussion method rather than critical thinking skills." (T13). Teacher candidates think that 21<sup>st</sup> century learning skills can be easily taught with critical thinking skills based on the argumentation method. However, there are also teacher candidates who believe that the teaching of 21<sup>st</sup> century learning skills by the method of argumentation-related discussion will also have a positive impact on teaching.

*Question 2. What do you think about the effect of teaching* 21<sup>st</sup> *century learning skills with critical thinking skills based on the argumentation method on understanding and comprehension?* 

Since the argumentation method is a method based on ideas, opinions, understanding, proof or evidence, the topics covered in the courses should be explained by proving them with documents or ideas. Moreover, when the topics covered with these methods are also handled with critical thinking techniques, it will be ensured that the students understand the topics down to the smallest detail without leaving any question marks in their minds. Moreover, the conversation and speech abilities of the students who explain the topics in the classroom and discuss them with their friends will also improve. All these will help the individuals' mind to develop, and will also improve their ability to understand and comprehend.

"...in the lessons taught with argumentation-based critical thinking skills, students can understand and comprehend the subjects better as they constantly generate ideas, try to prove everything and discuss. However, for all these events and defenses, it is necessary for the students to have developed skills such as their readiness, expression skills and speaking ability, especially their persuasion ability." (T6).

"...if the environments in which these methods will be used or applied are not an oppressive and authoritarian environment, the methods can be easily used in all areas of social sciences and students can better understand and comprehend the subjects thanks to these methods." (T19).

"...if the classes are made into groups of several people for the topics to be covered with the critical thinking method depending on the argumentation method, the students in the group can better understand and comprehend by discussing with each other or by collaborating and explaining the issues to each other." (T28).

"...as there will be a culture of continuous discussion and thinking among the students in the lessons taught with critical thinking skills depending on the argumentation method, the topics will be discussed in every aspect, down to the smallest details, even their positive and negative sides. This, in turn, will enable students to better grasp and understand the subjects in every aspect." (T35).

It can be said that the argumentation method, together with critical thinking techniques, will positively affect students' understanding and comprehension. In addition, students can develop not only their comprehension skills, but also other skills such as effective speaking, rhetoric and expression skills.

*Question 3.* What do you think about the effect of teaching 21<sup>st</sup> century learning skills with critical thinking skills based on the argumentation method on increasing students' motivation?

The teaching of 21<sup>st</sup> century learning skills with critical thinking methods based on the argumentation method in the lessons, and especially the fact that the subjects are related to digital technologies, coping with difficulties, nature, natural life, graduating from a university, qualified personnel and workforce attracted the attention of teacher candidates beyond measure. Another important issue here is that teacher candidates who are about to graduate or start work life should also concern themselves with issues such as workforce, graduation and qualified personnel. For this reason, the teacher candidates were more motivated for the topics covered since they were in their area of interest or related to them.

"... in the lessons taught with the argumentation method, students have to be more careful both to listen to the other person very well and to develop a counter-view, as they try to refute the opinion of the other person. This, of course, increases the motivation of all students in the lessons taught with this method." (T20).

"...the students who will be prepared for the lessons according to these methods will focus more on the subjects as they will constantly plan what to say, how to respond to the ideas and thoughts of the other person, how to refute the ideas of the other person and how to defend what is told, and this situation will increase the motivation of the student." (T12).

"...according to the argumentation method and the critical thinking method, students should listen carefully to the topics their friends are talking about or defending. For this, all students must listen to what is told and produce ideas and information which they will use to defend their opinions. All these will make students more motivated for the subject." (T29).

"... teaching with critical thinking skills based on the argumentation method or students' defending their ideas against other ideas is a stressful situation and puts students under serious stress. Since students who are under stress have to develop ideas both to understand what the other person is saying and to refute what is being told, their motivation will increase along with stress and they will be more motivated for the subjects." (T1).

The desire to win a sweet competition in students can increase motivation and lead students to success. A little stress will increase motivation, and this type of stress can also bring success. However, while little stress brings success, too much stress can disrupt the student's physiological and psychological balance. Excessive ambition and desire to win can sometimes lead to undesirable results for students. For this reason, especially teachers should be very careful in such lessons and intervene where necessary in the lessons to prevent in advance all events that may develop negatively.

*Question 4. What do you think about the effect of teaching* 21<sup>st</sup> *century learning skills with critical thinking skills based on the argumentation method on reinforcement and forgetfulness?* 

Reinforcement in education can be explained as motivating the student during the lesson, as well as being perceived as repeating the previously covered topics, encouraging learning, motivating and giving attention to the topics covered, or making routine repetitions about the topics covered. Forgetfulness is the forgetting of a learned subject over time as a result of not being repeated. In places where there is reinforcement, forgetfulness is minimized or even almost nonexistent. Because researching or repeating a subject eliminates forgetfulness. Since the argumentation method is a method that depends on evidence, proving and generating ideas, thus thinking, reinforcement is a necessary condition in the subjects taught with critical thinking methods based on the argumentation method, while forgetfulness becomes a rare or even non-existent situation due to these reinforcements.

"...reinforcement is the repetitions made in order not to forget a previously learned subject or to learn if there are deficiencies in the previously learned subjects. While I was learning 21<sup>st</sup> century learning skills, I listened to the opinions of my friends and developed new ideas for their defense. While doing this, I put a lot of effort into thinking at a higher level and being motivated. I think it is very difficult to forget a subject that is learned by constantly thinking, contemplating, trying to keep in mind and repeating in this way." (T15).

"... I was very excited while listening to the lessons with the method of argumentation and critical thinking. I was listening to what was being taught very carefully and paying attention to everything that was told in case I could come across a different idea at any moment. I think that I will not forget what I learn in a lesson in which I am so attentive and motivated for the rest of my life." (T31).

"...we were not so excited and so careful in the previous lessons. In particular, the groups trying to refute each other's ideas or arguments and defending their ideas against each other prompted all my classmates to be more careful and to constantly reinforce each topic discussed. This, I think, eliminated our forgetfulness problem. I think that teaching the lessons with these methods will enable students to better understand, reinforce and think about the subjects, and not to forget the subjects covered for a long time." (T27).

Since the topics to be covered with the argumentation method and critical thinking theories are given to the students before the lessons, the students do research on the given or determined topics before they come to the lesson and increase their readiness. Therefore, while researching the subjects and teaching the subjects in the classroom, what they learned is reinforced and their forgetfulness decreases.

#### **Conclusion and Discussion**

Argumentation method is a learning method that aims to develop the individual's thinking skills such as critical thinking, creative thinking, problem solving, analytical thinking, decision making, causation, deep thinking and more in-depth questioning. The argumentation method is based on believing scientific claims by justification, rather than just believing scientific claims. In the research, the teacher candidates stated that their critical thinking skills improved thanks to the argumentation method. In some studies (Türkoğuz & Cin, 2013; Öğreten, 2014; Demir, 2006; Yeşildağ-Hasançebi & Günel, 2013; Tahiroğlu, 2006; Demircioğlu & Uçar, 2015), it has been concluded that argumentation-based teaching improves the individual's critical thinking skills and increases academic success.

In the research, as a result of the opinions of the teacher candidates, it has been concluded that the demonstrable or provable situations or events can be better understood by the students, the subjects with evidence can be better grasped with critical thinking methods and skills, and the students can develop different perspectives and more logical thoughts. In some studies, the vital thing in the lessons taught using the argumentation method is that the topics include critical thinking during the discussions, they are based on proof and whether the ideas defended in the discussions can be refuted or not. According to Kuhn (1991-2010), the quality of the topics covered depends on claims, grounds, warrants and rebuttals, and carefully determined arguments with these features increase the motivation of students by improving their quality of thinking. In a study conducted by Topçu (2008), it was concluded that teacher candidates mostly supported the grounds they created during the discussions with warrants and tried to prove those grounds. In a study carried out by Torun and Acıkgül-Fırat (2020), it was concluded that the teacher candidates defended their grounds by conducting high-level thinking during a discussion. Hence, since the topics covered by the argumentation method are based on proving and refuting, the individuals who will be involved in the discussion according to this method should think at a high level, keep their motivation high and use their minds very well, especially so that their claims are not refuted by the other party.

In the research, it has been concluded that when the discussion method is added to the methods and techniques used in the lessons taught with the argumentation method and critical thinking methods, the subjects can be learned in a more in-depth and detailed manner without leaving any question marks in the minds. In a study conducted by Birdal, (2019), it was inferred that teacher candidates acquire more in-depth information while preparing for the lessons that will be taught with the argumentation method, and they place the information they have acquired in their minds based on proof and evidence. In a study conducted by Dori, Tal and Tsaushu (2003), it was concluded that the students' decision-making skills, and, accordingly, their thinking skills improved in the lessons taught using the argumentation method. Based on the data of those studies, it can be said that when the

argumentation method is used with the right techniques and methods, it improves the students' skills such as in-depth learning, high-level thinking and decision making.

Subjects such as qualified personnel, graduation, workforce, nature and technology related to 21<sup>st</sup> century learning skills attract the attention of teacher candidates and all individuals and all students with future plans. Since 21<sup>st</sup> century learning skills consist of future-oriented, attention-grabbing topics, and the topics are taught with the argumentation method and critical thinking techniques, it has been found out in the research that students' high-level thinking skills and likewise their motivation for lessons will increase in lessons taught in this way. In some studies (Simon & Richardson, 2009; Nussbaum, 2002), it has been concluded that choosing the topics to be taught using the argumentation method from technological topics, remarkable topics or daily life increases the interest and motivation of the students in the course.

In the research, it has been concluded that students' motivation, interests, desires and attention regarding the subjects will be higher in the lessons taught with the argumentation method and critical thinking methods in schools, unlike traditional methods. In addition, in the research, it has been concluded that the students can constantly discuss the subjects among themselves and exchange ideas, therefore the reinforcers and reinforcements on the subjects covered in the lessons will constantly increase and this will lead to a decrease in the forgetfulness, and the knowledge and positive behaviors will be acquired in a more permanent way.

In the research, some basic skills that should be possessed by teachers who will teach their lessons with the argumentation method and critical thinking techniques were determined by the teacher candidates. These are skills such as teachers being a good observer, solving questions, listening to students' ideas, respecting the ideas produced, having strong communication skills, knowing the subjects in depth and clearly, having a grasp of other subjects related to the subject covered, making the points to be evaluated more prominent and having up-to-date information on the subject (Aydoğdu, 2017; Tahiroğlu; 2006; Republic of Turkey Ministry of National Education, 2013; Rojas-Drummond & Mercer, 2003; Saygılı, 2015; Mcneill & Pimentel, 2009). In addition, in the research, it has been concluded that teachers who want to teach the lessons according to these methods have also trained themselves in subjects such as correcting the misconceptions about the subject, making the lesson more productive, creating awareness, permanent learning by reducing forgetfulness, self-confidence and self-reliance, increasing motivation and better understanding of the subject.

## Recommendations

In the classrooms or environments where the lessons will be taught with the argumentation method and critical thinking skills, a safe and comfortable environment should be created (Yaşar, 1998). In fact, before starting any lessons in the classroom, an environment should be created where

there are basic rules such as being respectful to each other, obeying the rules and not making personal attacks.

It is very important to determine and plan the topics so that the topics to be covered by the argumentation method can be suitable for proof and discussion. The topics to be taught with this method should be determined by considering factors such as students' readiness, physical conditions of the school, success level, access and use of technology, the number of students in the classroom, access to information and the duration of the lessons.

Each student should be given as much time and opportunity as possible to defend their opinion, evaluate the arguments being defended, or express themselves, furthermore, students should be encouraged by the teacher to create arguments, generate ideas, and participate in discussions.

Learning and teaching methods and techniques such as argumentation method, discussion method, critical thinking methods and skills are provided to teacher candidates in the teaching principles and methods courses in education faculties. Teacher candidates take these courses mostly in theory at universities. Therefore, both the argumentation method and critical thinking techniques as well as other methods and techniques that teacher candidates can use throughout their teaching life should be given to all teacher candidates in education faculties of universities on an applied basis.

All teachers, teacher candidates or academicians who regard themselves as inadequate in terms of methods and techniques and in other subjects needed and used in education or who want to improve themselves should be provided in-service trainings on all methods and techniques needed and necessary and this should be provided by institutions and organizations (Kardaş, 2013).

When the studies on the argumentation method or the literature are reviewed and examined, it is obvious that there are a limited number of studies in the field of social sciences, and the studies and research were mostly conducted in science or numerical/computational fields. Therefore, the number and type of studies in the field of social sciences related to or based on the argumentation method should also be increased.

# **Conflict of Interest**

The author declares that he has no conflicts of interest.

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# Investigation of the Relationship between Pre-service Social Studies Teachers' Attitudes towards Purchasing Geographically Indicated Products and their Status as Conscious Consumers

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## Abstract

The purpose of this study is to investigate whether there is a relationship between social studies teacher candidates' attitudes towards purchasing geographically indicated products and their status as conscious consumers. The study was carried out with a total of 211 teacher candidates studying at two different state universities in Turkey in the spring semester of 2022-2023 academic year. The relational survey model, one of the quantitative research types, was utilized in the study. The data in the study were collected through the Attitude Scale Towards Buying Geographically Indicated Products, developed by Yüce & Korucuk (2020), and the Conscious Consumer Scale developed by Buğday (2015). The SPSS 22nd statistical program was used in the analysis of the quantitative data obtained. As a result of the study, the following findings were attained. It was found that the attitudes of teacher candidates towards purchasing geographically significant difference in terms of gender; similarly, it was observed that there was no significant difference in terms of the "parent average monthly income" variable. Nevertheless, it was revealed that there was a positive and significant relationship between the attitudes of pre-service teachers towards purchasing geographically indicated products and their status as conscious consumers.

Keywords: Geographical Indication, Social Studies, Conscious Consumer

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#### Introduction

As in every field, there have been some great changes and transformations in sociological, cultural, economic and political fields regarding the technological developments in the world. In this change and transformation atmosphere experienced in different societies around the world, the phenomenon of being nationalistic has also had its share, and this situation has accelerated the process of returning back to basics due to the cultural degeneration apprehension of many societies. The increase in the value of the local and the return to being national with the phenomenon of globalization have not only significantly impacted the image of geographically indicated products in consumers, but also encouraged the individuals to be conscious consumers.

Even though many types of products have been introduced to the market due to the globalization of trade in the world and the increase in new technological opportunities, this state of affairs has also brought along some problems. The introduction of poor quality raw materials and genetically modified products to the market in order to make more profits has, in the long run, put human health at risk (Alemanno, 2006; De Rosa, 2015; Toklu, Usta Ahmetoğlu & Öztürk Küçük, 2016). This situation has led to an increment in quality and reliability concerns among the consumers and a serious increase in consumers' demands for the local products (Teuber, 2011).

#### **Geographically Indicated Products**

Geographical indication is one of the intellectual and industrial property rights (Gökovalı, 2007). Geographical indication is a quality mark that shows and guarantees the source of a particular product, its characteristics and the relationship between the characteristic features of that product in question and the geographical area (Web1: https://www.turkpatent.gov.tr/cografi-isaret). As it is possible to define geographical indication as the meeting of the local with the world, it is also possible to define it as a series of legal measures taken to ensure that authentic (original, authentic) products are safely transferred to future generations without deterioration (Sahin, 2013; Mertol & Yaylacı, 2021). Culture and the geographical indication as its product can also be defined as a brand today (Tanrıkulu, 2011; Murat & Ergen, 2022). Even though the agricultural products spring to mind when geographical indication is mentioned, the concept of geographical indications is composed of many products such as handicrafts, industrial products and mineral products (Oraman, 2015). Geographical indications and the traditional characteristic descriptions are important tools of the European Union's product quality policy (Ucuncuoglu, 2020). Nevertheless, the local product sector has become a growing sector in food consumption all over the world and especially in Europe (Tekelioğlu & Demirer, 2008; Wirth, 2018). Geographical indications (GIs), if used correctly and well protected, are likely to be an effective marketing tool with great economic value for the country they belong to. GIs define the cultural identity of a nation, region or a particular area. Therefore, it makes it possible to

add value to the country's natural wealth and the skills of its people and gives the local products a distinctive identity (Addor & Grazioli, 2002).

Geographically indicated products are classified and registered under three headings: "Protected Designation of Origin-PDO", "Protected Geographical Indication-PGI" and "Traditional Standard Guaranteed-TSG". (Dikici, Koluman & Aktaş, 2013).

Geographical indications are divided into two as the name of origin and indication of origin.

# The name of origin

"If all or the essential qualities of a product originate from the natural and human elements that belong to a certain geographical area, the geographical indications in this case are called "name of origin" (Web1: https://www.turkpatent.gov.tr/cografi-isaret). The production, processing and other operation stages of the product in question must take place within the boundaries of the determined geographical area. The relationship between the product named origin and the geographical region is very strong (Yüce & Korucuk, 2020). In other words, the product in question must take its qualities from the geography to which it is connected (Özgür, 2011). Afyon double-cream, Amasya Apple, Erzincan Tulum cheese, Finike Orange, Kars Kashar (Cheddar) cheese, Kars honey, Malatya Apricot, Gemlik Olive, Taşköprü Garlic etc. products can be mentioned as the examples of origin-indicated products.

# The indication of origin

"The geographical indications, which are the subject of products that are identified with a certain geographical area in terms of their distinctive quality, reputation or other characteristics, and whose production, processing or other operations must take place within the specified geographical region, are called "the indication of origin" (Web1: https://www.turkpatent.gov.tr/cografi-isaret). The most important point to be considered in the indication of origin is that the quality of the product is exactly the same and that the raw materials and production and processing methods of the region are implemented in exactly the same way (Orhan, 2010). In other words, after the raw material or at least one of the stages in the production process of the product in question is registered as the indication of origin in the relevant region, other production or processing stages of that product can be carried out outside the region to which it is connected. The products of such regions as Hatay (Antakya) Künefe, Antep Baklava, Hereke Carpet, Adana Kebab, Afyon Sausage (Turkish style fermented sausage), Damal (Ardahan) Baby Doll, Siirt Blanket, Isparta Carpet etc. products can be exemplified as the products with the indication of origin.

## **Traditional Product Name**

"The names that are proven to have been traditionally used for at least thirty years to describe a product in the relevant market that are not covered by the name of origin or the indication of origin, are defined as the traditional product name if they meet at least one of the following conditions."

a) The fact that there is a situation arising from the traditional production or processing method of the product or the traditional composition.

b) The fact that the product must be manufactured from a traditional raw material or ingredient (Web1: https://www.turkpatent.gov.tr/cografi-isaret). The products such as Turkish Delight, Ottoman sherbet, Baklava etc. can be exemplified as the traditional product names.

As of June 2022, 1139 products have obtained the geographical indication registration certificates in Turkey. However, there are a total of 722 products for which registration applications have been made but have not received the registration certificate yet (Web1: https://www.turkpatent.gov.tr/cografi-isaret).

## The Concept of Conscious Consumer

Consumption is an important source that enables the life cycle for all living things (Köroğlu, 2014; Cici Karaboğa, 2022). Considering that consumer needs are the basis of economic activities, it is possible to claim that the role of consumer behavior is of great importance in generating a sustainable life source in the long run (Buenstorf & Cordes, 2008). Basically, the so-called conscious consumer can be defined as an individual who knows and uses his/her rights and makes purchases according to his/her needs (Buğday, 2015). There are five dimensions of being a conscious consumer: These can be listed as "socially responsible consumption", "ethical consumption", "modest consumption", "rational consumption" and "environmental consumption". The individual with these five dimensions can be defined as a person who possess the qualities of a conscious consumer as a whole. As individuals tend to be conscious consumers, businesses, decision makers or legislators will have to act more meticulously, respect human rights and demonstrate more rational behaviors (Buğday & Babaoğul, 2016).

Considering the fact that the individuals, in this day and age, focus on the symbolic meanings of the products consumed rather than their functional benefits (Ünal Kestane, 2020), the basic characteristics of a conscious consumer are to avoid excessive consumption, spend in accordance with their needs, and consciously choose the most suitable products among alternatives that do not endanger the environment and society. It is possible to say that it emerges in the form of choosing behaviors (Kılıç, Aydıner Boylu, Günay, 2019). In a nutshell, a conscious consumer is an individual who is fully aware of the effects of each consumption behavior on the society and environment (Kozinets & Handelman, 2004).

It is an indisputable fact that the concept of responsibility lies on the basis of citizenship education (Ersoy & Sarıabdullahoğlu, 2010). In the world today in which we have turned into a society of consumers, it is crucial that we take account of our traditions, being nationalistic, and carefully take into account the interests of the country in every consumption. As far as the need to illuminate the present in the light of the past by acting with this awareness is concerned, we need to act with the awareness that we should to be conscious consumers and resort to our own internal resources while doing this.

There is no doubt that one of the most important courses in schools that fulfills the greatest responsibility in preparing the individuals for life at educational institutions and educating them with this awareness is the Social Studies course. The Social Studies teachers are directly responsible for teaching this course in line with its intrinsic purpose. Therefore, this study was carried out in an attempt to identify how much the pre-service teachers who would practice the teaching profession in the future, became conscious consumers and how much they consumed the geographically indicated products. When the relevant literature is examined, it is assumed that since there are very few studies on the subject, this study will surely contribute to the relevant field.

## **Purpose of the Study**

The purpose of this study is to investigate the relationship between the pre-service Social Studies teachers' attitudes towards purchasing geographically indicated products and their status as conscious consumers.

In line with the purpose of the study, answers to the following questions were sought.

1. Do the attitudes of pre-service social studies teachers towards purchasing geographically indicated products and their status as conscious consumers differ significantly in terms of the "Gender" variable?

2. Do the attitudes of pre-service social studies teachers towards purchasing geographically indicated products and their status as conscious consumers differ in terms of the "Parent Average Monthly Income Level" variable?

3. Is there a significant relationship between the attitudes of social studies teacher candidates towards purchasing geographically indicated products and their status as conscious consumers?

### Method

#### **Research Ethics**

The necessary permission for the conduct of the study was obtained from the E-95531838-050.99-37514 document numbered E-95531838-050.99-37514 with the decision dated 23.03.2022

223

and numbered 85 from the Scientific Research Ethics Committee of the Ağrı İbrahim Çeçen University.

## Model of the Study

In this study, which investigated the relationship between pre-service teachers' attitudes towards purchasing geographically indicated products and their status as conscious consumers, the relational survey model, which is one of the quantitative research types, was utilized. The relational screening models aim to identify whether there is a co-change between two or more variables and the degree of existence of this change (Cohen, Manion & Morrison, 2000).

## **Study Group**

The study group of the study consisted of 211 pre-service teachers selected by random sampling, studying at the Çanakkale 18 Mart and Ağrı İbrahim Çeçen Universities in the 2021-2022 academic year.

# **Data Collection Tools**

The data in the study were collected by the method of questionnaire consisting of three sections. In the first part of the questionnaire, there was a personal information form. In this form, there were questions that identified the descriptive characteristics of the students (class, gender, etc.). In the second part, the "Attitude Scale Towards Purchasing Geographically Indicated Products" developed by Yüce and Korucuk (2020), which consisted of 33 items and whose validity and reliability studies were conducted, was used to identify the attitudes of the participants towards purchasing Geographically Indicated Products. In the third part, the Conscious Consumer Scale developed by Buğday (2015) was used.

# Attitude Scale Towards Purchasing Geographically Indicated Products (ASTPGIP)

The "Attitude Scale Towards Purchasing Geographically Indicated Products" developed by Yüce and Korucuk (2020) was prepared as a five-point Likert type and consisted of 33 items. The total variance value of the scale was established as 53.46%. The fact that the variance load obtained from the scale in social sciences was between 40% and 60% indicated that the scale was explanatory at a sufficient level (Pallant, 2017; Taşgın & Korucuk, 2018; Tavşancıl, 2014). The Cronbach's Alpha reliability coefficient of the scale was established as .95 for the total of the scale. The KMO (Kaiser–Meyer–Olkin) value of the scale was .928; Barlett Test Value was established as ( $\chi$ 2= 4022.375 p= .000). For the present study, the Cronbach's Alpha reliability coefficient of the scale.

# **Conscious Consumer Scale (CCS)**

The scale developed by Buğday (2015) consists of 4 dimensions and a total of 25 items. The distribution of the items according to the dimensions is illustrated below.

Dimension	Name	Number of Items
1.	Environmentally Conscious	7
	Consumption	
2.	Ethical Consumption	5
3.	Modest Consumption	5
4.	Socially Responsible Consumption	8

It was found that the Cronbach's alpha value for the whole scale, which consisted of 25 items and 4 dimensions, was 0.856. This value can generally be expressed as an acceptable value (Nunnally, 1994, p. 245-246). It was also found that the KMO (Kaiser–Meyer–Olkin) value of the scale was. 0.914, and Barlett Test Value ( $\chi 2$ = 6970,119 p= .000). For this study, the Cronbach Alpha reliability coefficient of the scale was established as .812 for the total of the scale.

# Analysis of the Data

The data of this study were analyzed with the SPSS 22 Statistics program. The Pearson Moment Correlation Coefficient (r) was calculated in order to evaluate the Relationship between the Pre-service Social Studies Teachers' Attitudes towards Purchasing Geographically Indicated Products and Being Conscious Consumers.

# Results

# **Findings Related to the First Sub-Problem**

Do the attitudes of pre-service social studies teachers towards purchasing geographically indicated products and their status as conscious consumers differ significantly in terms of the "Gender" variable?

# Homogeneity of the Variances

Gender	Dimension	F	Sig
(ASTPGIP)	-	,286	,593
	Dimension	F	Sig
	Environmentally Conscious Consumption	9,685	,002
(CCS)	Ethical Consumption	14,303	,000
	Modest Consumption	,881	,349
	Socially Responsible Consumption	19,901	,000

Table 1. The levene test results for the gender variable

Whether the variances were equal was tested with the Levene Test. According to the result obtained in Table..., it was observed that the variances were evenly distributed in the Attitude Scale towards Purchasing Geographically Indicated Products (P=.593; P>0.05); however, it was also revealed that the variances in the Conscious Consumer Scale's Environmental Conscious Consumption (1), Ethical Consumption (2) and Socially Responsible Consumption (4) dimensions did not display an equal distribution (P=,002, 000, 000; P < 0.05). Therefore, it was decided to perform the independent variables T-Test in the 3rd dimension of CCS, and the Mann-Whitney U test, which is the non-parametric equivalent of the Independent Variables T-Test in the 1st and 4th dimensions of CCS.

The T-Test Results in terms of the "Gender" variable for the pre-service social studies teachers' attitudes towards purchasing geographically indicated products and the 3rd dimension of the scale of being conscious consumers (Modest Consumption) are illustrated below.

Scale	Gender	Ν	$\overline{\overline{X}}$	SS	t	*p
	Female	117	3,5826	,64661		
(ASTPGIP)	Male	94	3,4928	,63273	1,011	,313
	Total	211				
	Female	117	2,2803	1,00174		
(CCS) 3. Dimension	Male	94	2,5511	,94069	-2,005	,046
	Total	211				

**Table 2.** Gender" variable for the pre-service social studies teachers' attitudes towards purchasing geographically indicated products

(\*p<0.05 significance level was taken into account.)

T-test was implemented to establish the effect of the "gender" variable on the pre-service social studies teachers' attitudes towards purchasing geographically indicated products and their status as conscious consumers. When Table.... is examined, it was seen that the attitudes of pre-service social studies teachers towards purchasing geographically indicated products did not cause any significant difference in terms of the "Gender" variable. In other words, the attitudes of pre-service teachers towards purchasing geographically indicated products were statistically similar in the female  $((X)^-: 3,5826)$  and male participants  $((X)^-: 3,4928)$  (P=,313; p>.05). On the other hand, when preservice social studies teachers' state of being conscious consumers was examined in terms of the "Gender" variable, it was seen that there was a statistically significant difference in favor of boys between females  $(X)^-: 2,2803)$  and males  $(X)^-: 2.5511)$  in the 3rd dimension of BBL (P=.046; p<.05). In other words, as far as this result is concerned, it is possible to say that the males were more conscious in the 3rd (Modest Consumption) dimension of the Conscious Consumer Scale.

The Mann-Whitney U Test Results in terms of the "Gender" variable for the 1st, 2nd and 4th dimensions of the pre-service social studies teachers as conscious consumers scale are illustrated below.

Scale	Gender	Ν	Rank Average	Rank Sum	U	*p
(CCS)1st Dimension	Female	117	115,78	13546,00		
	Male	94	93,83	8820,00	4355,000	,008
	Total	211				
	Female	117	110,98	12985,00		
(CCS)2nd Dimension	Male	94	99,80	9381,00	4916,000	,176
Dimension	Total	211				
(CCS)4th Dimension	Female	117	123,13	14406,50		
	Male	94	84,68	7959,50	3494,500	,000
	Total	211				

**Table 3.** The mann-whitney u test results in terms of the "gender" variable

The Mann-Whitney U Test was implemented to identify the effect of the "gender" variable on the pre-service social studies teachers as conscious consumers. When the status of pre-service social studies teachers as conscious consumers was examined in terms of "Gender" variable, it is revealed that there was a statistically significant difference in the 1st and 4th dimensions of CCS in favor of females between the females  $(X)^-$ : 115.78; 123.13) and males  $(X)^-$ : 93.83; 84.68) (P=0.008; 000, p<.05).

In other words, as far as this particular result is concerned, it is possible to say that the female participants were more conscious in the 1st and 4th dimensions of the Conscious Consumer Scale. On the other hand, in the 2nd dimension of CCS, it was observed that the pre-service teachers' status as conscious consumers did not cause a significant difference in terms of the "Gender" variable. In other words, it is possible to say that there was a statistically similar point of view in the second dimension of the conscious consumer scale between the females  $(X)^-$ : 110.98) and males  $(X)^-$ : 99.80) (P=,176; p>.05).

# Findings Related to the Second Sub-Problem

Do the attitudes of pre-service social studies teachers towards purchasing geographically indicated products and their status as conscious consumers differ in terms of the "Parent Average Monthly Income Level" variable?

# Homogeneity of the Variances

	· · ·	•			
Grade Level	Dimension	F	df1	df2	Sig
(ASTPGIP)	-	1,354	4	206	,251
	Dimension	F	df1	df2	Sig
	Environmentally Conscious	4,156	4	206	,003
	Consumption				
(CCS)	Ethical Consumption	,830	4	206	,508
	Modest Consumption	1,015	4	206	,400
	Socially Responsible	3,107	4	206	,016
	Consumption				
	Socially Responsible Consumption	3,107	4	206	,016

Table 4. The levene test results for parent average monthly income level

Whether the variances were equal was tested with the Levene Test. According to the finding obtained in Table..., as the variances displayed an equal distribution in the Attitude Scale towards Purchasing Geographically Indicated Products, it was decided to implement the One-Way ANOVA Test (P=,251; P>0.05). Nevertheless, it was seen that the variances in the Environmentally Conscious Consumption (1) and Socially Responsible Consumption (4) dimensions of the Conscious Consumer Scale did not show an equal distribution (P=.003, 016; P < 0.05). Therefore, it was decided to perform the One-Way ANOVA Test in the 2nd and 3rd dimensions of CCS, and the Kruskal Wallis test, which was the non-parametric equivalent of the One-Way ANOVA Test in the 1st and 4th dimensions of the CCS.

Scale	Parent Average Monthly Income Level	Ν	$\overline{\mathbf{X}}$	SS
0-2000 TL		51	3,4427	,72738
_	2000-5000 TL	84	3,5819	,63409
(ASTPGIP)	5000-8000 TL	42	3,5469	,48169
	8000-1000 TL	16	3,6212	,64889
	10000 TL and above	18	3,5724	,75839
Total		211		

Table 5. The descriptive statistics results related to the parent monthly average income level variable

**Table 6.** One-Way ANOVA test results of the pre-service social studies teachers' attitudes towards purchasing geographically indicated products according to the variable of "parent monthly average income level"

Scale	Source of Variance	Sum of Squares	Sd	Mean Squares	F	*р
(ASTPGIP)	Intergroup	,755	4	,189		
	Intragroup	85,432	206	,415	,455	,769
	Total	86,186	210			

p<0.05

According to the results of the "Parent Monthly Average Income Level" Variable "One-Way ANOVA" illustrated in Table 6, it was revealed that the attitudes of the pre-service social studies teachers towards purchasing geographically indicated products did not cause a statistically significant difference. As far as these findings are concerned, regarding the Parent's Average Monthly Income Level 0-2000 TL (X = 3.44), 2000-5000 TL (X = 3.58), 5000-8000 TL (X = 3.54), 8000-1000 TL (X = 3.62), 10000 TL and above (X = 3.57) year range, it is possible to say that the attitudes of the preservice social studies teachers towards purchasing geographically indicated products were similar (P=,769; p>.05).

Scale	Parent Monthly Average Income Level	Ν	$\overline{\overline{X}}$	SS
	0-2000 TL	51	4,4930	,60563
(CCS) 1 DIMENSION	2000-5000 TL	84	4,6017	,59398
	5000-8000 TL	42	4,5540	,46313
1. DIMENSION	8000-1000 TL	16	4,2941	,98906
	10000 TL and Above	18	4,3529	1,05598
	0-2000 TL	51	4,3294	,79682
(CCS)	2000-5000 TL	84	4,4682	,62072
	5000-8000 TL	42	4,3073	,67394
2. DIMENSION	8000-1000 TL	16	4,3059	,91137
	10000 TL and Above	18	4,7059	,55280
	0-2000 TL	51	2,3647	1,01091
(CCS)	2000-5000 TL	84	2,3082	,89312
2 DIMENSION	5000-8000 TL	42	2,5512	1,08515
3. DIMENSION	8000-1000 TL	16	2,6235	,98459
	10000 TL and Above	18	2,3882	1,09652
	0-2000 TL	51	4,1005	,74541
	2000-5000 TL	84	4,2500	,63269
(CCS)	5000-8000 TL	42	4,2713	,58021
4. DIVIENSION	8000-1000 TL	16	4,2132	,88252
	10000 TL and Above	18	3,9853	1,03066

**Table 7.** The descriptive statistics results of the conscious consumption scale and parent monthly average income level variable

**Table 8.** Conscious consumer scale "parent average monthly income level" 2nd and 3rd dimension

 One-Way ANOVA test results

Scale	Dimension Va	Source of riance	Sum Squares	of Sd	Mean Squares	F	*р
	Dimension2	Intergroup	2,724	4	,681	1,397	,236
CCS		Intragroup	100,457	206	,488		
		Total	103,181	210			
CCS	Dimension3	Intergroup	2,568	4	,642	,662	,619
		Intragroup	199,951	206	,971		
		Total	202,520	210			

Conscious Consumer status of the pre-service social studies teachers given in Table 6 was examined according to the 2nd and 3rd Dimensions of the Conscious Consumer Scale, according to the "Parental Average Monthly Income Level" variable.

When the findings obtained are examined, it is seen that there was no statistically significant difference between the status of being conscious consumers of individuals with different income levels in the 2nd and 3rd dimensions of the scale. As far as this finding is concerned, it is possible to say that pre-service teachers had similar mindset in terms of being conscious consumers in the 2nd and 3rd dimensions of the scale (P=.236; 619; p>.05).

Scale	Dimension	Parent Average Monthly Income Level	Ν	Rank Average	Sd	$\chi^2$	*p
	ſ	0-2000 TL	51	99,95			
sion	2000-5000 TL	85	113,31				
Č	Jeni	5000-8000 TL	41	98,73	4	2,400	,663
0	Din	8000-1000 TL	17	104,29			
	1.1	10000 TL and Above	17	106,85			
		Total	211				
	ſ	0-2000 TL	51	98,46			
70	sion	2000-5000 TL	85	109,20			
Ŭ	nen	5000-8000 TL	41	108,70	4	1,780	,776
0	Din	8000-1000 TL	17	114,65			
	4	10000 TL and Above	17	97,47			
		Total	211				

**Table 9.** Conscious consumer scale parent average monthly income level 1 and 4 dimensions kruskalwallis-h test results

Conscious Consumer status of social studies teacher candidates given in Table... was examined according to the 1st and 4th Dimensions of the Conscious Consumer Scale, according to the "Parent Average Monthly Income Level" variable. As far as the findings are concerned, it was found that there was no statistically significant difference between the status of being conscious consumers as individuals with different income levels in the 1st and 4th dimensions of the scale. Accordingly, it is possible to say that the pre-service teachers had similar mindset in terms of being conscious consumers in the 1st and 4th dimensions of the scale (P=,663; 776; p>.05).

### **Findings Regarding the Third Sub-Problem**

Is there a significant relationship between the attitudes of social studies teacher candidates towards purchasing geographically indicated products and their status as conscious consumers?

**Table 10.** The relationship between the attitude towards purchasing geographically indicated products and being a conscious consumer (pearson correlations) is illustrated below.

Ν	r	** p	
211	,281**	,000	

\*\* p< 0.01. \* p< 0.05

When the table is examined, as a result of the simple linear correlation analysis performed to reveal whether there was a relationship between the attitudes of pre-service social studies teachers towards purchasing geographically indicated products and their status as conscious consumers, it was found that there was a positive and significant relationship between the attitudes of pre-service teachers towards purchasing geographically indicated products and their status as conscious consumers ( $\mathbf{r} = 0,281, \mathbf{p} < 0.01$ ). Based on this particular result, it is possible to say that there was an increase in the attitudes of pre-service social studies teachers towards purchasing geographically indicated products as their status as conscious consumers (increase in the attitudes of pre-service social studies teachers towards purchasing geographically indicated products as their status as conscious consumers increased.

## **Discussion, Conclusion and Recommendations**

In this study, in which the relationship between the attitudes of pre-service social studies teachers towards purchasing geographically indicated products and their status as conscious consumers were investigated, the following results were obtained.

- ✓ In the present study, when the attitudes of pre-service social studies teachers towards purchasing geographically indicated products and their status as conscious consumers were examined in terms of the "gender" variable, it was revealed that there was no statistically significant difference in the attitudes of pre-service teachers towards purchasing geographically indicated products. It is possible to interpret this particular finding as follows; the male and female participants had similar attitudes at the point of purchasing geographically indicated products.
- ✓ Nevertheless, it was observed that there was no significant difference in terms of gender the variable in the second dimension of the Conscious Consumer Scale (Ethical Consumption). It is possible to interpret this particular finding as follows; the male and female participants had similar attitudes in terms of being conscious consumers. On the other hand, it was revealed that there was a statistically significant difference in favor of females in terms of the gender variable in the 1st (Environmentally Conscious Consumption) and 4th (Social Responsible Consumption) dimensions of the Conscious Consumer Scale. The result of the study done by Çakaloğlu and Çağatay (2017) overlaps with the result of the present study. In the study, it was concluded that the female consumers considered the geographically indicated products as a brand value and attached more value to these products. In the 3rd (Modest Consumption) dimension of the Conscious Consumer Scale, it was observed that there was a statistically significant difference in favor of males.
- ✓ When the attitudes of pre-service Social Studies teachers towards purchasing geographically indicated products and their status as conscious consumers are concerned by the "Parent Monthly Average Income Level" variable, it was found that there was no statistically significant difference both in their attitudes towards purchasing geographically indicated products and in behaviors of acting as conscious consumers (In all dimensions). This situation can be interpreted as the fact that the income level of the families did not have any impact over the participants' preference for geographically indicated products.
- ✓ The last finding obtained from the study was whether there was a significant relationship between the attitudes of pre-service social studies teachers towards purchasing geographically indicated products and their status as conscious consumers. When the findings were examined, it was observed that there was a positive and significant relationship between the attitudes of pre-service social studies teachers towards purchasing geographically indicated

products and their status as conscious consumers. This particular finding can be interpreted as the fact that the participants acted consciously when choosing geographically indicated products and they did so deliberately. These results are similar to the results of the studies conducted by Grunert (2005) and Anselmsson, Bandesson, Johansson (2014).

In the light of the data obtained from the present study, the following recommendations can be offered.

- ✓ This study can be duplicated with the pre-service teachers studying different subjects at different departments.
- ✓ Qualitative studies can be conducted on the concept of geographical indication and being a Conscious Consumer.
- ✓ In order to obtain more qualitative results, the study can be duplicated in different age and occupational groups.

# **Policy Implications**

Today, due to the rapid changes in technology and internet access, various changes and transformations are experienced in many areas of life. Accordingly, the comfort of reaching many products in a short time, although it seems like a useful situation in a short time, brings many negative situations in the long run. For example, access to poor quality products, loss of local and cultural products, loss of values, global powers bringing their own markets to the fore, the shrinkage and shrinkage of national markets, the phenomenon of fraud, the emergence of health problems, the disappearance of national products, the individual's need for products that are not needed. being directed as if it is a necessity, etc. Of course, raising individuals who invest in their own domestic and national products and shape their consumption in line with this perspective in a society is of course a very important factor in the development of that society and the society's having a say in the export share to be made in the world global platform. Teachers are undoubtedly important members of the society who undertake an important mission in transferring this consciousness to future generations. Students should avoid unnecessary expenditures in the lessons, prefer domestic products in consumption, create the perception of consuming what is necessary and what you need by moving away from the concept of consuming for consumption can be expressed as the topics that should be given importance in the education policies of the societies. Considering that the Social Studies course is one of the courses that have a say in creating this awareness, it is thought that the Social Studies teacher candidates who will practice this profession in the future should be trained with this understanding. Accordingly, it is assumed that this study will contribute to the relevant stakeholders in the field of education in the current situation and will shed light on the researchers who will work from now on.

## **Conflicts of Interest**

The Authors named in the article do not have any personal or financial conflicts of interest.

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# **Examination of Creativity Levels of Preschool Children**

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## Abstract

The study aims to examine whether the interaction of parents' education and income levels has a significant effect on the creativity scores of preschool children. The research was conducted in a district of Ankara, where parents are thought to vary in terms of income and education level. 123 children studying in independent kindergartens affiliated with the Ministry of National Education participated in the research. "Early Childhood Creativity Scale" was used as a data collection tool in the study. In the study, a 2x3 two-way analysis of variance was preferred because it was aimed to examine the possible effects or interaction effects of categorical independent variables on the continuous dependent variable. Test procedures were run after ANOVA assumptions were checked and it was observed that the assumptions were met. As a result of the research, it was determined that the interaction between parents' education levels and income levels had an effect on their children's creativity. When looking only through the main effects, independent of the interaction effect, it was determined that the level of parental education was influential on the creativity scores of the children, but the income level alone was not.

Keywords: Creativity, Preschool Children, Education Level, Income Level

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#### Introduction

The concept of creativity, which is included in the 21st century skills, has started to be used in every field today and has gradually become an important part of our lives. The concept of creativity, which manifests itself in all areas of life, has increased its importance even more today since the existence of constructive and creative individuals is needed to keep up with the developing and changing world (Özer & Yıldırım Polat, 2019). Creative individuals generally have features that can look at an event or situation from different perspectives, think outside of traditional ways, go beyond the given information and create original products (Yıldız Bıçakçı, 2012).

The specified features cover the most important competencies within 21st-century skills. Competencies of such important point to the concept of creativity. Creativity enables the production of new ideas and concepts. However, it is a mental and social process involving the creative mind's new associations between existing ideas or concepts. The conscious or unconscious process of insight fosters creativity. Good education, appropriate care, and providing opportunities for creative expression inspire, encourage and sharpen creative minds (Sharma, 2011). For this reason, the step related to creativity is also included in Bloom's revised taxonomy. Due to its importance and function, this step is at the top of the hierarchy of educational goals (Yeşilyurt, 2020). In recent years, interest in creativity has increased in the field of education. The development of creativity has increasingly been seen as an educational imperative. However, current educational strategies are limited to teaching rigid models that do not encourage creativity and knowledge acquisition through creative exploration. Children are considered smarter when they are able to acquire, remember and apply information that opposes a creative perspective (Castillo-Vergara et al., 2018). For this reason, it has become one of the main objectives of the education systems of many countries today. It is aimed to develop the creativity of individuals at all levels of education from preschool to university (Tuğluk & Özkan, 2019; Yeşilyurt, 2020).

In particular, the preschool period is a period in which all developmental areas of children gain momentum. This period is very important in terms of the development of creativity in children as well as forming the basis for formal education (Chien & Hui, 2010). In this period, while creativity shows an improvement of 90% in children aged 2-5, this rate may decrease to 20% from the age of 6-7. In other words, as age increases, the level of creativity also decreases. When children start school, they enter a new environment and recognize the rules and authority in the environment (Özer & Yıldırım Polat, 2019; Yeşilyurt, 2020). Children who have higher creativity skills in the pre-school period cannot maintain a large part of these creativity skills after they start primary school (Bogoyavlenskaya, 2013, as cited in Yeşilyurt, 2020). Environmental factors are the basis of this decrease. Among the environmental factors involved in creativity, variables such as parents' educational status and income level are very important. In the preschool period, these environmental

factors are largely dependent on parents' understanding and presentation of creativity education (Chien & Hui, 2010). Conscious parents can help their children to reveal their creativity-related powers by providing stimulants to improve their creative features, allowing freedom in their thoughts and activities, and creating environments based on respect and tolerance (Çeliköz, 2017). It is seen that this skill, which significantly affects the whole life of children, is affected by many factors.

Another environmental factor affecting creativity is the income level of the child's family (Sternberg & Lubart, 1992, as cited in Yang et al., 2020). Many studies have shown that there is a difference in creativity between children from low- and high-income families. It is claimed that children raised in families with high-income levels have higher creativity levels than children raised in families with low-income levels (Can Yaşar & Aral, 2011; Dai et al., 2012). Children raised in lowincome families have fewer resources, such as books, electronics, and travel opportunities. It can be argued that the reduction of these resources may also lead to negative cognitive, financial, and emotional states. As a result, when faced with unmet needs and external threats or problems, lowincome children may face difficulties in being creative (Kraus et al., 2012; Yang et al., 2020). Empirical research shows that high-income parents create a more positive learning environment to consciously develop children's creative abilities. In contrast, children from low-income parents will be more likely to face more pressure and difficulties due to the lack of good educational resources. More depression, anxiety, and other negative emotions are also factors that may be detrimental to the development of creativity (Dai et al., 2012; Zhang et al., 2018). When the literature is examined, it has been shown that there is a close connection between the income level of the parents and creativity, although there are exceptional cases.

Another factor affecting the development of creativity is the level of parental education. Parental education level is the source of creativity and family is the fertile ground for creativity. Since child discipline is the foundation and preliminary stage of school, there are differences in the development of creativity with age, but the development of creativity does not begin at the university stage. There is no doubt that the key to childhood experiences is largely associated with parents (Fang & Shen, 2021).

Çeliköz (2017)'s research on creativity and parental education level found that parental education level differentiated children's creativity levels. In the study of Tekin and Taşğin (2009), in which they examined the relationship between parental education level and their children's creativity, it was seen that the creativity level of children whose parents were undergraduate graduates was higher than those whose parents were primary school graduates. Heinla (2006) reported that creative thinking is higher in children when one or both parents have a high level of university education. Öztunç (1999), as a result of the research, stated that the creative thinking abilities of children whose parents are college graduates are higher than those of the children of high school, secondary school,

primary school, and illiterate parents. When the studies are evaluated, parents can be effective in satisfying their children's curiosity, presenting a rich stimulating environment, and displaying a democratic attitude in terms of education level. Therefore, the level of education can make a positive contribution to supporting and developing creativity.

As a result, creativity, which plays a key role in social and cultural change and is the focus of recent research, appears in every aspect of daily life. Creativity develops in the individual when positive environmental conditions are provided and emerges as a skill that can show itself in all areas of life. The development of this skill is possible with the opportunities that parents offer to their children. In line with the opportunities offered by the parents to their children, the creativity rates of children may differ. The fact that each child has different rates confirms that there are factors affecting the development of this skill (Özer & Yıldırım Polat, 2019; Zhang et al., 2018). When previous studies on the factors affecting creativity were examined, it was found that creativity was affected by parents' income and education level. In this study, it was examined whether the interaction of parents' education and income levels had a significant effect on the creativity scores of children in early childhood, and the aim of the study was formed in this direction.

# Method

## **Participants**

First of all, a region of Ankara, which is thought to vary in terms of income and education level of parents, was determined. In accordance with the purpose of the research, three schools from this region were selected for the study. Then, an independent kindergarten affiliated with the Ministry of National Education, which was confirmed to vary in terms of parents' income and education level, was included in the study by interviewing school administrators. It was decided to conduct the research with a total of 123 children (67 girls, 56 boys) who did not receive special education support and showed normal development in this school. Children live at home only with their parents. There are no other family elders. The mean age of the children was 63.18 months (SD=5.87). 13.8% of the parents are secondary school graduates, 38.2% are high school graduates and 48% are university graduates. In addition, it was determined that 61.8% of the parents were at the low-income level and 38.2% at the upper-income level, according to their own statements. The participants were informed that the data obtained would be used in scientific studies and that the names of the parents would be kept confidential, and consent was obtained from the parents.

# Materials

"Early Childhood Creativity Scale" was used as a data collection tool in the research (Çeliköz, 2017). The original version of the scale and permission to use were obtained by reaching the author via e-mail. The part of the scale that measures children's creative thinking skills consists of 12

items. As an example of scale items; "Child finds many solutions to a problem", "The child is imaginative and enjoys fantasy", "Child is flexible and can adapt to expected changes in situations" such as. The options of the 7-point Likert-type scale are "(1) Almost never, (2) Very rarely, (3) Rarely, (4) Sometimes, (5) Often, (6) Very often, (7) Almost always. "Çeliköz (2017) states that the scale consists of one dimension, this dimension explains 65% of the total variance and has a very high-reliability coefficient ( $\alpha$ =.95). After collecting data for this study, the reliability of the scale was retested and it was seen that the scale had sufficient reliability ( $\alpha$ =.87). In addition, demographic information about children and their parents was collected with the "General Information Form". While collecting information about the education level of the parents, the mother or father, who is interested in the education of the child and registered as the first parent to be contacted at school, was preferred.

# Procedure

Parents were informed about the scope and purpose of the study. All of the parents consented to the data collection and their children to participate in the study. The form prepared by the researchers for the parent's education, income, and age information of the children was delivered to the parents. The forms were collected from the parents within the specified time. For the scale to be filled by the teachers, before applying the scale, the researchers gave explanatory information about the items in the scale to the teachers, and what each item represented was explained with examples. It was filled in by the teachers after a careful observation process for each child individually. When the teachers were unsure about specific situations of the child according to the questions on the scale, they did not score the child.

### Data analysis

First of all, the forms collected from the teachers were transferred to the computer environment after they were checked and counted. It was checked again for missing or incorrect data entry. The independent variables of the study are the education status of parents in three categories (Secondary School-High School-University) and income status (Minimum Wage-Above Minumum Wage) in two categories. The dependent variable is the scores of the children in the creativity test. In this study, a 2x3 two-way analysis of variance (ANOVA) was preferred because it was aimed to examine the possible effects or interaction effects of categorical independent variables on the continuous dependent variable. First of all, ANOVA assumptions were checked, and after it was seen that the assumptions were met, ANOVA procedures were run. Levene's test was used for homogeneity in the variances of the variables, and the Shapiro-Wilk test for normality distributions for each cell in the 2x3 pattern was used. Corrected Bonferroni and Tukey tests were used from multiple comparison tests. All analyzes in the study were performed with SPSS 22 (IBM Corp, 2013). Partial η2 was reported in the analyzes and the significance level was accepted as .05.

#### Results

#### Analyzes for ANOVA Assumptions

In this study, there is no relationship between the observations in each group of independent variables or between the groups themselves, so the observations are independent of each other. In order to determine the extreme values, Boxplots graphs of the residual values of the dependent variable were examined and it was seen that there were no outliers. Normality distributions for each cell formed in the ANOVA design were evaluated with the t-Shapiro-Wilk's test and it was seen that the data were normally distributed (p > .05). Levene's test was conducted for the homogeneity of variances, which is another assumption. There was homogeneity of variances, as assessed by Levene's test for equality of variances, p = .537.

After the ANOVA assumptions were met, descriptive statistics were calculated for each group formed in the dependent and independent variables design (Table 1).

Income	Education Level	Ν	Μ	SD	Skewness	Kurtosis
Minimum	Secondary School	12.00	4.00	0.97	0.01	0.12
Wage	High School	23.00	4.11	1.09	-0.51	-0.71
	University	40.00	4.60	0.89	-0.04	-0.30
Above	Secondary School	4.00	3.33	0.76	-1.42	2.30
Minimum	High School	24.00	4.86	0.98	-0.34	-1.00
Wage	University	19.00	4.34	0.80	1.03	0.90

## Table 1. Descriptive statistics

#### Variance analyses and multiple comparison tests

In this step of the research, the results of the multivariate analysis were first examined in terms of the interaction effect. Educational status and income status, which are independent variables, were found to have a statistically significant interaction effect on creativity scores (p = 0.010). This shows that the effect of the educational status variable on the creativity scores depends on the income status, or similarly, the effect of the income status variable on the creativity scores depends on the education level. In short, there was a statistically significant interaction between income and education level for the "Creativity" score, F (2, 116) = 4.742, p = .010, partial  $\eta$  2 = .076 (Table 2). Since there is a statistically significant interaction, after this stage, it is necessary to determine whether there are univariate interaction effects for each independent variable separately (Pituch & Stevens, 2016). Therefore, follow-up univariate two-way ANOVAs were run.

	Sum of					Partial Eta
Source	Squares	df	Mean Square	F	Sig.	Squared
Corrected Model	15.139ª	5	3.028	3.432	.006	.129
Intercept	1284.876	1	1284.876	1456.248	.000	.926
Income Level	.059	1	.059	.066	.797	.001
Education Level	7.050	2	3.525	3.995	.021	.064
Income * Educa	8.367	2	4.184	4.742	.010	.076
Error	102.349	116	.882			
Total	2499.210	122				
Corrected Total	117.488	121				

**Table 2.** Univariate interaction effects for education and income status

Since a significant interaction effect was observed between Income Level and Education Level for creativity scores, analyzes were carried out to determine simple main effects (Laerd Statistics, 2016; Pituch & Stevens, 2016).

First, simple main effects by income level were run. According to the results of the analysis, creativity scores differed according to the income levels of the parents in the high school group, F (1, 116)=7.529, p=.007,  $\eta$  2 =.061. Looking at the averages, among high school graduate parents, those with income above the minimum wage had higher scores than those with income at the minimum wage level, .752 (95% CI, 209-1,295). Second, simple main effects were studied by education level. There was a statistically significant difference in the mean creativity scores of parents with a Secondary, High, and University School education above the minimum wage, F (2, 116) = 5.108, p < .01, partial  $\eta$  2 = .081.

When the Bonferroni-adjusted multiple comparison results were examined, there was a significant difference between the creativity scores of the children of secondary school and high school graduate parents with an income above the minimum wage (p= .010). According to creativity scores, the averages of High School graduate parents with income above minimum wage were higher than the averages of Secondary School graduate parents, 1,528 (95% CI, .295-2.760), p = .010. There was no significant difference between the other pairs of multiple comparisons.

#### Discussion

As the aim of the research was to determine whether the effect of parental education level on children's creativity is different for low and high-income groups. The results obtained for this purpose are that the interaction between parents' education levels and income levels has an effect on their children's creativity. When we look at only the main effects, independent of the interaction effect, we saw that the education level of the parents was effective on the creativity scores of the children, but the income level alone was not.

One of the main questions that we seek to answer in the research is whether the educational status of the parents has an effect on the creativity of the children. The results showed that parental

education levels had an effect on children's creativity scores, regardless of parents' income status. In their study, Dewing and Taft (1973) found that maternal education level was associated with both creativity test scores and the creative performances of children. Dursun and Ünüvar (2011) found in their study that parents with a high level of education are more conscious than parents with a low level of education. Can Yasar and Aral (2011) found that parental education levels make a significant difference in children's creative thinking skills. Lu (2003) reported that fathers' education level is a positive predictor of children's creativity. Laosa (1978) found a positive relationship between mothers' level of education and creativity. Regarding the effect of a mother's education level on creativity, Brophy (1970) reported that mothers' teaching strategies with their children were related to the mother's education level. Again, studies have found that the higher education level of parents from parents affects the creative development of children (Lin, 2009). The findings given above show parallelism with our research results in terms of revealing the relationship between the education level of the parents and the creativity levels of their children. So the fundamental question we should ask is "Why is that so?" When we look at the literature, it can be shown that the most likely answer to this question is that parents with a high level of education spend more time with their children (Guryan et al., 2008). The fact that parents spend more time with their children, especially in the preschool period, may cause children to develop at the desired level in cognitive and affective terms. Educated parents generally have high incomes (Guryan et al., 2008), and the opportunities brought by this situation can be reflected as a facilitating factor in meeting the cognitive and affective needs of children.

Again, studies have shown that better-educated parents provide children with more support and cognitive stimulation than children from socially disadvantaged homes. They also stated that they engage in various intellectual activities with their children more frequently. Therefore, they indirectly support their children's creativity (Dai et al., 2012; Jankowska & Karwowski, 2019). From this point of view, the education level of the parents emerges as an important determinant in the education structure. The education a parent gives to their child plays a decisive role in the child's behavior and thinking. A parent whose cognitive process is higher due to education will be a better mentoring model for their child. At the same time, during the child's educational stages, a cognitive explanation and mindset will prevail over a non-cognitive teaching behavior. This child is likely to have difficulty developing creative roots. The development of a logical thought progression maximizes cognitive abilities. This development of cognitive structure is vital to creativity. Therefore, education level can be a powerful influence on the development of a creative mind (Griffith et al., 2018). Regarding this variable, it can be thought that a well-educated parent figure contributes positively to the child's learning process and thus affects their children's creativity.

Another question that is tried to be answered in the study is whether the income level of the parents has an effect on the creativity scores of the children. According to the results of the analysis, income level does not have a significant effect on creativity scores when all education levels of the parents are taken into account (Table 2). However, since a significant interaction effect was reached in this study, the results of the simple main effects analysis show that the income levels of the parents in the high school group make a difference in the creativity scores of the children. In fact, this is a very important point that shows that the evaluation of income level independently of the education level of the parents may be insufficient. However, when we look at the literature, it is seen that the income level is mostly evaluated alone in the studies on the relationship between income level and creativity. Castillo-Vergara et al. (2018) examined the creativity scores of 5th-grade students according to their socio-economic status, which is an important indicator of their income level, and found that all dimensions of creativity differed significantly according to SES. More generally, Tang et al. (2022) stated that school location is a significant predictor of Creative Ideation Behavior (CIB) in a Structural Equation Modeling study examining the effects of different variables on students' CIB scores. In other words, as the socioeconomic level of the region where the school is located increases, the CIB scores of the children also increase. Although the results of the related research are not directly related to this study, it is very important in terms of revealing the effects of socioeconomic level on creative thinking behaviors. As can be seen, income level is generally associated with creative skills. When this relationship is examined in more detail, the result does not change. Haley (1984) concluded in his study that socioeconomic status has a significant effect on verbal fluency, verbal originality, kinetic fluency, kinetic originality, and integrative fluency, which are subdimensions of creativity. However, in this study, as seen in Table 1, the relationship between income level and creativity did not show a significant difference regardless of education level. There could be several reasons for this. First of all, the sample group participating in this study is preschool children and this age group has not completed their intellectual development yet. Because the influence of individual experiences and experiences on the development of creative skills is quite high (Xu & Pang, 2020), it becomes difficult to talk about creativity development that is enriched by experiences at younger ages. Another reason is that in studies associated with SES, the components that make up SES do not consist only of income level. Occupation type, place of residence, prestige, ethnic origin, and even religious groups are included in SES determinations (APA, 2022).

According to the results of the analysis, perhaps the most important output of the research is the significant interaction effect of income status and education level on creativity scores. In fact, this result is very important in that it shows that income level alone is no longer a significant predictor of creativity, but when evaluated together with education level, it makes a significant difference in the creativity of the children of parents with higher education levels since the income levels of the parents may not have created enough life and experience environment to be reflected in the creativity scores of the children in the preschool age group in this study. It is also conceivable that income level and a range of psychosocial factors potentially mediate creativity. However, this situation is different for the education level of the parents. Educated parents may approach their children more consciously, both verbally and behaviorally, starting from the birth of their children. Similarly, Can Yaşar and Aral (2011) stated the relationship between education level and creativity; They argue that the level of education is effective in developing mothering styles, and it helps parents to raise and develop themselves in all areas such as child care, development, and education.

The interaction effect, on the other hand, reveals that the gains of the parents from the education level are actually more meaningful with the income level. As the education level rises, the participation rate of parents in social life may increase and they can take part in a good job. Naturally, there is an increase in the income level and it can offer a rich stimulating environment to the child. At this point, the creativity of the child can be greatly supported (Çeliköz, 2017). Considering the contrary, it can be predicted that the creativity of children of high-income parents will not always be high. As a result, the combination of education level and high-income level are highly effective variables in children's creativity. It can also be said that the combination of these variables rather than their separate effects is more meaningful and can provide children with richer experiences.

## **Conclusion and Recommendations**

The preschool period is a period in which the emotional and cognitive development of children is quite rapid. In this period, it is very important to create environments that are supported and that help him gain rich experiences. In this study, we have brought a different perspective to the findings in the field by revealing how the education levels and income levels of parents, whose effects on creativity are generally investigated separately in the literature, interact together. In other words, the interactions of independent variables that have an effect on creativity can also affect their level of influence. For this reason, the coexistence of different variables in such studies directly affects the interpretation of the outputs to be obtained from the study. As a result, at the point of development of creativity, it is necessary to focus on both variables instead of considering the effect of education level or income level alone. In this sense, it is very important to identify and strengthen the aspects of parents that need to be supported in terms of raising more creative children.

### Limitations

This research has several limitations. First of all, the sample group in which the study was conducted is the preschool period and it is a stage in which the creativity skills of the children continue to develop. For this reason, the results of the study should be continued in the following age ranges and compared with the findings obtained. Another limitation is that parents' income levels cannot be obtained by more objective institutions or tools. Therefore, these data are limited to the self-reports of the parents.

### **Policy Implications**

From the past to the present, the creativity skills of children have always brought about a serious change, especially in the 21st century, although it is always tried to be kept in the foreground. In this century, more importance has been given to creativity skills and the development of these skills of children has been taken as a basis. For this, it is important to offer creative environments to children. This is only possible thanks to the consideration of education policies in the light of 21st century skills. Because one of the important goals of education is to solve the difficulties encountered in a creative and original way. It is noteworthy that the creativity ability, which is thought to exist in children, decreases over time. Today, children do not encounter difficulties in accessing information with the convenience of the digital age. However, children face difficulties in making sense of information or using it effectively. This situation may appear as a situation that negatively affects the current and future academic and personal development of children. At this point, the important thing is that the institutions that determine the education policy should produce education policies on how to support creativity in education and learning processes in a more qualified way. As it is known, creativity can improve as long as it is supported. However, today's education and training materials also undergo changes in the process. For this reason, it is the adaptation of these materials to the process without reducing their effectiveness within the processes that support creativity. Because the 21st century necessitates the creation of new skills and new behaviors in children.

#### **Ethical Approval**

All procedures of this study involving human participants complied with the 1964 Helsinki Declaration, subsequent changes and the standards of Düzce University Scientific Research Publication and Ethics Committee (Report No E-78187535-050.06-223.

## **Conflict of Interest**

The authors have declared that they have no competing or potential conflicts of interest. The authors confirm full responsibility for reporting the research and data and maintain that the material contained in the manuscript represents original work.

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The contributions of the authors in the study are as follows: "Conceptualization, methodology, investigation, drafting and writing, Elcin Yazici Arici; Conceptualization, review and editing, H. Kagan Keskin; methodology, writing-review and editing,

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# The Effects of Out-Of-Class Learning on Students' Interest in Science and Scientific Attitudes: The Case of School Garden

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# Abstract

This study aims to reveal the effects of out-of-class learning activities conducted in the school garden on students' interest in science and their scientific attitudes. Research designed as a pretest-posttest control group quasi-experimental design of quantitative research methods. The research group of the study consists of 37, 7th grade students enrolled in a public school in Turkiye. Reproduction, growth and development in plants were conducted through school garden-based science activities for seven weeks. The research data were collected using Science Interest Scale and Scientific Attitude Scale. The study findings showed that garden-based activities have a moderate and close to moderate effect on students' interests in science and scientific attitudes. As per these findings, we can say that school gardens are out-of-class learning environments that can be used to help increase students' interest and attitudes toward science.

**Keywords:** Out-Of-Class Learning, School Garden, Scientific Interests, Scientific Attitudes, Science Education

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#### Introduction

Nowadays, science and technology are developing at an unprecedented pace. Changes that take place naturally affect the needs of societies, characteristics that individuals should have, and the structure of education. Current educational approaches focus on the acquisition of characteristics such as producing knowledge, making functional use of knowledge, problem-solving, critical thinking, research inquiry, entrepreneurship, creativity, and effective communication. Educators often mention the limitation of the learning mode realized only inside the classroom walls to have students acquire these characteristics (Akçalı, 2015). At this point, learning environments, where students can have first-hand experiences, see, practice, and feel the real-life equivalents of knowledge gain significance. These learning environments could be within or beyond the classroom walls. As Lieverman states, "For a more effective education reform, teachers should free children from classrooms" (as cited in Louv, 2017). According to these facts, the notion of conducting teaching activities not only in the classroom environment but also using out-of-class environments are generally referred to as "outdoor learning/education", "out-of-school learning/education", and "out-of-class learning/education". In this study, out-of-class learning, was adopted in line with the research content.

### **Out-of-Class Learning**

Out-of-class learning can be defined as children learning about people, their heritage, and natural environments through playing and other first-hand experiences in various settings beyond the classroom. Among other things, out-of-class learning can help students (Grigg & Lewis, 2016):

- Acquire knowledge about the environment
- Develop personal and social skills
- Learn about how things work and link together
- Think critically and creatively when they solve problems in real-world contexts
- Foster open-mindedness and caring responsible attitudes towards their environment.

Out-of-class learning is not the same as outdoor learning because out-of-class contexts include indoor settings such as museums, galleries, archives, science centers, as well as virtual worlds and the home environment (Grigg & Lewis, 2016). Outdoor learning can take place in any outdoor setting, from a schoolyard to remote wilderness settings, such as swamps, meadows, forests, shores, and so forth. Outdoor education can take place through walking around the block, or visiting a cemetery, a gravel pit, or an urban renewal project. It could happen in the playground, weeds of a vacant lot, a sewage treatment plant, a zoo, a forest trail, or in a national park. Such places are offer
first-hand learning experiences, having direct connection with the topic and fostering interaction and socialization (Ford, 1986).

Priest (1986, p. 13) defines outdoor education as "an experiential method of learning by doing, which takes place primarily through exposure to the out-of-doors." The actual "outdoor education" is conducted "outdoors". This is because outdoor education encourages interaction between the students and the outdoor setting (Priest, 1986). Outdoor education can be described as integrating the learning activities with real-life in outdoor settings beyond the school and classroom walls.

Another term including learning environments beyond the classroom and school walls is outof-school learning. Out-of-class learning is not the same as out-of-school learning, despite sharing common features and similarities. Out-of-school learning encompasses many activities from living areas to virtual environments beyond the school boundaries (Eshach, 2007). Informal daily informal experiences in visual, print, and digital media and informal settings such as science centers, museums, zoos, industrial sites, aquariums, botanical gardens, library visits, and programs such as science festivals, camps, or after-school activities are examples of out-of-school learning education (Falk & Dierking, 2000). As such, outdoor education encompasses a multi-dimensional process, which links outdoor settings and learning activities. Out-of-school learning comprises learning environments that integrate outdoor or indoor settings outside the school with learning activities. However, out-of-class learning involves a comprehensive process, which integrates the outdoor or indoor settings beyond the classroom walls with learning activities. According to these definitions, as stated before, the term, out-of-class learning, was adopted.

The document, Learning Outside the Classroom Manifesto, argues that learning outside the classroom can offer students direct experiences that provide powerful contexts for learning plus deepen and enrich the classroom learning (DfEs, 2006). Out-of-class learning has no fixed boundaries. It can include cultural visits, environmental education, fieldwork in science and geography, outdoor and adventurous group activities, learning through outdoor play, visits to museums, galleries, and heritage sites. However, considering the convenience of curriculum planning, out-of-class activities may cover three main areas: the schoolyard, the immediate neighborhood, and remote areas requiring transportation (Grigg & Lewis, 2016). Of out-of-class learning environments, this study focuses on the school garden.

#### School Gardens as Out-of-Class Learning Environments

Educators can no longer teach the scientific concepts using course books alone. They have to employ hands-on and minds-on science techniques. School gardens are used as immediate learning environments suitable for these techniques and convenient contexts for pupils to see natural processes and cycles in person (Blair, 2009). The purposes of school gardens are named as academic, behavioral, entertainment, social, political, and environmental. Students not only will acquire knowledge from school garden experiences but also may begin to appreciate the natural resources in the environment and adopt a sustainable way of thinking and behavior (Blair, 2009).

A school garden gives students a chance to discover plant life cycles and provides a practical learning environment for teaching many skills in various disciplines such as science, mathematics, social studies, language arts, health, and visual arts. School gardens can inform students about collaboration, nature, science, creativity, and social services. In addition, gardens can help teachers to address various needs and interest areas of students. Integrating the course topics into the garden can fulfill other curricular objectives (Bundschu-Mooney, 2003). A classroom garden may also offer interdisciplinary project-based activities. Creating a school garden habitat where various small theme gardens can be developed is persuasive and students can obtain information about local ecology, bio-diversity, and gardening. Apart from developing an increasing appreciation for the natural world, these outdoor classrooms create an environment where students can plan and implement private projects on nutrition, environmental consciousness, and beautifying society (Bundschu-Mooney, 2003).

At present, generally, the educational practices related to school gardens are approached together with nutrition education (Gardner-Burt & Koch, 2017; Cotugna, Manning, & DiDomenico, 2012, Morgan, Warren, Lubans, Saunders, Quick, & Collins, 2010), agricultural practices (Duncan, Collins, Fuhrman, Knauft, & Berle, 2016), environmental education (Blair, 2009; Fisher-Maltese & Zimmerman, 2015), food preferences/behaviors (Cairns, 2016; Blair, 2009; Ratcliffe, Merrigan, Rogers, & Goldberg, 2009; Morgan, Warren, Lubans, Saunders, Quick, & Collins, 2010), Health education (Greer, Rainville, Knausenberger, & Sandolo, 2019), and science education. When studies on school gardens in science education are examined, they mostly focus on academic outcomes/achievement or scientific knowledge (Camasso & Jagannathan, 2018; Klemmer, Waliczek & Zajicek, 2005; Ürey & Cepni, 2015; Berezowitz, Andrea, Bontrager, & Schoeller, 2015). A metaanalysis study of 48 studies (1990-2010) in the United States reported the positive effects of gardenbased learning programs on students' academic achievement in science, math, and language arts and the indirect effects of emotions and behaviors, supporting academic achievement (Williams & Dixon, 2013). In addition to their academic skills, students' affective skills are also of great importance during the educational process. Stimulating students' interests and attitudes toward science is one of the major objectives of teaching. The fact that how science courses are structured is important for students who are interested in scientific issues, investigate, inquire, conduct experiments and observations, discuss, and have positive scientific attitudes.

Planned educational practices developed in school gardens are reported to offer an interdisciplinary active learning environment and have positive effects on students' academic achievement and attitudes (Stoecklin, 2009).

## **Research Problem and Research Focus**

Using of out-of-class learning environments in science teaching is endorse changing the learning environment, fuel interest in science, and increase students' science achievement. (Dori & Tall, 2000).

Research shows that teachers welcome learning in out-of-school settings, but do not often prefer these environments (Carrier, 2009; Köseoğlu & Türkmen, 2020). Dillon et al. (2006) grouped the barriers to the implementation of out-of-school education into two categories: external and personal factors. External factors were listed as teachers' fears and concerns about the health and safety of their students, self-efficacy concerns towards out-of-school teaching, and lack of resources, time and support. Personal factors were listed as students' age, previous knowledge and experience, fears and phobias, learning styles and preferences, and students with special educational needs (Tatar & Bağrıyanık, 2015). At this point, school gardens stand out as more practical alternative learning environments. As educators, we can claim that school gardens are our immediate out-of-class learning environments.

As a result of the literature review on the topic, we can note two critical points that emerge before us. First, there is a relatively small number of studies conducted in school gardens as out-ofclass learning environments in a science course. Therefore, it is thought that an increase in the number of empirical studies regarding the school garden that offer many learning opportunities as an out-ofclass learning environment is imperative. Second, studies regarding science courses conducted in school gardens mostly focus on academic achievement. This study focuses on students' scientific attitudes and interest in science.

#### **Research Aim and Research Questions**

This study aims to reveal the effects of out-of-class learning activities conducted in the school garden on students' attitudes in science and their scientific attitudes. The research questions are listed below:

1. Is there a significant difference between the "Science Interest Scale" pretest scores of the experimental and control group students?

2. Is there a significant difference between the experimental and control group students' "Science Interest Scale" posttest scores?

3. Is there a significant difference between the "Science Interest Scale" pretest and posttest scores of the experimental group students?

4. Is there a significant difference between the "Science Interest Scale" pretest and posttest scores of the control group students?

5. Is there a significant difference between the "Scientific Attitude Scale" pretest scores of the experimental and control group students?

6. Is there a significant difference between the "Scientific Attitude Scale" posttest scores of the experimental and control group students?

7. Is there a significant difference between the "Scientific Attitude Scale" pretest and posttest scores of the experimental group students?

8. Is there a significant difference between the "Scientific Attitude Scale" pretest and posttest scores of the control group students?

## Method

# **Research Model**

Research designed as a pretest-posttest control group quasi-experimental design of quantitative research methods. In educational research, it is not often possible for the researchers to conduct true experiments, for instance, through a random selection and assignment of participants to control or experimental groups. In such cases, researchers employ a quasi-experimental research design. Quasi-experiments involve field experiments, outside the lab (Cohen, Manion & Morrison, 2018).

Quasi-experimental designs are used in cases when working on existing groups where the participants cannot be randomly assigned to groups. As situations requiring the use of the true experimental design could not be created and using a random sampling method was not possible, a pretest-posttest control group quasi-experimental design was used in this study.

The pretest-posttest control group quasi-experimental designs examine the effect of an experimental procedure on a dependent variable (Fraenkel, Wallen, & Hyun, 2012). In this study, the independent variable is the out-of-class learning practices, and the dependent variables comprise interest in science and scientific attitudes. In the experimental group, out-of-class learning practices were conducted in the school garden. However, in the control group, the lessons were conducted based on the existing methods foreseen in the textbook and science curriculum determined by the Ministry of National Education. The model of the research method is presented in the following table.

Groups	Pretests	Procedure	Posttests
Experimental	Science interest scale	Conducting the lessons with out-	Science interest scale
group	Scientific attitude scale	school garden	Scientific attitude scale
Control group	Science interest scale	Conducting the lessons as	Science interest scale
	Scientific attitude scale	foreseen in science curriculum	Scientific attitude scale

Table 1. The model of the research method

#### **Study Group**

The research group of the study consists of 37, 7th grade students enrolled in a public school in Antalya/Kaş, Turkey. When determining the study group, easy accessibility was used as a base. Three main factors were taken into consideration while determining the school and study group where the research would be conducted. (i) The school garden was suitable for out-of-class learning activities, (ii) the science teacher in the school was open to new educational practices and collaboration for research, (iii) the number of students in classes was small.

After reaching a consensus on the suitability of the school for this study, two scales were administered in two grade 7 intact classes and their pretests were compared to determine the study groups. As there were no significant pretest differences, these two classes were determined as the study group. The groups were assigned to experimental and control groups through a random assignment. The class consisting of 17 students was determined as an experimental group, and the class consisting of 20 students was determined as a control group.

The teacher is willing to participate in the research and has sufficient teaching experience. While planning the activities, the views and suggestions of the teacher were taken into consideration. A meeting was held with the teacher on how to apply each activity. The activities were applied by the science teacher. Researchers participated in the classes as observers.

#### Instruments

The research data were collected using two different scales. In order to measure the effects of out-of-class activities carried out in the school garden on students' interests in science and their scientific attitudes, the "Science Interest Scale", developed by Laçin Şimşek and Nuhoğlu (2009), and the "Scientific Attitude Scale", developed by Moore and Foy (1997) and adapted into Turkish by Demirbaş and Yağbasan (2006), were used, respectively.

The Science Interest Scale consists of 27 five-point Likert type items. Some items include positive expressions and some negative. While scoring the scale, the negative statements were reverse-scored. A minimum of 27 and a maximum of 135 scores can be obtained from the scale, where high scores indicate high interest in science subjects. The Cronbach's Alpha reliability coefficient of the scale was calculated as 0.79.

The Science Attitude Scale includes a total of 40 items. The 40 five-point likert type items in the scale are about explaining the nature of science, the working styles of scientists, and what students feel about science. Of the items included in the scale, 20 are positive and 20 negative. While scoring the scale, the negative items were reverse-scored. The highest and lowest obtainable scores from the scientific attitude scale range from 200-40, respectively. The Cronbach's Alpha reliability coefficient was 0.76, and the Spearman Brown split-half correlation was 0.84.

# Procedure

Reproduction, Growth, and Development in Plants were taught to both groups for a total of seven weeks, four hours a week. In the experimental group, the instructional activities were conducted in the school garden as an out-of-class learning environment. However, in the control group, the lessons were conducted depending on existing methods in the textbook and science curriculum determined by the Ministry of National Education. The instructional activities in the control were carried out according to the textbook used in the current syllabus.

Activities conducted in the school garden were planned in such a way that would offer opportunities for students to do observations and experiments in the school garden. All activities were created based on the question "How do reproduction, growth, and development occur in plants?" During seven weeks, various out-of-class activities were conducted in the school garden for the students to observe the reproduction type, growth and development processes in plants, the factors affecting the growth and development, and to take care of a plant and report its development process. The procedure of out-of-class learning practices are summarized in the following table 2.

Week	Topics and Concepts	Out-of-Class Learning Activities	Activity Objective
1	-Sexual and asexual reproduction -Lifecycle	-Sexually and asexually reproducing organisms in our environment -Determining a plant for lifecycle	<ul> <li>-Understanding the lifecycle of organisms</li> <li>- Giving students examples from the sexually and asexually reproducing organisms by unraveling their prior knowledge on sexual and asexual reproduction</li> <li>-Cultivating plants in the school garden and observing the suitability of plants for growth, and deciding on plants to grow.</li> </ul>
2	-What is the seed?	-What is required for	-Observing the conditions required for
3	-The concepts of growth and development in organisms -Factors affecting growth and development in plants	-Can there be life without water, sun, and air?	-Understanding the concepts of growth and development -Observing some factors affecting growth and development in plants
4	-Asexual types of reproduction in plants	-Reproduction of plants from the stem	-Explaining asexual types of reproduction (vegetative, cutting, grafting, and budding reproduction). -Observing the vegetative reproduction

Table 2. The Procedure or	of Out-of-Class	Learning Practices
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5	-Photosynthesis	-The effect of sunlight on	-Observing the effect of sunlight on
		photosynthesis	photosynthesis
		-Do plants sweat?	
6	The reproduction process in	-Let's compare the growth	-Observing the growth and development
	plants from seed to sapling	and development of plants.	process of a plant
7	-Lifecycle in plants	-Reporting the reproduction,	-Presenting and discussing the
		growth, and development	observation notes, pictures, and graphics
		processes in plants	

#### Week 1

The experimental group students to work with in out-of-class learning environments were met up in the school garden. They were asked to determine the organisms by observing the environment in the school garden. By directing the question "How do the organisms that you see in your surroundings come into existence?" they were enabled to reveal their knowledge about how the organisms continue their breeds through reproduction.

By unraveling their prior knowledge of sexual and asexual reproduction, students were asked to give examples from the sexually and sexually reproducing organisms they determined in the school garden (cats, birds, pines, roses, etc.), and the organisms in their near surroundings. In line with these examples, explanations were provided about sexual and asexual reproduction. In this stage, visual materials were used.

Students were asked about what the "lifecycle" was for organisms they saw in their environment. After getting the responses, they were told that they will observe the lifecycle of a plant, providing explanations.

Decisions were made together with students that which plants to grow per the region and weather conditions. At the same time, it was decided on which plants to grow from seeds and which plants to grow from saplings. In order to make the school garden suitable for growing plants, the soil was aerated with the students and watered to moisten, with the help of school staff. For the procurement of seeds and saplings, the researchers talked to relevant people or institutions.

# Week 2

The activity started by asking questions to students regarding the topic, such as "What is seed?", "How do the plants grow?", "What is germination?", and "What conditions are required for germination?" After receiving answers from students, necessary explanations were made according to the answers.

The areas where the seeds and saplings will be planted were determined together with the students, and each student planted their seeds and saplings in the soil and watered them under the guidance of the teacher. Each student was asked to follow and note down the development process of

his/her seed and sapling on weekly basis. For students to note down the process healthily, a "plant development observation form" was distributed to them.

# Week 3

Students were asked about the concepts of growth and development. Based on the answers obtained, the difference between the two concepts was highlighted. They were asked to determine non-living elements interacting with living creatures in the environment by observing the school garden (factors affecting the living creatures). Students gave answers such as temperature, sunlight, soil, water, and air. In this respect, factors affecting growth and development in plants, including air, water, temperature, minerals, and light factors were discussed one by one.

For the "Can there be life without water, sun, and air?" activity, three equal-sized small trees were selected. One of these trees was not watered, the other was covered from sunlight, and the last one was covered with plastic and the air inside was vacuumed out. Students were asked to note the changes occurring in the three trees in subsequent days. Students explained which tree continued developing and which one did not.

# Week 4

In the activity called "reproduction of plants from the stem", it was observed that plants not only can reproduce from seeds or saplings but can also reproduce from the stem through vegetative reproduction. The teacher asked students questions such as "How do plants reproduce? Do all plants reproduce with the same method?" and evaluated their answers. Based on the answers provided by students, the information on asexual reproduction was repeated and the types of asexual reproduction (reproduction through vegetative, cutting, grafting, and pudding) were explained. It was explained that plants not only can reproduce from seeds but can also reproduce through vegetative, cutting, and grafting methods. They were asked to observe the vegetative reproduction process by cultivating potatoes in the school garden and to note down their observations.

# Week 5

Activities called "the effect of sunlight on photosynthesis" and "do plants sweat?" were conducted. Information about photosynthesis was provided to students. In order to examine the effect of light on photosynthesis, the leaves of the plant were covered with aluminum folio. After storing them for a few days, the folio was opened and the colors of the leaves were compared to other leaves. Tincture of iodine was dripped on a leaf and the color change in the leaf was observed. However, when it was dripped on the leaves not covered with the folio, they turned blue. The change of color indicated the presence of starch, a nutrient in the leaves. In order to observe sweating in plants together with students, the plants were covered with airtight bags and stored for two days. The bags

were removed and evaluations were made together with students. As a result of the observations, it was concluded that plants sweat as a vital activity.

#### Week 6

The development process of the plants planted in the school garden as saplings and seeds were examined with students based on the observation forms and a general evaluation was made of the process. Students evaluated the characteristics relating to the growth and development processes of plants, such as their growth rate, height, number of leaves, number of branches, bud formation, and flowering, based on the notes they had taken. In addition, the plants cultivated as seeds and saplings were compared according to these characteristics. In the last section of the lesson, they prepared an illustration and graphic showing the school garden and the growth and development processes of their own plants to present next week.

## Week 7

As in previous weeks, students met up in the school garden in the last week. The out-of-class learning activities conducted in the process were summarized. Students presented their presentations regarding the growth and development processes of their plants to their classmates. Finally, students were asked to share their feelings and ideas about the learning practices carried out in the school garden for seven weeks.

#### Results

#### **Findings Regarding the First Research Question**

The question "Is there a significant difference between the "Science Interest Scale" pretest scores of the experimental and control group students?" constitutes the first research question. In the analysis of the data related to this research question, the Mann Whitney U test was used. Through this test, the science interest scale pretest scores of students in the experimental and control groups were compared.

Table 3 provides the mean of ranks and the Mann Whitney U test analysis results of the interest scale administered to the experimental and control students before the intervention process.

**Table 3.** Mann Whitney U Results for Science Interest Scale Pretest Scores of Experimental and Control Groups

Groups	Ν	Mean Rank	Sum of Ranks	U	Z	р
Experiment	17	22.32	379.50	113.5	-1.723	.085
Control	20	16.18	323.50	-		
Total	37			-		

According to the results in Table 3, the Mann Whitney U test yielded no significant difference between the Science Interest Scale pretest scores of the experimental and control group students (Z = -

1.723; p = .085 > .05). It shows that the level of interest of the experimental and control groups in science was relatively close to each other before starting the research.

#### **Findings Regarding the Second Research Question**

As the second research question in the study, an answer was sought to the question "Is there a significant difference between the "Science Interest Scale" posttest scores of the experimental and control group students?" At the end of out-of-class learning practices, the Science Interest Scale was administered to both groups, and the collected data were analyzed using the Mann Whitney U test. Through this test, the Science Interest Scale posttest scores of students in the experimental and control groups were compared. Table 4 shows the resultant findings.

**Table 4.** Mann Whitney U Results for Science Interest Scale Posttest Scores of Experimental and Control Groups

Groups	Ν	Mean Rank	Sum of Ranks	U	Z	р	r
Experiment	17	26.79	455.50	37.500	-4.042	.000	0.66
Control	20	12.38	247.50	-			
Total	37			-			

When Table 4, showing the results of the Mann Whitney test conducted to compare the Science Interest Scale posttest scores of the experiment and control groups, is examined, there is a statistically significant post-experiment difference between the groups at a p < .05 level, favoring the experimental group (Z = -4.042; p = .000 < .05). While the mean rank of the posttest scores of students in the experimental group was 26.79, the mean rank of the posttest scores of students in the control was 12.38. The results of this analysis showed that the Science Interest Scale scores of students in the experimental group were higher after out-of-class learning practices than those of students in the control. Considering the effect size value (r = 0.66), the effect size of this between-group difference is at a moderate level.

#### **Findings Regarding the Third Research Question**

As the third research question in the study, an answer was sought to the question "Is there a significant difference between the "Science Interest Scale" pretest and posttest scores of the experimental group students?" In order to compare the pretest and posttest scores that the experimental group students obtained from the Science Interest Scale, the Wilcoxon Signed Ranks Test was applied. Table 5 shows the resultant findings.

 Table 5. Wilcoxon Signed Ranks Results for Science Interest Scale Pretest-Posttest Scores of

 Experimental Group

Pretest-Posttest	Ν	Mean Rank	Sum of Ranks	Z	р	r
Negative Rank	4	4.63	18.50	-2.747	.006	0.45
Positive Rank	13	10.35	134.50			
Total	17					

Table 5 shows that there is a significant difference between the pretest and posttest scores obtained by the experimental group students from the Science Interest Scale (Z = 2.747, p = .006 < .5). When we examine the sum of ranks of difference scores, the difference favors the positive ranks, showing that the posttest scores are in favor of the experimental group. According to these findings, the out-of-class learning practices conducted in the school garden may have significantly increased the experimental group student's interest in science subjects. Considering the effect size value (r = 0.45), the effect size of this between-group difference is small but close to moderate.

# **Findings Regarding the Fourth Research Question**

As the last research question relating to the interest scale in the study, an answer was sought to the question "Is there a significant difference between the "Science Interest Scale" pretest and posttest scores of the control group students?" In order to compare the pretest and posttest scores that the control group students obtained from the Science Interest Scale the Wilcoxon Signed Ranks Test was applied. The resultant findings are shown in Table 6.

 Table 6. Wilcoxon Signed Ranks Results for Science Interest Scale Pretest-Posttest Scores of Control

 Group

Pretest-Posttest	Ν	Mean Rank	Sum of Ranks	Ζ	р
Negative Rank	13	11.88	154.50	-1.851	.064
Positive Rank	7	7.93	55.50		
Total	20				

As seen in Table 6, there is no significant difference between the pretest and posttest scores obtained by the control group students from the Science Interest Scale (Z = 1.851, p = .064 > .5). According to these findings, the learning practices carried out in the control group did not lead to a significant difference in students' interests in science subjects.

# **Findings Regarding the Fifth Research Question**

The question "Is there a significant difference between the "Scientific Attitude Scale" pretest scores of the experimental and control group students?" constitutes the fifth research question of the study. The Mann Whitney U test was used in analyzing the data collected regarding this research question. Using this test, the Scientific Attitude Scale pretest scores of students in the experimental and control groups were compared. Table 7 provides the analyses results for the Scientific Attitude Scale administered to the experimental and control students before conducting the out-of-class learning practices.

Table 7. Mann	Whitney	U Results	for	Scientific	Attitude	Scale	Pretest	Scores	of Experiment	ntal a	and
Control Groups											

Groups	Ν	Mean Rank	Sum of Ranks	U	Ζ	р
Experiment	17	16.21	275.50	122.50	-1.449	.149
Control	20	21.38	427.50			
Total	37					

As shown in Table 7, no statistically significant difference exists between the Scientific Attitude Scale pretest scores of students in the experimental and control groups (Z = -1.449; p = .149 > .05). Therefore, one could say that the level of scientific attitude of students in the experimental and control groups was somewhat close to each other before starting the research.

## **Findings Regarding the Sixth Research Question**

As the sixth research question in the study, an answer was sought to the question "Is there a significant difference between the "Scientific Attitude Scale" posttest scores of the experimental and control group students?" At the end of the out-of-class learning practices, the Scientific Attitude Scale was administered to both groups, and the collected data were analyzed using the Mann Whitney U test. Through this test, the Scientific Attitude Scale post-test scores of the students in the experimental and control groups were compared. The results are shown in Table 8.

**Table 8.** Mann Whitney U Results for Scientific Attitude Scale Posttest Scores of Experimental and Control Groups

Groups	Ν	Mean Rank	Sum of Ranks	U	Z	р	r
Experiment	17	23.85	405.50	87.50	-2.516	.011	0.41
Control	20	14.88	297.50	-			
Total	37			-			

As seen in Table 8, there is a statistically significant between-group difference at a p < .05 level, favoring the experimental group (Z = -2.516; p = .011 < .05). The mean rank of the posttest scores of the experimental group students was 23.85, and the mean rank of the control group students was 14.88. As a result of this analysis, the Scientific Attitude Scale scores of the experimental group students were higher than those of the control group students after the out-of-class learning practices. When we examine the effect size value (r = 0.41), the effect size of this between-group difference is small but close to moderate.

## **Findings Regarding the Seventh Research Question**

The question "Is there a significant difference between the "Scientific Attitude Scale" pretest and posttest scores of the experimental group students?" is the seventh research question of the study. The Wilcoxon Signed Rank test was conducted to compare the pretest and posttest scores of the experimental group groups from the Scientific Attitude Scale. The results are shown in Table 9.

Pretest-Posttest	Ν	Mean Rank	Sum of Ranks	Ζ	р	r
Negative Rank	1	1.00	1.00	-3.577	.00	0.58
Positive Rank	16	9.50	152.00			
Total	17					

 Table 9. Wilcoxon Signed Ranks Results for Scientific Attitude Scale Pretest-Posttest Scores of Experimental Group

When table 9 is examined, there is a significant difference between the pretest and posttest scores of the experimental group students from the Scientific Attitude Scale (Z = -3.577, p = .00 < .05). When the sum of ranks of the Scientific Attitude Scale difference scores of the experimental group students are examined, the difference favors the positive ranks; that is, in favor of the posttest scores of the experimental group. According to these findings, one can argue that the out-of-class learning practices carried out in the school garden have increased the scientific attitude levels of students in the experimental group. When the effect size value is examined (r = 0.58), the effect size of this between-group difference is at a moderate level.

# **Findings Regarding the Eighth Research Question**

As the last research question in the study, an answer was sought to the question "Is there a significant difference between the "Scientific Attitude Scale" pretest and posttest scores of the control group students?" The Wilcoxon Signed Rank test was conducted to compare the pretest and posttest scores of the control group students from the Scientific Attitude Scale. The results are provided in Table 10.

Table	10.	Wilcoxon	Signed	Ranks	Results	for	Scientific	Attitude	Scale	Pretest-	Posttest	Scores	of
Contro	l Gr	oup											

Pretest-Posttest	Ν	Mean Rank	Sum of Ranks	Ζ	р
Negative Rank	9	11.78	106.00	443	.658
Positive Rank	10	8.40	84.00		
Equal	1				
Total	20				

Table 10 shows that there is no significant difference between the pretest and posttest scores of the control group students from the Scientific Attitude Scale (Z = -.443, p = .658 > .05). According to these findings, the educational practices carried out in the control group did not lead to a significant difference in scientific attitude levels of students.

## **Discussion, Conclusion and Recommendations**

This study investigated the effects of out-of-class learning activities conducted in the school garden on students' interests in science and their scientific attitudes. For this purpose, various science activities were conducted with the students in the school garden for seven weeks. Through the scales

administered to students before and after the intervention, the effects of the school garden intervention on students' interests in science and scientific attitudes were evaluated.

In line with past research findings on positive outcomes offered by school gardens (Williams & Dixon 2013), the present study demonstrated that garden-based science learning activities can increase student interest in science and their scientific attitudes. The study findings showed that garden-based activities have a moderate and close to moderate effect on students' interests in science and scientific attitudes. As per these findings, we can say that school gardens are out-of-class learning environments that can be used to help increase students' interest and attitudes toward science. Studies with similar results are also available in the literature.

Williams, Brule, Kelley and Skinner (2018) examined the science engagement, learning, achievement, and identity of ethnically diverse grade 6 students in two low-income urban middle schools participating in the Science in the Learning Gardens (SciLG) program. The researchers conducted garden-based practices within the scope of units such as Growth and Development of Organisms, Organization for Matter and Energy Flow in Organisms, and Cycle of Matter and Energy Transfer in Ecosystems for one year. They applied a nine-item scale to reveal students' science identity. The scale included items such as "I am the kind of person who belongs in science," "People like me do not get jobs in science," "I am the kind of person who can succeed in science", and "I would like to have a job that uses science." Students stated that they will be someone capable and accepted in science, showing increased interest in pursuing a science career or receiving further science education. At the end of the study, the researchers revealed that students who participated in the Science in the Learning Gardens (SciLG) program reported a stronger science identity.

As a result of their experimental study, Dirks and Orvis (2005) applied the school garden program to primary school third-grade students (N=277) in 14 different classes and revealed that the program had a positive effect on students' attitudes towards science, environment, and gardening. In addition, the evaluations of teachers who applied the program to the students were examined. Teachers highlighted the positive changes in student behaviors and stated that students were excited during the school garden activities and their interest increased in learning science.

A study examining three afterschool indoor gardening programs in low-income urban schools determined that the program significantly improved students' desires to engage in scientific activities, reduced their anxiety when engaging in or thinking about science, and improved their self-concepts in science (Patchen & Barnett, 2016).

Jagannathan, Camasso and Delacalle (2018) studied low-income primary and secondary school students in experimental and control groups for six years and employed Singleton's (2015) model via a place-based nature and garden studies program to enhance student performance and interest in STEM careers. Their study showed significant improvement in students' science grades,

interest in science, and science knowledge. School gardens proved to be an evitable part of the program to bolster the curriculum topics, establish a connection with the real life outside of the classroom, and stimulate interests in science.

The common point of the results of these studies indicated that participation in school garden activities is promising in supporting students' affective characteristics such as motivation, interest, and attitude towards science or science lessons. According to Passy (2014), since children enjoy the time spent outside, participating in school garden activities can provide emotional and motivational benefits to them. In a similar vein, Maltese and Zimmerman (2015) stated in their study that school gardens can increase students' willingness to participate more in such activities and their interest in science by providing an enjoyable learning opportunity. In our study, these can be noted as reasons behind the changes in students' interests and attitudes. In addition, seeing the topics and concepts in science lessons in their own environment may have positively affected students' interests and attitudes. Based on all these findings, we can say that school gardens have the potential to support students' cognitive and affective characteristics.

To sum up, when the results obtained in this study were examined it was determined that garden-based activities have an effect on students' interests in science and scientific attitudes. According the results, we can say that school gardens are out-of-class learning environments that can be used to help increase students' interest and attitudes toward science. School gardens can be used to increase students' affective characteristics for lessons. As mentioned in the significance of research, school gardens are practical and useful learning environments as an out-of-class learning environment. As educators, we can claim that school gardens are our immediate out-of-class learning environments.

The limitation of this study is that the data were collected using only scales. It is of great significance to support the data collected through scales with different data collection tools such as observation and interview. Maltese and Zimmerman (2015) worked with primary school second graders seeking an answer to the question, "Do students' attitudes toward the environment shift over the course of their engagement in a school garden curriculum?" As a result of the study, quantitative research data showed no statistically significant change in attitudes, but contrary to the survey data, the data collected from the pre/posttests, interviews, and student conversations revealed that students have a more empathetic view of nature and demonstrated positive changes in their environmental attitudes. Researchers emphasize collecting different types of data and developing better measurement tools. Therefore, researchers can be recommended to carry out well-planned and practical school garden activities, using mixed-research approaches.

## **Policy Implications**

In today's education programs, approaches that support the use of out-of-class environments are adopted. In the Science Curriculum in Turkiye, it is emphasized to conduct lessons in learning environments based on student-centered methods. In this context, informal learning environments such as school gardens, science centers, museums, planetariums, zoos, and botanical gardens should be used in science lessons (Turkish Ministry of National Education [MoNE], 2018).

Although the importance of informal learning environments is emphasized, the curriculum mostly include activities and goals that can be applied in the classroom. Among informal learning environments, school gardens are easily accessible teaching environments for teachers. Especially due to the nature of many subjects in science lessons, school gardens can be used as a laboratory. Their use can be expanded to increase students' interest and attitudes towards science and contribute to their academic development.

In order for school gardens to be used in science lessons, it is important to first determine the conditions of school gardens and to carry out studies to improve them. In addition, teachers can be encouraged to use these learning environments through trainings on how they can make arrangements to integrate school gardens into science lessons within their current conditions. Science curriculum can include learning outcomes and activities that can be carried out in school gardens.

On the other hand, in school, gardens could be integrated into the curriculum to teach children not only about plants, nature, and outdoor settings but also about other subjects. Gardens could provide information about the history, poetry, mathematics, and scientific studies to children. In order to teach students an idea about a specific field, teachers can base the school garden on a theme, concept, or issue. Theme gardens provide an agenda, as plants are directly related to a general theme. Fields include an interdisciplinary approach to the garden. Curriculum or classroom interest areas may provide direction to the theme (Bundschu-Mooney, 2003).

Increasing the number of academic studies on the use of school gardens in other courses that are not related to natural sciences such as language, history, and mathematics can be encouraged. In the light of the results of these studies, explanations and instructions on how school gardens can be used as a learning environment in these courses can be added to the curriculum.

# **Credit Author Statement**

The authors contributed equally to this research.

# **Conflict of Interest**

No potential conflict of interest was declared by the authors.

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## **Ethical Statement**

This research was carried out with the approval of Kilis 7 Aralık University Scientific Ethics Evaluation Committee dated 13.12.2022 and numbered 03.

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# The Relationship Between Students' 21st-Century Skills and Academic Performance in Science and Mathematics

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# Abstract

This study aimed to reveal a relationship between high school students' 21st-century skills and academic performance in mathematics and science courses. The research was designed in a relational survey model. In the study group, there were 596 students. Descriptive statistics, the one-way analysis of variance, the Pearson correlation test, and simple partial regression analyzed the research data. As a result of the research, it was concluded that the 21st-century skills of high school students are above the intermediate level. It is also revealed that there is no significant difference between the dimensions other than critical thinking and problem-solving of 21st-century skills scores according to the type of high school. According to high school type, a difference was found in the dimension of critical thinking and problem-solving. It has been concluded that there is a significant relationship between the 21st-century skills scores of high school students and their academic performances in science and mathematics courses. Information and technology literacy, critical thinking and problem-solving, entrepreneurship and innovation skills, and 21st-century skills overall scores could be used to predict academic performances in science and mathematics courses in science and mathematics courses concerning this study.

Keywords: High School Students, 21st-Century Skills, Math, Science, Academic Performance

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## Introduction

Today, there are changes and developments in science and technology globally at a dizzying speed. In this process of change and development, it is a matter of debate which skills individuals should have to adapt to professional and social life. For this reason, many studies are carried out, and reports are published on what these skills are in the international arena (Cansoy, 2018; Topçu & Çiftçi, 2018).

The skills that individuals need to adapt to the society and era we live in are 21st-century skills (Belet-Boyacı & Güner-Özer, 2019). The mentioned skills are classified and defined by many different institutions and organizations (Hilliker & Loranc, 2022). For example, 21st-century skills are defined as ten different skills in four categories. These skills are categorized as (Scardamalia, Bransford, Kozma, & Quellmalz, 2012):

- Ways of thinking; creativity and innovation, critical thinking, problem-solving and decision making, leadership and metacognition for learning.
- Working tools; information and communication technology literacy, information literacy.
- Ways of working; communication and cooperation.
- Life skills; local and global citizenship, life and career, personal and social responsibility.

Among these, the classification made by the Partnership for 21<sup>st</sup>-Century Skill (P21) is the most used and valid (Cansoy, 2018). 21st-century skills are grouped as learning and innovation skills, information, media and technology skills, and life and career skills by P21 (Öğretir-Özçelik, 2018). These skills were tabularized by Bal (2018), as in Table 1.

Sub-Skills
Creativity and regeneration
Critical thinking
Problem-solving
Information literacy
Media literacy
Information and communication technology literacy
Flexibility and harmony
Entrepreneurship
Self-orientation
Social skills
Intercultural skills
Productivity and responsibility
Leadership and responsibility

 Table 1. 21st-century skills

Apart from the classifications presented above, 21st-century skills EnGauge (The Metiri Group and The Learning Point Associates), NETS/ISTE (National Educational Technology Standards/International Society for Technology in Education), EU (European Union), OECD (Organization for Economic Cooperation and Development) has been defined (Erten, 2020). However, communication, cooperation, problem-solving, creativity, critical thinking, and information communication technologies literacy are skills included in various definitions (Siddiq, Hatlevik, Olsen, Throndsen & Scherer, 2017).

In the 21st-century, individuals need to have special skills to succeed in business and social life. For this reason, education systems should be structured in such a way as to enable individuals to participate actively in today's business and social life and to gain these skills so that they can lead a prosperous life (Abdullah & Osman, 2010). Individuals who will take place in the business world of the 21st-century should know science and mathematics, creativity, problem-solving skills, and use information and communication technologies (Business-Higher Education Forum, 2005). Therefore, education systems must be transformed to provide students with 21st-century skills. In order to achieve this, it is necessary to establish a link between economic development and the reform of education systems (National Academy of Science, 2006).

The most crucial responsibility in bringing 21st-century skills to individuals falls on the education system and institutions. In this respect, today's curricula must provide students with creativity, problem-solving, critical thinking, effective communication, and cooperation (Gülen, 2013). In addition, since 21st-century skills have been designed with a lifelong learning approach, these skills are expected to be included in teaching environments, and students are expected to graduate with these competencies (Kurudayıoğlu & Soysal, 2019). For future students to overcome the problems they will encounter, it should be ensured that they learn 21st-century skills throughout their entire education life, starting from the pre-school period (Cetin & Cetin, 2021). For this reason, activities that will teach and gain students 21st-century skills should be included in each stage and element of the education process. 21st-century skills have been included with the updates made in the education system and curriculum in Turkey. In the Turkish Qualifications Framework, which was created in line with the European Qualifications Framework, the principles regarding all competencies to be acquired through vocational, general and academic education programs covering primary, secondary, and higher education were determined, and the "Regulation on the Procedures and Principles Regarding the Implementation of the Turkish Qualifications Framework" was put into effect by being published in the Official Gazette dated 9 November 2015 and numbered 29537, with the decision of the Council of Ministers numbered 2015/8213 (Official Gazette, 2015). In this direction, raising individuals who have acquired the basic skills and competencies determined in the Turkish Qualifications Framework has been included in the updated curricula. In these programs, the aim of raising individuals who can think critically, solve problems, are entrepreneurs, and have communication skills has also been put forward (MoNE, 2018). Based on the information in question, it can be stated that the latest education programs aim to raise individuals with 21st-century skills.

Since 2003, Turkey has been participating in PISA exams consisting of three areas; science literacy, mathematical literacy, and literacy skills, which measure the ability of students in the age group of fifteen to use the information they learned at school in daily life (Cepni & Ormancı, 2017). According to Batur, Ulutas, and Beyret (2019), the PISA application raises individuals with 21stcentury skills. The results of Turkey's PISA exams are not promising. For instance, the last PISA 2018 application it participated in ranked 42nd among 79 countries in mathematical literacy and 39th in science literacy (MoNE, 2019). In addition, in Turkey, students take an LGS exam to be placed in high schools after primary education. The purpose of LGS is determined "to enable students to use the information given at school in daily life" (Batur, Ulutaş & Beyret, 2019). In this respect, it can be said that the questions in this exam will be similar to the questions in the PISA exams and will measure the 21st-century skill levels of the students. Students' mathematics and science course scores in Turkey are deficient in the said exam. In LGS in 2021, the average number of correct answers of students on a 20-question math test is 4,20, and the net average of correct answers in science tests is 8,04 (MoNE, 2021). In the light of this information, it can be stated that students studying in Turkey cannot acquire 21st-century skills during their primary education, and their academic performance in mathematics and science courses is deficient. However, program-specific skills are included in the science curriculum, and 21st-century skills are included in the mathematics curriculum, in the particular objectives section of the curriculum (MoNE, 2018). For this reason, it is expected that students who have completed primary education will graduate with these skills and have high academic performance in science and mathematics courses.

When the national and international literature on 21st-century skills is examined, it is seen that there are many studies. Karakaş (2015) in order to measure the 21st-century skill levels of secondary school eighth grade students for science lessons; Engin and Korucuk (2021) in order to examine the 21st-century skills of university students in terms of various variables; Nacaroğlu (2020) in order to measure the 21st-century skills of gifted and typically developing students; Diker Akman (2020) in order to determine the relationship between eighth grade students' TIMSS science results and 21st-century skills; Zeybek (2019) in order to determine the 21st-century learning skill usage levels of high school students; Sukor, Osman, and Abdullah (2010) in order to examine students' 21st-century skills and their perceptions and attitudes towards physics; Woods-Groves, Choi, and Balint-Langel (2021) conducted studies to determine the relationship between students' 21st-century skills and academic achievement.

It can be stated that students who are successful in mathematics and science courses will have higher 21st-century skills. It is essential to conduct scientific studies that test the accuracy of this hypothesis. Determining the development levels of students' 21st-century skills, conducting research to facilitate the development of these skills, and assessing the extent to which students' demographic factors affect the development of these skills are of paramount importance. Also, it is crucial to conduct studies to reveal the impact of students' 21st-century skills development levels on their academic success. However, when the body of literature is examined, no research has been found examining the relationship between students' 21st-century skills and academic performance in science and mathematics courses. For this reason, it is thought that the study will contribute to the field. Based on this information, the research questions were determined as follows:

- What is the level of 21st-century skills do high school students have?
- Do high school students' 21st-century skills differ according to the type of high school they study?
- Is there a relationship between the 21st-century skills of high school students and their academic performances in science and mathematics courses?
- Do 21st-century skills predict academic performances in science and mathematics courses?

# Method

# **Research Design**

This study revealed the relationship between high school students' 21st-century skills and academic performances in science and mathematics courses. The research was designed in a relational survey model. In the relational survey model, a questionnaire or scale is applied to reveal specific characteristics of a group, and the relationships with the descriptive variables obtained are examined (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2014; Karasar, 2012).

# Sampling

The convenience sampling method was used to determine the sample. In this sense, students included in the sample have the same probability of being selected. The research study group consists of 617 students studying in the first year of high school or preparatory class in nine different public schools in the city center of Tokat, in the Republic of Turkey. Descriptive statistics of the gender and grades of the students in the research group are presented in Table 2.

Table 2. Distribution of students by gender and grade level

Gender	Frequency	Percent	Grade	Frequency	Percent
Male	387	64.9	Preparatory	109	18.3
Female	209	35.1	9th grade	487	81.7
Total	596	100.0	Total	596	100.0

The study includes 387 (64.9%) male and 209 (35.1%) female students. There were 109 (18,3%) students in preparatory class and 487 (81,7%) students in 9th grade.

High school type	Frequency	Percent
Science High School	199	33.4
Social Sciences High School	73	12.2
Anatolian High School	231	38.8
Vocational and Technical Anatolian High School	58	9.7
Fine Arts & Sports High School	35	5.9
Total	596	100.0

Table 3. Distribution of students by high school type

The number of students included the following: 199 (33.4%) of the students in science high school, 73 (12.2%) in social sciences high school, 231 (38.8%) in Anatolian high schools, 58 (9.7%) in vocational and technical Anatolian high school, and 35 (5.9%) of them in fine arts and sports high school which accepts students with talent exam.

## **Data Collection Tools**

#### LGS academic performances

In the research, LGS science and mathematics course nets attended in 2021 were used to determine students' academic performance in mathematics and science courses. It was stated that the internal consistency (reliability) coefficient for the subtests was 0.84 for science and 0.76 for mathematics.

## Multidimensional 21st-century skills scale

In order to determine the 21st-century skills of the students, the Multidimensional 21st-Century Skills scale developed by Çevik and Şentürk (2019) was used. The scale comprises five subdimensions. These dimensions are as follows: Information and technology literacy skills (15 items), critical thinking and problem-solving skills (6 items), entrepreneurship and innovation skills (10 items), social responsibility and leadership skills (4 items), and career awareness (6 items). The scale is in a 5-point Likert type, graded between "Strongly agree" and "Strongly disagree." The scale can be applied to people between 15-25. It was stated that the scale's Cronbach's alpha internal reliability coefficient was 0.86. In this study, Cronbach's alpha coefficient was found to be 0.90. Therefore, it can be said that the scale has an acceptable internal reliability coefficient.

## **Data Collection Process**

Research data were collected through Google Forms from students who have just started high school according to their scores in the 2021 LGS in the 2020-2021 academic year fall semester.

#### **Data Analysis**

Research data were analyzed using the IBM SPSS software. While analyzing the quantitative data in the research, normality status was determined by looking at the descriptive statistics of the scores obtained from the scales.

Table 4.	Test of	normality
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Variable	Skewness	Kurtosis
Academic performance in mathematics (APM)	0.043	-1.070
Academic performance in science (APS)	-1.257	1.220
Information and technology literacy	-0.027	-0.315
Critical thinking and problem-solving	-0.389	-0.333
Entrepreneurship and innovation skills	0.102	-0.108
Social responsibility and leadership	-0.167	-0.270
Career awareness	-0.616	-0.321
21st-century skills overall	0.054	-0.099

The skewness and kurtosis coefficient values obtained from the 21st-Century Skills Scale, mathematics, and science course academic performance data are in the range of -2, +2. Therefore, it can be stated that the data obtained from the scales show normal distribution characteristics (George & Mallery, 2010). In line with this information, parametric tests were used to analyze the data in the research.

# Findings

Descriptive statistics about 21st-century skills and sub-dimensions of high school students participating in the research are presented in Table 5.

Table 5. Descriptive statistics of 21st-century skills of high school students

21st-century skills	Ν	Ā	Sd
Information and technology literacy	596	4.09	0.42
Critical thinking and problem-solving	596	4.05	0.58
Entrepreneurship and innovation skills	596	3.53	0.59
Social responsibility and leadership	596	3.70	0.62
Career awareness	596	4.43	0.48
21st-century skills overall	596	3.96	0.39

When Table 5 is examined, it is seen that the 21st-century skills of high school students are close to the level of agree ( $\bar{X}$ =3.96). In addition, when the 21st-century skills of high school students are examined in terms of sub-dimensions, it is seen that the highest score ( $\bar{X}$ =4.43) and the lowest score ( $\bar{X}$ =3.53) from *career awareness* are obtained from *entrepreneurship and innovation skills*.

One-way ANOVA tests were conducted to reveal whether the 21st-century skills of high school students differ according to the type of high school. One-way ANOVA results are presented in Table 6.

21st-century skills	Component of	Sum of	df	Mean	F	р	Scheffe
	Variance	Squares		Square			
Information and	Between Groups	0.641	4	0.160	0.897	0.465	
technology literacy	Within Groups	105.483	591	0.178			
	Total	106.123	595				
Critical thinking and	Between Groups	6.277	4	1.569	$4.790^{*}$	0.001	a>e
problem-solving	Within Groups	193.601	591	0.328			b>e
	Total	199.877	595				
Entrepreneurship and	Between Groups	0.346	4	0.087	0.250	0.910	
innovation skills	Within Groups	204.728	591	0.346			
	Total	205.074	595				
Social responsibility and	Between Groups	0.708	4	0.177	0.461	0.764	
leadership	Within Groups	226.891	591	0.384			
	Total	227.598	595				
Career awareness	Between Groups	1.282	4	0.320	1.422	0.225	
	Within Groups	133.133	591	0.225			
	Total	134.415	595				
21st-century skills overal	l Between Groups	0.255	4	0.064	0.417	0.796	
	Within Groups	90.242	591	0.153			
	Total	90.497	595				

Table 6. One-way ANOVA test results by type of high school in terms of 21st-century skills

\*. The mean difference is significant at the 0.05 level. a= Science High School, b= Social Sciences High School, e= Fine Arts & Sports High School.

When Table 6 is examined, it is seen that the *critical thinking and problem-solving* in 21stcentury skills of high school students differ significantly by the type of high school they study (F=4.79, p>0.05). The other dimensions in 21st-century skills of high school students do not differ significantly according to the type of high school they study (p>0.05). The post-hoc test was conducted to understand better the difference seen in the *critical thinking and problem-solving* dimensions of 21st-century skills. Students at science high school differ significantly in terms of their *critical thinking and problem-solving* when compared to students at fine arts or sports high school differ significantly in terms of their *critical thinking and problem-solving* when compared to students at fine arts or students at fine arts or sports high school (Mean difference =0.38004, p<0.05).

One-way ANOVA tests were conducted to reveal whether the academic performance in science and mathematics courses of high school students differ according to the type of high school. One-way ANOVA results are presented in Table 7.

Academic Performance	Component of	Sum of	df	Mean	F	р	Scheffe
	Variance	Squares		Square			
Science course	Between Groups	3974.634	4	993.659	92.908	0.000	a>b, c, d, e
	Within Groups	6320.807	591	10.695			b>c, d, e
	Total	10295.441	595				c>e
							d>e
Mathematics course	Between Groups	8863.017	4	2215.754	228.331	0.000	a>b, c, d, e
	Within Groups	5735.144	591	9.704			b>e
	Total	14598.161	595				c>e

Table 7. One-way ANOVA test results by type of high school in terms of academic performance

\*. The mean difference is significant at the 0.05 level. a= Science High School, b= Social Sciences High School, c= Anatolian High School, d= Vocational and Technical Anatolian High School, e= Fine Arts & Sports High School.

In Table 7, it is seen that academic performance in both science (F=92.908, p>0.05) and mathematics (F=228.331, p>0.05) courses of high school students differs significantly by the type of high school they study. The post-hoc test was conducted to understand better the difference seen in academic performances. Students at science high school differ significantly in terms of their academic performance in science course when compared to students at social sciences high school (Mean difference=2.797, p<0.05), Anatolian high school (Mean difference=4.519, p<0.05), vocational and technical Anatolian high school (Mean difference=5.599, p<0.05) and fine arts and sports high school (Mean difference=9.03, p<0.05). Students at social science high school differ significantly in terms of their academic performance in science course when compared to students at Anatolian high school (Mean difference=1.722, p<0.05), vocational and technical Anatolian high school (Mean difference=2.802, p<0.05), and fine arts and sports high school (Mean difference=6.233, p<0.05). Students at Anatolian high school differ significantly in terms of their academic performance in science course compared to fine arts and sports high school (Mean difference=4.511, p<0.05). Furthermore, students at vocational and technical Anatolian high school differ significantly in terms of their academic performance in science course compared to fine arts and sports high school (Mean difference=3.431, p<0.05).

Students at science high school differ significantly in terms of their academic performance in mathematics when compared to students at social sciences high school (Mean difference=7.846, p<0.05), Anatolian high school (Mean difference=7.652, p<0.05), vocational and technical Anatolian high school (Mean difference=8.759, p<0.05) and fine arts and sports high school (Mean difference=10.175, p<0.05). Students at social science high school differ significantly in terms of their academic performance in mathematics compared to students at fine arts and sports high school (Mean difference=2.328, p<0.05). Moreover, students at Anatolian high school differ significantly in terms of their academic performance in mathematics compared to fine arts and sports high school (Mean difference=2.523, p<0.05). As understood, academic performance in both courses differs significantly according to the type of high school graduate.

Correlation analysis was conducted to determine whether there is a relationship between high school students' 21st-century skills and their academic performances in science courses, and the results are shown in Table 8.

	1	2	3	4	5	6	7
1. Academic performance in	-	-	-	-	-	-	-
Science Course							
2. Information and technology	$0.166^{**}$	-	-	-	-	-	-
literacy							
3. Critical thinking and problem-	$0.241^{**}$	$0.337^{**}$	-	-	-	-	-
solving							
4. Entrepreneurship and	0.074	$0.684^{**}$	$0.240^{**}$	-	-	-	-
innovation skills							
5. Social responsibility and	0.050	$0.496^{**}$	$0.282^{**}$	$0.522^{**}$	-	-	-
leadership							
6. Career awareness	-0.025	$0.510^{**}$	$0.253^{**}$	$0.451^{**}$	$0.362^{**}$	-	-
7. 21st-century skills overall	$0.148^{**}$	$0.888^{**}$	$0.528^{**}$	$0.852^{**}$	$0.669^{**}$	$0.657^{**}$	-
** .0.01 (0 ( 11 1)							

Table 8. Correlations of 21st-century skills and APS variables

\*\*p<0.01 (2-tailed).

There is a low, positive, and significant relationship between high school students' overall 21st-century skills scores and academic performance in science courses (r=0.148, p<0.05). In addition, when the relationship between 21st-century skills and academic performance of the students in science courses is examined in terms of sub-dimensions, it is seen that there is a significant relationship in terms of *information and technology literacy* (r=0.166, p<0.01), *critical thinking and problem-solving* (r=0.241, p<0.01).

The regression analysis results performed to see whether the 21st-century skills of the students are significant predictors of the academic performance in science course are given in Table 9.

Independent Variables	APS (Academic performance in science course)									
(Predictors)	R	$\mathbb{R}^2$	F	В	SE	β	t	р		
Information and technology	0.166	0.027	16.771	1.632	0.399	0.166	4.095	0.000		
literacy										
Critical thinking and problem-	0.241	0.058	36.495	1.727	0.286	0.241	6.041	0.000		
solving										
Entrepreneurship and	0.074	0.005	3.248	0.522	0.290	0.074	1.802	0.072		
innovation skills										
Social responsibility and	0.050	0.003	1.500	0.338	0.276	0.050	1.225	0.221		
leadership										
Career awareness	-0.025	0.001	0.376	-0.220	0.359	-0.025	-0.614	0.540		
21st-century skills overall	0.148	0.022	13.362	1.582	0.433	0.148	3.655	0.000		

Table 9. Linear regressions between dimensions of 21st-century and APS

From the results in Table 9, information and technology literacy (B=1.632, t=4.095; p<0.05), critical thinking and problem-solving (B=1.727, t=6.041; p<0.05), entrepreneurship and innovation skills (B=0.522, t=1.802; p<0.05) and 21st-century skills overall scores (B=1.582, t=3.655; p<0.05) could be used to predict academic performance in science course. The other variables like social responsibility and career awareness cannot predict academic performance in science course.

Correlation analysis was conducted to determine whether there is a relationship between high school students' 21st-century skills and their academic performances in mathematics, and the results are given in Table 10.

0.240\*\*

0.282\*\*

0.253\*\*

0.528\*\*

0.522\*\*

0.451\*\*

0.852\*\*

0.362\*\*

0.669\*\*

7

6

0.657\*\*

•					
	1	2	3	4	5
1. Academic performance in	-	-	-	-	-
Mathematics Course					
2. Information and technology	0.084*	-	-	-	-
literacy					

0.151\*\* 0.337\*\*

0.082\* 0.684\*\*

0.023 0.496\*\*

-0.071 0.510\*\*

0.087\* 0.888\*\*

Table 10. 21st-century skills and APM variables correlations

\*\* p<0.01 (2-tailed), \* p<0.05 (2-tailed).

3. Critical thinking and problem-

4. Entrepreneurship and innovation

5. Social responsibility and

7. 21st-century skills overall

6. Career awareness

solving

skills

leadership

When Table 10 is examined, it is seen that there is no significant relationship between high school students' overall 21st-century skills scores and their academic performance in mathematics (r=0.087, p>0.05). However, when the relationship between students' 21st-century skills and mathematics course academic performance is examined in terms of sub-dimensions, it is seen that there is a significant relationship between *mathematics course academic performance* and *information and technology literacy* (r=0.084, p<0.05), *critical thinking and problem-solving* (r=0.151, p<0.01) and *entrepreneurship and innovation skills* (r=0.082, p<0.05).

The regression analysis results performed to see whether the 21st-century skills of the students are significant predictors of academic performance in mathematics are given in Table 11.

Independent Variables	APM (Academic performance in mathematics course)									
(Predictors)	R	$\mathbb{R}^2$	F	В	SE	β	t	р		
Information and technology	0.084	0.007	4.222	0.985	0.480	0.084	2.055	0.040		
literacy										
Critical thinking and problem-	0.151	0.023	13.811	1.288	0.347	0.151	3.716	0.000		
solving										
Entrepreneurship and	0.082	0.007	4.012	0.691	0.345	0.082	2.003	0.046		
innovation skills										
Social responsibility and	0.023	0.001	0.323	0.187	0.329	0.023	0.568	0.570		
leadership										
Career awareness	-0.071	0.005	2.981	-0.736	0.427	-0.071	-1.727	0.085		
21st-century skills overall	0.087	0.008	4.545	1.107	0.519	0.087	2.132	0.033		

Table 11. Linear regressions between dimensions of 21st-century and APM

From the results in Table 11, information and technology literacy (B=0.985, t=2.055; p<0.05), critical thinking and problem-solving (B=1.288, t=3.716; p<0.05), entrepreneurship and innovation skills (B=0.691, t=2.003; p<0.05) and 21st-century skills overall scores (B=1.107, t=2.132; p<0.05)

could be used to predict academic performance in mathematics. The other variables like social responsibility and career awareness cannot predict academic performance in mathematics.

#### **Discussion, Conclusion, and Suggestions**

This study revealed the relationship between high school students' 21st-century skills and academic performances in science and mathematics course. As a result of the research data analysis were interpreted in the context of the total scores obtained from the scale, it was concluded that there was a positive and significant relationship between the 21st-century skills of high school students and their academic performances in both science and mathematics courses. The study examined the relationship between the type of high school in which high school students' study and their 21stcentury skills. It was concluded that the 21st-century skills of the students differed according to the high school type in terms of some sub-dimensions. Students at science high school and social science high school differ significantly in terms of their critical thinking and problem-solving compared to students at fine arts and sports high school. However, according to the overall scores of 21st-century skills, 21st-century skills of students did not differ according to high school type. However, academic performance in science and mathematics courses differs significantly by type of high school graduate. There are other research results in the literature that support this finding. For instance, Aydın and Duman (2020) found that the 21st-century skills of university preparatory class students showed a significant difference in favor of those studying in associate degree programs. Considering that the academic performance of students placed in undergraduate programs is higher than those placed in associate degree programs, the thesis that there is a significant relationship between 21st-century skills and academic performance can be strengthened. In the study conducted by Göktepe-Yıldız (2020), it was found that there is a low level of positive correlation between the academic performance levels of high school students and their 21st-century skills. It is expected and desired that students possess high levels of 21st-century skills. In the current 21st-century information age, students at all levels are expected to have developed 21st-century skills. They have access to various technological tools such as tablets, mobile phones, laptops, smart boards, 3D printers, and projectors that can enhance their 21st-century skills, and they utilize these tools constantly, whether they are at home, at school, or elsewhere. Although academic achievement levels may vary across different types of high schools, the fact that 21st century skills do not differ suggests that students may be engaging in activities outside of their academic life that contribute to the development of these skills. A new research topic could be the extent to which activities students engage in throughout the day impact their 21st century skills.

When the findings obtained in the research are examined in terms of the sub-dimensions of 21st-century skills, it is found that there is a significant positive relationship between information technology literacy, critical thinking and problem-solving, and academic performance in science

courses. It is also found that there is a significant positive relationship between information and technology literacy, critical thinking and problem-solving, entrepreneurship and innovation skills, and academic performance in mathematics courses. Akbiyik and Seferoğlu (2006) state that students with high critical thinking skills are more successful in science courses. There are other research results in the literature that support this statement. For instance, Jacob's (2012) research with university students found a significant relationship between critical thinking skill scores and mathematics final exam grades. Also, it was concluded in the study conducted by Özcan (2017) that critical thinking skill is an essential predictor of mathematics achievement. Study results also reveal the significant relationship between problem-solving, another 21st-century skill, and academic performance in science and mathematics courses. Kumlu and Doğan (2018) determined that there is a positive relationship between problem-solving skills and science literacy, according to PISA 2015 results. Özsoy (2005) also found in his study that there is a significant relationship between students' mathematics achievement and their problem-solving skills. Another study has also reported that 21st-century skills have a positive effect on academic achievement in general (Engin & Korucuk, 2021). The internet is considered the most influential factor in the development of students' 21st-century skills. Through the internet, students can acquire information and learn various ways of obtaining information. For example, in a learning environment with robotics activities, students can better understand and develop their 21st-century skills. It has been observed that the learning environments created by robotics activities have an impact on the creativity, problem-solving, critical thinking, communication, and collaboration skills of teacher candidates, which are among the 21st-century skills (Erdoğan, 2019).

In the PISA 2003 study, students' science proficiency was examined for various variables. One of these variables is the level of students' use of information and communication technologies. As a result of this research, a significant relationship was found between information and communication technologies and students' science proficiency (Balım, Evrekli, İnel & Denis, 2009). According to the research findings, it was concluded that there is a significant relationship between academic performance in science courses and entrepreneurship and innovation skills. Upon conducting a comprehensive literature review, no prior research was discovered that established a significant relationship between the two variables under investigation. Nevertheless, subsequent research findings indicated that there exists a positive correlation between critical thinking skills and entrepreneurship skills. Öztürk, Önder, and Güven-Yıldırım (2019) determined that there is a positive and significant relationship between these two skills. A link can be established between entrepreneurship skills and academic performance in line with this finding. In summary, in the light of these findings, it can be stated that developing students' information technology literacy, critical thinking and problem-solving literacy, and entrepreneurship and innovation skills can increase

academic performance in science courses. Also, it can be stated that improving critical thinking and problem-solving skills can increase academic performance in mathematics courses.

In the research, the 21st-century skills of high school students were examined. As a result of the analysis of the research data, it was concluded that the 21st-century skills of high school students are close to the acceptable level. In line with this finding, it can be stated that high school students have high 21st-century skills. Research results find the 21st-century skills of high school students above the average (Zeybek, 2019; Göktepe-Yıldız, 2020). When the scores obtained from the 21st-century skills scale are examined in terms of sub-dimensions, it is seen that the students get the highest score from career awareness and the lowest score from entrepreneurship and innovation skills. Aydın and Duman (2020) obtained similar results in their research with university students and stated that their decision-making skills regarding the profession they want to do in the future are high in line with this finding. Although the scores of the students in the sub-dimension of entrepreneurship and innovation skills are low, it can be stated that they are inclined to develop new ideas and products because they are above the medium level.

As a result, there is a low-level significant positive correlation between high school students' 21st-century skills and academic performance in science course; it was found that there was no significant relationship with academic performance in mathematics courses. In addition, it has been determined that high school students have high 21st-century skills. In line with these findings, the following recommendations can be made:

1- The research was conducted with high school students in a small region. New research can be carried out with high school students across the country.

2- The relationship between high school students' 21st-century skills and their academic performance in mathematics and science courses was examined in the research. In future studies, the relationship between all course achievements can be examined.

3- The research sample can be changed from high to primary or secondary schools.

# **Policy Implications**

In the 21st century, it is expected that individuals will be able to use knowledge by grasping it instead of memorizing it. For this reason, the skills that individuals should have also changed in this century. These skills are defined and categorized as 21st century skills. Educational institutions have the most important role in acquiring these skills to individuals. For this reason, updates are made in education policies in the world and in Turkey, and education policies are prepared in such a way that individuals gain these skills. The basis of 2023 Vision Education Document, curriculum updates and Turkish Qualifications Framework studies is to create the necessary infrastructure for individuals to gain these skills (Hamarat, 2019). 21st century skills have also been reflected in the curriculum with

these policy studies and have taken their place as skills that should be acquired by students. In addition to these skills, in order to have a good profession in Turkey, it is necessary to be successful in disciplines such as science and mathematics. In this study, academic success in science and mathematics courses and 21st century skills of students studying at different high schools were examined; It has been tried to reveal the predictive power of 21st century skills in science and mathematics course academic success. For these reasons, it is thought that the research will contribute to educational policy makers in revealing and guiding the relationship between course content and 21st century skills.

# **Conflict of Interest**

The corresponding author states that there is no conflict of interest on behalf of all authors.

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# **Credit Author Statement**

Author 1: Conceptualization and Methodology, Writing- Original draft preparation, Visualization, Investigation, Data Curation, Formal Analysis, Writing – Review & Editing, Validation.

Author 2: Conceptualization and Methodology, Writing- Original draft preparation, Visualization, Investigation, Data Curation, Formal Analysis, Writing – Review & Editing, Validation.

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