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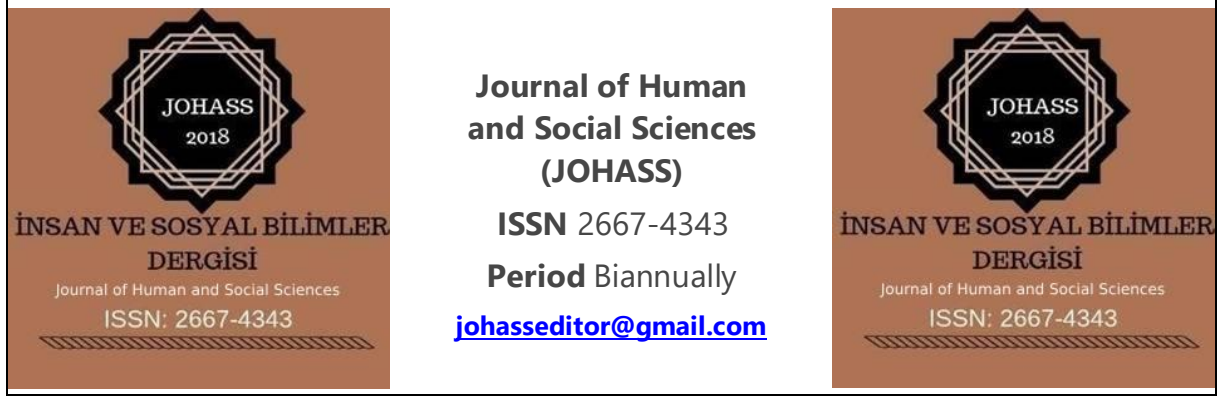
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"The Street" From the Past to the Present - Examining the Views of Academician Parents whose Children in Early Childhood

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"The Street" From the Past to the Present - Examining the Views of Academician Parents whose Children in Early Childhood

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Abstract	Research Article
In this study, it is aimed to examine the views of academician parents who have children in the early childhood period towards the street from past to present and to reveal the changes between the views of the academician parents. Semi-structured interview technique was used in this research, which was carried out with a case study from qualitative methods. The study group of the research consists of 10 parents working as academic staff in at a state university who have children in early childhood. In the study, an interview form developed by the researchers used as a data collection tool. This form consists of nine basic questions. The obtained data were subjected to content analysis. As a result of the research, it was determined that, according to the parents who have children in early childhood, the street was a playground and living space in the past, but today it is only a tool used to achieve certain goals. However, when compared to the past, it has been determined that street games are played less frequently by children today. It has been determined that today's street games have lost their originality as played in the past and children have difficulties in setting up games. In addition to these, it has been determined that the streets are inadequate in terms of security, physical elements and structures are differentiated, and social elements and structures have changed, and social interaction and communication have become more limited.	

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Introduction

Society is a great wealth that exists with people, with the relationships between these people, and with the lifestyles of these people. This wealth is much more than the sum of the individuals of that society. Sag (2003) refers to society as a whole of relationships that accepts a common culture and can ensure its own continuity within the boundaries of the geographical areas it determines. A change in individuals, who have a large share in the existence of society, in human relations and in structures that make up society results in social change (Uca-Guneş, 2016). One of the structures where social change demonstrates its effects is the street, one of the basic units of living spaces (Alver, 2010). To make sense of the street and the changes that occur in it, it is necessary to understand socio-cultural change first.

Socio-cultural change expresses the reflections of differentiation occurring in various areas in social life, such as economic, technological, scientific, and natural fields in social and cultural dimensions. Changes in the family structures, lifestyles, and areas of individuals living in a particular society, the values they adopt, their life practices, and the technologies they use reveal socio-cultural change (Kongar, 1995). Time, one of the defining elements of socio-cultural change (Fichter, 1994; Kongar, 1995), has also led to various changes in the street. With the change in the street, the perceptions of the old street and the new street emerged. Reflections of this perception have been seen in the differentiation of the general street life, play, security, communication, and interaction along with the structural, physical, and architectural elements on the street (Arslan, 2017; Demırel-Etlı & Yamaçlı, 2015; Kalish, Banko, Burke & Lapidus, 2010; Sezer & Gultekın, 2020).

The physical environment in which children are individuals of society and interact in their development and socialization process is of great importance (Tandogan, 2014). The more suitable the environment in which the child lives, the healthier the child's development (Cakırer-Ozservet, 2015). The street where the children's houses are located can be accepted as the first physical environment they interact with. Providing the necessary security conditions on the streets to contribute to children's physical and social development is seems essential (Demırel-Etlı & Yamaçlı, 2015). Street design is one of the important elements for ensuring security on the streets. A street designed to create a sense of trust in individuals can contribute to individuals' safe use of the street (Rashid et al., 2017; Aydogan & Dilek, 2024).

Today, streets are perceived as dangerous spaces due to traffic and security problems (Ayaz & Yamaçlı, 2019). It is stated that it is becoming increasingly difficult for children to

play on the streets and even to be on the streets. Over time, children's freedom at home has increased, whereas their freedom outside has decreased substantially. The daily living spaces where children can spend time independently has diminished rapidly (Karsten & Van Vliet, 2006). In the past, children often played outside the house, on the street, or in an empty area, and they preferred group games with many children (Aksoy, 2009; Başal, 2007). Especially in parents, the perception of high fear of crime for various reasons prevents their children from spending enough time on the streets (Oztoprak et al., 2012). However, streets should be places where children can feel safe and have a say in their designs. It is recommended to reorganize areas especially those open to traffic for children's safety needs. This will allow children to play on the streets on their own without the presence of their parents (Demırel-Etlı & Yamaçlı, 2015).

The street is also expressed as the basic texture of the city. Streets can be accepted as not only physical but also social units. As streets connect buildings and houses that make up the cities, they also link people (Alver, 2010). Streets are also social spaces that respond to the basic needs of people and where they communicate effectively with each other. It is stated that traditional and cultural values can be achieved by maintaining the culture of the city and neighborhood, including the street (Ayaz & Yamaçlı, 2019; Demırel-Etlı & Yamaçlı, 2015).

While the street is among the best learning environments for the child, it also has the characteristic of being a place where individuals in early childhood (0-8 years old) spend most of their time in the past. Today, the street has started to lose its trait of being the outdoor space where children spend most of their time. Arslan's (2017) study, which aimed to determine and compare how children spent time in the past and present, the games and the toys they played with, the playgrounds where they played, and their playmates, puts forward that ready-made toys and individual games are prevalent today. The study has also determined that there is a decrease in the amount of time children spend for games and that there are not enough safe playgrounds nowadays. It is likely that owing to the feeling of their absence, these traditional games became the subject of cartoons over time, trying to ensure that these games did not completely leave the children's minds. In addition, it has been stated that the traditional children's games addressed in these cartoons support the psycho-motor, psycho-social, cognitive, and language development areas in children (Talu & Yuzbaşıoglu, 2020). Taking the impact of street on the development of children into account, the present study might be necessary because the efforts of parents, who notice the change between the past and present streets, to use the street as a place of learning and entertainment for their children as it

was in their own childhood may contribute to the effective use of the street by children. In addition, it is thought that the research will contribute to the relevant literature in terms of addressing the change of elements on the street from the past to the present with a holistic perspective. In this context, this study aims to examine the views of academician parents whose children in early childhood from the past to the present and reveal the changes between the views of academician parents. With this purpose, the change from the parents' perspective was examined in terms of the street, street games, street security, physical structures on the streets, and social items on the streets. The research problem of the study is the question "How do the views of academician parents who have children in early childhood change about the street from the past to the present?" In this regard, answers to the following research questions are sought:

1. How have street games changed from the past to the present according to academician parents who have children in early childhood?

2. How have streets changed in terms of security from the past to the present according to academician parents who have children in early childhood?

3. How have social elements/structures on streets changed from the past to the present according to academician parents who have children in early childhood?

4. How have physical elements/structures on streets changed from the past to the present according to academician parents who have children in early childhood?

5. What are the metaphoric perceptions of academician parents who have children in early childhood about streets today and streets in their childhood?

Method

Model

With the aim of investigating the views of academician parents whose children in early childhood about the street from the past to present and examining the change in the street in terms of street games, street security, the physical structures and social elements on the street, this study is designed as a case study, one of the qualitative research methods. In case studies, detailed and in-depth information about real life or an up-to-date system

(situation) is collected and described through multiple sources of information such as observation, interviews, and documents (Creswell, 2020). It is stated that case studies that allow in-depth examination of complex situations with "how" and "why" questions without the intervention of the investigator can be used to understand social phenomena (Yıldırım & Şimşek, 2016; Yin, 2014). Semi-structured interview technique was used in the research. In the semi-structured interview technique, interview questions prepared by the researchers are completed with probe questions aiming to detail the participant answers (Turnuklu, 2000).

Study Group

The study group of this research consists of 10 parents (four females, 40%; six males, 60%) who have at least one child in early childhood (0-8 years). The participants, who were working as academic staff at Sakarya University Faculty of Education, were determined through the convenience sampling method. The demographic information about the parents is presented in Table 1.

Table 1

Demographic Information about Parents

	Mine	Ahmet	Özkan	İsmail	Zeynep	Derya	Ali	Alper	Ayşe	Selçuk
Gender	Female	Male	Male	Male	Female	Female	Male	Male	Female	Male
Where do you live?	City	Town	City	City	City	City	City	Town	Town	City
Where did you spend your childhood?	City	Town	Town	City-Village	City	City	City	City	City	City-Village
How many siblings do you have, including yourself?	2	3	4	5	4	3	2	3	2	2
Where are you in the birth order of your siblings?	1st	3rd	2nd	3rd	1st	1st	1st	1st	1st	1st
Were your parents working?	Father	Father	Father	Father	Father	Father	Both	Both	Father	Father
What was the socioeconomic status of your family?	Middle	Low	Middle	Low	Low	Middle	Middle	Middle	Low	Middle
Did you receive pre-school education?	No	No	No	No	No	Yes	No	Yes	No	No

What type of family were you raised in? *	NF	NF	EF	NF	EF	NF	NF	EF	EF	EF
Did you have a room of your own when you were a child?	Yes	Yes	No	No	No	Yes	No	No	No	No
Does your child have a room of his/her own?	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
The age of your child	4	5	7	6	5,5	5	5	4	5,5	5,5
The gender of your child	Girl	Girl	Boy	Girl	Girl	Girl	Boy	Boy	Boy	Boy

*EF: Extended Family, NF: Nuclear Family

Data Collection Tools

In this study, the "Interview Form for Parents' View of the Street" prepared by the researchers taking the opinions of two different field experts in classroom and preschool education was used as the data collection tool. The form consisted of two parts. There were 12 questions to collect demographic information in the first part, and the second part consisted of eight semi-structured interview questions. When preparing the form used in individual interviews with parents who have children in early childhood, the relevant literature was first reviewed, and a list of questions that could reveal the situation to be examined was prepared. The interview questions were finalized by taking the opinions of two field experts, one in pre-school and one in classroom education. In line with expert opinions, the proposed arrangements were made in the expressions in the interview questions, and the overlapping questions were reformulated as a single question

Collection of Data and Analysis

Before starting the data collection process, a questionnaire was created that included voluntary participation consent to identify the participating parents, and it was communicated electronically to all academic staff of Sakarya University Faculty of Education. Parents with at least one child in early childhood were identified with this form. The voluntary participation consent of the parents who wish to participate in the research was also obtained through this questionnaire. A preliminary interview was conducted with the participating parents in the study group prior to the research, the purpose of the research was explained to the parents, and the day and time were planned for the interviews to be carried out. The interviews with ten parents who wanted to participate voluntarily in the study were conducted

face-to-face and through online meeting platforms. The interviews lasted an average of 75 minutes. The participants were asked the interview questions, and the questions were completed with probe questions during online and face-to-face interviews. The interviews were recorded with participant permission, and the data obtained were transcribed. A total of 93 pages of written documents were obtained after the transcription of the interview recordings.

The data collected in the research were analyzed through content analysis. Content analysis aims to identify data and uncover facts that may be hidden in the data. The underlying process of content analysis is to combine similar data into specific concepts and themes and interpret them arranging them in a way that readers can understand (Yıldırım & Sımsek, 2016). The responses of the academician parents who participated in the study to interview questions were evaluated within the framework of the categories and themes created. The common codes created were expressed descriptively in the same category and theme, together with direct excerpts from the views of academician the parents. Following ethical principles, parents who participated in the study were encoded with the pseudonyms "Mine, Ahmet, Özkan, İsmail, Zeynep, Derya, Ali, Alper, Ayşe, and Selçuk" to protect their identity. To calculate the reliability of the study, the formula "Reliability= Consensus/Consensus + Disagreement" by Miles and Huberman (1994) was used. Accordingly, the reliability of the study was determined as 91%. Miles and Huberman (1994) point out that the reliability level must be 70% and above. When the reliability value of this study (91%) is compared to the critical value (70%), it can be said that the results obtained from the research are reliable.

Ethics Committee Approval

The ethics committee permission of this research was obtained with the decision numbered "32" at the meeting of Sakarya University Social and Human Sciences Ethics Committee dated 07.04.2021 and numbered 33.

Findings

In this section, the findings of the study are presented.

Research Question: How have street games changed from the past to the present according to academician parents who have children in early childhood?

Table 2

Academician Parents' Views on The Change in Street Games from The Past to The Present

Theme	Codes
Originality In The Game	Children's play and building playgrounds in the past
	Original and creative games in the past
	Imitation, fiction, ready-made, and directed games today
Communication In The Game	Decrease in peer teaching
	Decrease in in-game communication and interaction
	Decrease in exchange of ideas between children
	Decrease in in-game democratic decision-making
Person, Place, And Time In The Game	Gaming in limited spaces today
	Gaming in limited times today
	Change in places of games
	Playing games in the parks today
	Presence of group games in the past
	Individuality and loneliness in games today
	Decrease in game rituals
Materials in The Game	Decrease in authentic gaming materials
	Integration of technology into games
	Playing games with technological tools
	Increase in toy-based games
	Disappearance of mobile chair swing rides
Type of Game	Decrease in traditional children's games
	Decrease in action games

Table 2 contains the views of academician parents whose children in early childhood about the change in street games from the past to the present. As Table 2 demonstrates, parents' views on the change in street games are gathered under five main themes: *"Originality in the Game," "Communication in the Game," "Person, Place, and Time in the Game," "Material in the Game,"* and *"Game Type."* Parents stated that there were "original and creative games" in the past, along with "children's games and building playgrounds" under the theme of *"Originality in the Game."* Under the theme of *"Communication in the Game,"* parents said that today there are "imitation, fiction, ready-made, and directed games," and they mentioned that decreases occurred in "peer teaching," "in-game communication and interaction," "exchange of ideas between children," and in "in-game democratic decision-making."

Within the theme of *"Person, Place, and Time in the Game,"* parental opinions about today are collected under the codes "game in limited spaces," "game in limited time,"

"change in places of games," "playing games in parks," "individuality and loneliness in games," "decrease in game rituals," and the "presence of group games" in the past. Parental opinions collected under the theme of *"Materials in the Game"* put forward that today "authentic game materials have decreased," "technology is integrated into games," "games are played with technological tools," "there is an increase in toy-based games," and "mobile chair swing rides are disappearing." In the theme of *"Game Type,"* parents stated in their opinions that "traditional children's games" and "action games" are decreasing today. Examples of direct quotes about parents' views on related themes are presented below.

Figure 1

Games Played in The Past, Present, and Both Past and Present
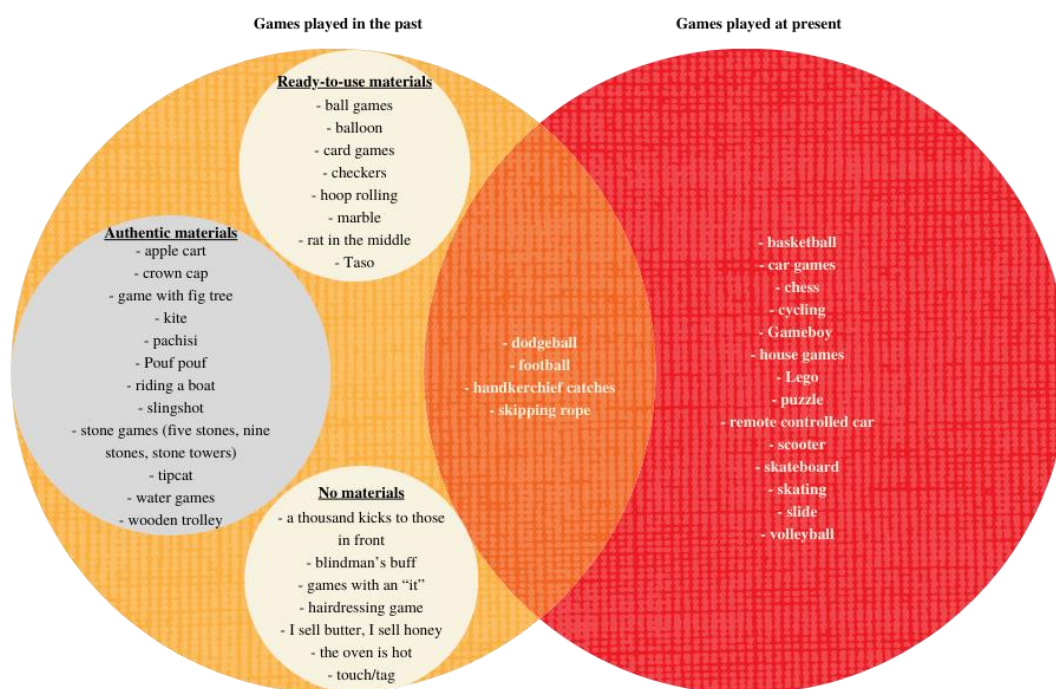
In Figure 1, the games played in the past, present and in both past and present are displayed in alphabetical order. As demonstrated in Figure 1, the games in the past and present differ from each other, and although they are few, it is seen that some of the games played in the past – such as football, handkerchief catching, dodgeball, and rope jumping –

are still played today. The games played in the past are grouped under the three main themes of "Authentic Materials," "Ready-to-use Materials," and "No Materials" games.

Games such as five stone, nine stone, tipcat, slingshot games, pachisi, crown cap, and apple cart were listed under the theme of "Authentic Materials." The theme "Ready-to-use Materials" included games such as marble, ball, card, checkers, and hoop games. The "No Material" theme, on the other hand, comprised games such as blindman's buff, 'I sell butter,' touch, the oven is hot, and games with 'it.' Today, it is seen that mainly puzzles, Legos, scooters, skateboards, remote-controlled car games and home games played within the boundaries of the home are played. One of the participants, Alper, gave his example for the Authentic Materials theme saying, "The inside of a fig tree is sponge-like. We would open the fig tree bark and remove the spongy structure. We would stuff up orange peels there, and then when you pushed them with a stick like that, the little orange peels would hit the other guys with a big pressure." About the theme of Ready-to-use Materials, Selçuk said, "Recently, for example, like Legos, he likes these things. He can buy them at the grocery store nearby. Of course, we were limited about these." For the No Materials game theme, Alper's example was "but hide-and-seek games have very large participation…." By comparing the games played in the past and those played today, it can be said that the structure of today's games is mostly within the framework of more individual and ready-made materials, and many of these games are shaped with technology integration.

Research Question: How have streets changed in terms of security from the past to the present according to parents who have children in early childhood?

Table 3

Academician Parents' Views on the Change in Street Safety from The Past to the Present

	Past	Present
Theme	**Codes**	
Positive Perceptions	People's familiarity and trusting each other No security problems The existence of values	The confidence provided by technological developments
	The existence of neighborhood culture Perception of safety towards the street Play without parental control Free movement of children in a safe	

	environment	
	Trust in neighbors	
	Confidence due to few vehicles on the streets	
Negative Perceptions		Perception of insecurity
		The need for strict supervision
		De-identification
		Inability to move freely on the street
		The need for privacy education in children
		Inability to entrust children to peers/elders
		The need to monitor children with a tracking device
		Increase in unfavorable cases
		Not being able to leave children on the street and not being able to provide ample spaces
		Inability to intervene in negativity
		Loss of neighborhood culture and values
		Diminished safety as vehicle traffic increased

Table 3 contains parents' opinions on the change in street safety from the past to the present. When table 3 is examined, it is seen that the parents' views on the change in street safety from the past to the present are gathered under two main themes of "Positive Perceptions" and "Negative Perceptions." Parents stated that in the past, "people knew each other and had trust relationships," "there was no security problem," "values and neighborhood culture existed," and "there was a sense of security in the street." They also said that children "played without parental control and moved freely in a safe environment," "neighbors were trusted," and "they felt safe about the street due to lack of many vehicles." This finding is reflected in the participant Mine's expressions as "Zero concerns about safety on the street where I spent my childhood. We never had any concerns." However, the participating parents also stated that there is still a "sense of safety provided by technological developments." Ahmet, the only participant with a positive opinion about street safety today, said, "'A' has a smartwatch, for example. I can see where she is."

Within the scope of the "Negative Perceptions" theme, it was determined that parents did not express any negative opinions regarding street safety in the past. This indicates that parents considered the street of the past to be reliable. This finding also supports parents' views on street safety in the past under the theme of "Positive Perceptions." Regarding the theme "Negative Perceptions," parents stated that there is a "perception of insecurity" on the streets today, "strict control is needed" on the streets, "there is de-identification," "there is no free movement in the streets," and "privacy education is needed for children." They also remarked that "children cannot be entrusted to peers/elders," "they need to monitor their

children with tracking devices," "children cannot be left on the street, and they are not given ample spaces." In addition, the codes "negative cases are increasing," "negativity is not intervened," "neighborhood culture and values are lost," and "safety decreases with the increase of vehicle traffic" were among the parental opinions. Ismail expressed his negative perception of the street today as "We take care not to leave our children out of sight," while Ahmet stated, "Unfortunately, there is a lot of difference in terms of security ... I'm not letting her go out alone. The fear of 'what if something bad happens to her?'"

Research Question: How have social elements/structures on streets changed from the past to the present according to parents who have children in early childhood?

Table 4

Academician Parents' Views on Social Change on The Street from The Past to The Present

Theme	Codes
Socio-Emotional Change	Disappearance of the sense of belonging
	Decrease in social sensitivity
	Decrease in the feeling of trust
	Decrease in kindness (decrease in thanking and gratefulness)
Change In Human Relations	Limited communication
	People becoming unfamiliar with each other
	Decrease in warm relationships and sincerity
	Disappearance of unannounced, sudden visits of neighbors
	Decrease in common activities on the street
	Leaving the responsibility of the children only to the family
	Weakening of relations due to technological developments
Socio-Cultural Change	Loss of neighborhood culture
	Change in family structure
	Increase in participation in business life
	Change in living conditions
	Change in working hours
	Increase in workload

Table 4 demonstrates parents' views on social change on the street from the past to the present. As seen in the table, the views of academician parents regarding social change on the street are gathered under three main themes: "Socio-Emotional Change," "Change in Human Relations," and "Socio-Cultural Change." Regarding the theme "Socio-Emotional Change," parents think that "the sense of belonging has disappeared," "social sensitivity has decreased," "the feeling of trust has lessened," and that "kindness has decreased." In the framework of the theme "Change in Human Relations," parents stated that "communication has become

limited, and people have become unfamiliar with each other," "warm relationships and sincerity have diminished," and "unannounced, sudden visits of neighbors have disappeared." In addition, the parents mentioned that "common activities on the street have decreased," "the responsibility of the children is left only to the family," and "technological developments have weakened relationships." Ahmet described the socio-emotional change from the past to the present as "I don't feel the neighborhood is mine," and Zeynep commented on the changes in human relationships as "The door was knocked all the time. It was my neighbor, or my friend, or one of the relatives to have tea and eat, just unannounced. There were a lot of unplanned visits like this." On socio-cultural change, Zeynep added, "Right now, I think family members are living as nuclear families."

Research Question: How have social elements/structures on streets changed from the past to the present according to parents who have children in early childhood?

Table 5

Academician Parents' Views on Physical Change on The Street from The Past to The Present

Theme	Codes
Spatial Change	Increase in the number of buildings and floors
	Creation of car parks
	Creation of housing estates
	Creation of special playgrounds
	Development, change, and aesthetic concerns in the physical structure
	Ignoring children in urban planning
	Designing of streets according to pedestrians and vehicles (sidewalks, walking and cycling paths)
	Transformation of houses from living spaces to shelters
	Disorganized and inappropriate planning
	Destruction of fields, gardens, and soil playgrounds
	Transition from stabilized roads to asphalt roads
Instrumental Change	Increase in vehicle numbers and traffic
	Change in playground materials (transition from metal to plastic)
	Mobile chair swing rides became stable and accessible
	Decrease in mobile food and drink vehicles

Academician parents' views on physical change on the street from the past to the present are demonstrated in Table 5. As shown in the table, the parents' views were grouped under the two themes of "Spatial Change" and "Instrumental Change." Within the theme of "Spatial Change," the parents stated that "the number of buildings and floors increased," "car

parks were created," "housing estates emerged," "special playgrounds were created," "developments, changes, and aesthetic concerns in the physical structure" occurred, and "children were ignored in urban planning." Besides these, they added that "streets were designed according to pedestrians and vehicles," "houses transformed from living spaces to shelters," "plans were made in a disorganized and inappropriate manner," "fields, gardens, and soil playgrounds were destroyed," and "stabilized roads were transformed into asphalt roads." About spatial changes from the past to the present in the street, İsmail said, "We were better in home design in the past… When we look at older traditional Turkish houses, they are places that offer more living spaces. What we're building now are places that offer sleeping areas." Regarding instrumental changes, Ayşe said, "Yes, there were mobile chair swing rides. They came like that; there were those mobile chair swing rides, rotating… We used to swing there. Now there is no such thing."

Research Question: What are the metaphoric perceptions of academician parents who have children in early childhood about streets today and streets in their childhood?

Table 6

The Metaphors Academician Parents Have Created About the Street from The Past To The Present

Metaphor (Street in the Past)	f	Metaphor (Street Today)	f
Home	1	Tool	1
Game and playmate	1	A place to get some air	1
Happiest place	1	Activity location	1
Entertainment center	1	Not the happiest; a happy place	1
Playground	2	Car park	1
Dessert/Pistachio	1	Means of transportation	1
Shadow	1	A road where vehicles pass/Road	2
The place where I live	1	Light	1
Game	1	Diet food	1

Table 5 demonstrates the metaphors generated by the parents about the street from the past to the present. As shown in the table, the parents likened the street in the past mostly to a "*Game/Play and Playmate*" (f=2) and a "*Free Playground/Playground*" (f=2). Furthermore, the parents used the metaphors of "*Home*" (f=1), "*The Happiest Place*" (f=1), "*Entertainment Center*" (f=1), "*Dessert/Pistachio*" (f=1), "*Shadow*" (f=1), and "*The Place Where I live*" (f=1) for the street in the past. On the other hand, the parents likened today's street mostly to "*A Road Where Vehicles Pass*" (f=2). Other metaphors for today's street were a *"Tool"* (f=1), "*A*

Place to Get Some Air" (f=1), "*Not the Happiest; a Happy Place*" (f=1), "*Car Park*" (f=1), "*Means of Transportation*" (f=1), "*Lamp*" (f=1), and "*Diet Food*" (f=1).

Below Are Examples of Quotes About The Metaphors That Parents Have Created for The Past and Present Streets and The Reasons For These Metaphors

Street in the Past

Home Metaphor: *"In the past, the street was like home to me because it was just as safe. (Mine)"*

Game and Playmate Metaphor: *"In the past, the street was like a play and a playmate to me because there was nothing else to do. What can you do? What's your alternative? Nothing. You must live your life there. You're either home or on the street; you have no other alternative. The conditions required this. (Ali)"*

Happiest Place Metaphor: *"In the past, the street was like the happiest place for me because I could do everything there. (İsmail)"*

Entertainment Center Metaphor: *"In the past, the street was like an entertainment center to me because it was a place where I had good times with friends. (Zeynep)"*

Playground Metaphor: *"In the past, the street was like a free playground to me because I could do whatever I wanted there the way I wanted. I mean, everything. I could also misbehave doing everything. (Ahmet)"*

Playground: *"In the past, the street was like a playground to me because – why? – I was with my friends. In fact, the street was a place where I played the most games and spent more time than at home in terms of games. (Derya)"*

Game Metaphor: *"In my childhood, the street was like a game to me. 'I'm going out on the street' means 'I'm playing a game' because the friends are waiting there. It is because you play on the street. It was because the TV wouldn't appeal to you. (Alper)"*

Dessert/Pistachio Metaphor: *"In the past, the street was like dessert/pistachio to me because food is enjoyed, and interaction with it is very much loved. You never want it to end because you can't do this; even if you are together and eat it for a while, you feel the need to ask for the next one. But it is limited, too, like, you have to go when it's evening, etc. But that was the way it was, what we felt in those times. (Selçuk)"*

Shadow Metaphor: *"In the past, the street was like a shadow to me because it was a dark place where I could suddenly be exposed to danger. (Ayşe)"*

The Place Where I Live Metaphor: *"In the past, the street was like a place where I lived because we were doing everything there. We were playing; we were walking around. We were playing something, digging somewhere. We were eating. I remember, for example, I usually ate lunch outside. Actually, we were living there. (Özkan)"*

Street Today

Tool Metaphor: *"Today, the street is like a tool to me because it's just something we use to take the road. The street doesn't mean anything cultural to us anymore. (Mine)"*

A Place to Get Some Air Metaphor: *"Today, the street is like a place for me to get some air because we're getting away from tablets, technology. (Ahmet)"*

Activity Location Metaphor: *"Today, the street is like a place of activity for me because guys, let's go play a truck, or, I don't know, let me do something. Now it's more like a place of activity. Let me go do this because the possibilities are very limited; the options are very limited. It's like you go to a grocery store, and you buy cheese and bread. The street is also like that – it is like I'm going to go and play with a toy and do something. In the past, the things you could do used to be wider in range. (Özkan)"*

Not the Happiest; a Happy Place Metaphor: *"Today, the street is not the happiest for me; it's like a place one feels happy because not everything, but a lot of things can be done there. (İsmail)"*

Car Park Metaphor: *"Today, the street is like a parking lot to me because it is merely an environment where cars are parked, unsuitable for play. (Zeynep)"*

Means of Transportation Metaphor: *"Nowadays, the street is like a means of transportation to me because they are just the routes we take when we go from place to place. (Derya)"*

A Road Where Vehicles Pass Metaphor: *"Today, for me the street is like a road where vehicles pass because, I mean, the street is a road now, just a road the way you know it. It's a place to access another place we can say. (Ali)"*

Road Metaphor: *"Today, the street is like a road to me because it's a route we use to commute somewhere, but if I was a kid, maybe I could associate it with the game again. (Alper)"*

Lamp Metaphor: *"Today, the street is like a lamp to me because I can control where I am. (Ayşe)"*

Diet Meal Metaphor: *"Nowadays, the street is like diet food to me because it's safe when you look at it, but it doesn't taste good. It does not hurt you. There are things you need, but you eat just for the sake of eating. (Selçuk)"*

Tablo 7

Conceptual Categories in Which the Metaphors of Parents from The Past to The Present Are Collected

Street in the Past Conceptual Categories	Key Features	Metaphors	Street Today Conceptual Categories	Key Features	Metaphors
Street as a Living Space	A place where everyday life activities are done.	Home, Happiest Place, Playground (2), The Place Where I live	**Street as a Route**	A route used for transportation purposes.	Means, Means of Transportation, A Road Where Vehicles Pass, Road
Street as a Game	A place where people can play games, come together, and experience different emotions.	Game, Play and Playmate, Entertainment Center	**Street as a Place**	An area where time can be spent, where various activities can be done.	Place to Get Some Air, Place of Activity, Not the Happiest; a Happy Place, Car Park
Street as a Danger	A place with dangers due to uncertainty and obscurity.	Shadow	**Street as Trust**	A controllable area.	Lamp
Street as an Indispensability	A place one does not want to give up because of its pleasure.	Dessert/Pistachio	**Street as Obligation**	A place used only to meet basic needs.	Diet Food

Table 7 contains conceptual categories in which the metaphors created by parents from the past to the present are collected. According to Table 6, five of the metaphors created by parents for the street in the past are collected in the category "*Living Space,*" three were in the *"Game"* category, and one was in the categories of *"Danger"* and *"Indispensable."* It is determined that four of the parental metaphors for today's street are in the category "Route," four are in the *"Space"* category, one is in the category of *"Trust,"* and one is in the *"Obligation"* category.

Discussion and Results

In this section, the results of this research were discussed, and recommendations were made within the framework of the relevant literature. The study was carried out to examine the views of academician parents whose children in early childhood about the street from the past to the present and reveal the changes in the street in terms of play, safety, physical structures, and social elements.

Streets can be characterized as places where individuals, especially children in early childhood, engage in various activities and events and gain life experiences through play. Within the scope of the research, when the opinions of parents who have children in early childhood are examined for street games from the past to the present, it has been observed that changes have occurred in multiple sub-themes under this theme between the past and present. According to the parents, these changes in games occurred in the originality, communication, person-time and space, materials, and types of games. The parents stated that creative and original games, as well as the in-game interaction and communication decreased, games played individually in limited spaces increased, authentic toys were replaced by the technological tools that today's technology age incorporated into our lives, and traditional action games began to disappear. In the literature on children and games, Arslan (2017) maintained that children play more individual games today than group games, and they play with ready-made toys in their games, spending a short and limited time during play. In their study, Talu and Yüzbaşıoğlu (2020) stated that traditional games are decreasing today, and this situation is felt as a deficiency. They reported that this deficiency is due to the integration of traditional games into cartoons which today's children spend a very long time watching. The results obtained within the framework of street games in the present study are similar to research results on the street and games in the literature. Accordingly, by comparing the street in terms of "play," parents who evaluated both the street in their own childhood and the street in the time of their children in early childhood, i.e., the street today, emphasized that the interest in street games from the past to the present has decreased and there are different reasons that lead to this consequence.

Streets are among the physical spaces where individuals live their lives and actively carry out many activities. This research determined that the views of academician parents who have children in early childhood have changed from the past to the present regarding the safety of the street. While parents had positive views of the streets in the past, these views

have changed over time and have become negative opinions towards the street today. The reasons for the change in parents' views on the safety of the street are varied. As regards the literature, Ayaz and Yamaçlı (2019) emphasized that there are various problems with security in the streets and that the streets are physical environments that are dangerous for individuals due to traffic problems. Öztoprak et al. (2012) determined that when compared to the past, today's streets create a fear of crime in parents. The results obtained from this current study are in line with research results carried out about the street and safety in the literature. In this respect, parents who evaluated both the street in their childhood and the street in their children's time by comparing it in terms of safety have feelings of mistrust towards the street contrary to the increased security measures in the developing technology world.

Streets can be viewed as important bridges that connect people's living spaces, and they help the people they connect to share socially common cultures. According to Alver (2010), streets are structures that connect people besides being social units. In this present research, it was determined that the views of academician parents who have children in early childhood have changed towards the social structure of the street. Parents evaluated the changes in the social structure of the street within the frameworks of socio-emotional, human relations, and socio-cultural themes. In the socio-emotional context, parents put forward that trust, the sense of belonging, and social sensitivity decreased. With regard to human relations, parents maintained that communication weakened explaining its cause as technological developments. In socio-cultural terms, they stated that differentiations occurred in the way people live their lifestyles and culture. Likewise, explaining the impact of globalization on cultural values in his study, Mahırogulları (2005) emphasizes that cultural changes are inevitable in our age of satellite technologies. However, he states that the prevention of imposing a single culture by taking the necessary measures in the protection of the existing national and cultural structure plays an important role. In the same vein, Ayaz and Yamaçlı (2019) express that the preservation of the street and neighborhood culture of the past has a critical function in the continuity of traditional cultural values. The results obtained in the present study are similar to the results of the research carried out within the framework of street and culture in the literature. Consequently, it can be said that parents who have children in early childhood believe that the street is contributing gradually less to the "social" and "cultural" development from the past to the present, and in this respect, the lives of children and their parents on the street are becoming increasingly different.

Streets are places where architectural structures are located, and they also constitute the movement area of vehicles. In this study, academician parents whose children in early childhood stated that the street has changed physically from the past to the present. It was determined that parents' opinions about physical change on the street could be classified under two basic headings: "spatial" and "instrumental." Concerning spatial changes, the changes occurring in the settlements come to the fore, whereas in terms of instrumental changes, the changes in vehicles and materials on the streets are emphasized. Regarding materials, play equipment was made of metal and wooden materials in the past, while plastic is preferred more today. Similarly, Ozyılmaz and Sahıl (2017) have reported in their study that the change in social structure has reflections on the architectural structure. Perker and Akıncıturk (2011) stated that the needs and wishes of individuals differed due to the changes in social life over time. The results obtained from this study are similar to research results carried out about street and physical structure in the literature. Accordingly, the views about the physical aspects of the street from the past to the present have changed among parents who have children in early childhood.

In this study, the metaphors created by parents towards the past and present street were examined, and the conceptual categories of "living space, play, danger, and indispensability" have emerged about the past street. On the other hand, the conceptual categories of "route, place, trust, and obligation" have been generated for today's street. When the conceptual categories for the street are examined in line with the opinions of the parents, it is seen that there has been a change in the views of individuals towards the street from the past to the present. Within the framework of parental views, the street has been seen as an environment where everyday needs were met, and children played their games freely in the past. However, the street is used for transportation purposes today, it is an instrument for meeting basic needs, and it is considered now as a place where there are no active gaming environments as there were in the past. There have been changes in the structure and function of the street today due to various reasons such as the unsafeness of street areas with technological developments and changing living conditions (Bredekamp, 2015); there has also been a decrease in game activities on the street (Ozyurek and Oztabak, 2016). Considering the results obtained from similar studies, the findings obtained in this study are similar to the research in the literature. Therefore, it can be said that there are differentiations in the function of the street from the past to the present and in the activities carried out on the street.

Recommendations

In line with the results of this research, which was carried out to examine the views of academician parents who have children in early childhood from the past to the present and to reveal the change in the street from various aspects, the following recommendations were developed:

Traditional children's games played on the street can be taught to children starting from the preschool period to ensure the transfer of culture accurately and systematically. It is considered that active play of these games in everyday life can also be encouraged by parents in out-of-school environments. In order to achieve this, parental play teaching workshops should be created to inform the children about the content, rules, spatial characteristics, and materials required for the street games of their parents' childhood. In addition, from the point of view of curriculums, lessons or contents can be integrated into the basic education system where children will learn traditional children's games that support many skills and development areas. Social street projects can be implemented with the support of public institutions and non-governmental organizations to revive the social communication and interactions of individuals and to reinvigorate the "neighborhood and street culture" that existed in the past. By organizing days when children can use the street as safely as in the past, examples can be set to carry the socio-cultural structure that made the street safe in the past to the present. Architectural planning can be made in the construction of physical elements on the streets that do not disturb the spirit of the street of the past, that carry traces of the past, and that can also improve the quality of life by meeting the needs and desires of people in today's world. While making these plans, the collaboration of experts from different disciplines may also reflect our culture on street designs in terms of architectural features. Metaphor studies to be carried out with different study groups to determine perceptions of the past street might provide the basis for new scientific studies by providing a holistic perception of the street in the past.

Ethics Committee Approval

The ethics committee permission of this research was obtained with the decision numbered "32" at the meeting of Sakarya University Social and Human Sciences Ethics Committee dated 07.04.2021 and numbered 33.

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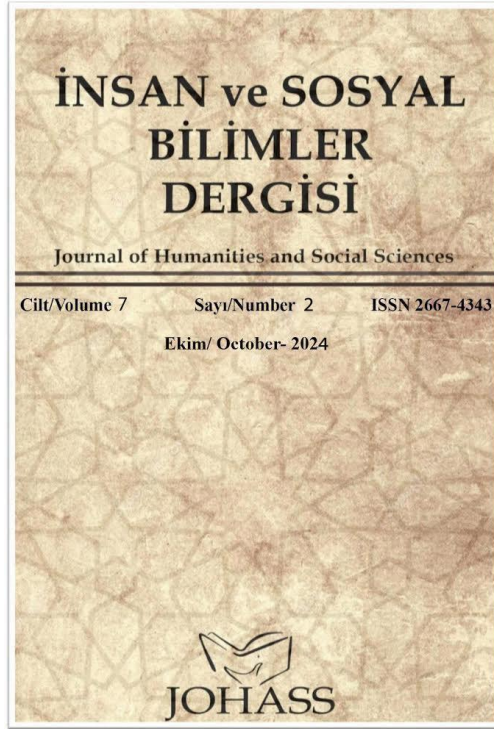
Artificial Intelligence, Transformation and Expectations in Graphic Design Processes

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Artificial Intelligence, Transformation and Expectations in Graphic Design Processes

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Abstract	Research Article

Artificial intelligence (AI), as the pioneer of today's technological advances, brings innovation to many sectors and graphic design is among these sectors. Within the rapidly developing technology of our age, the integration of AI technologies into the field of graphic design provides a significant acceleration in design processes. In this context, it is predicted that the use of AI in this field contributes to accelerate design processes, increase efficiency and improve user experience and interactive design. Additionally, the research examines the current and potential status. The study adopts qualitative methods of comparative analysis and logical reasoning and is limited to the reviewed literature and studies reviewed. The findings show that AI-assisted graphic design tools accelerate design processes, increase efficiency and enable more creative solutions. The results show that AI-supported graphic design tools accelerate design processes, increase efficiency and enable more creative solutions.

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Introduction

Today, AI is a technology that enables a significant transformation in many sectors and optimizes business processes. The use of artificial intelligence in the field of graphic design increases the efficiency of designers and users by offering analytical insights in design processes (Rezk et al., 2023a).

As a key form of communicatio. Graphic design has a great influence in many fields such as advertising, marketing, branding and communication. has traditionally relied on the designer's skills, experience and aesthetic taste (Wong & Li, 2023). However, with advancements in AI technologies, artificial intelligence-supported tools that offer analysis in graphic design have started to be used.

AI-assisted graphic design tools are equipped with extensive databases and advanced machine learning algorithms. These tools help designers analyze and optimize their designs. For example, when designing a logo, a graphic designer can use an AI-assisted tool to analyze the design's color harmony, balance, flow of lines, and visual memory (Li, 2021a). Thus, they can have a deep understanding of the impact and perceptibility of the design.

AI-assisted analysis of graphic design allows designers to optimize their designs more effectively. Designers can use the analysis results of AI models to make changes that increase aesthetic value (Shallal, 2023).

For example, they can use AI-powered tools to optimize the color scheme of a logo or make a poster more eye-catching.

In this context, the aim of the research is to explore the current and potential uses of AI-supported graphic design tools and to evaluate the effects of these tools on the design process. It also seeks to demonstrate how artificial intelligence has become an effective tool in the graphic design process and how it can improve designers' workflows. Literature review and logical reasoning were used as methodology. In this framework, the effects of artificial intelligence technologies on graphic design products and their usage areas are analyzed. This examination provides insights into on the development processes of graphic design works created with artificial intelligence in order to determine the current situation.

Method

This study examines the implications of artificial intelligence (AI) assisted graphic design and evaluates the integration of AI technologies into graphic design processes. The research adopts qualitative methods of comparative analysis and logical reasoning and is limited to the literature and studies reviewed.

Logical reasoning is the process of reaching logical conclusions by analyzing the relationships between available information, and this process forms the basis of intellectual activities such as inference, hypothesis generation and problem solving (Tuffaha & Perello-Marin, 2023).

Comparative analysis is a research method that evaluates the strengths and weaknesses of two or more elements by examining their similarities and differences. This method is used to determine which element is more effective or appropriate in a given context.

Findings

The findings of this study are based on the results of literature review and comparative analysis investigating the effects of artificial intelligence-supported graphic design tools on design processes. Research has shown that these tools save time, increase productivity, and improve the capacity to produce more creative solutions, especially on repetitive tasks. The automatic analyzes offered by artificial intelligence technologies in graphic design processes have contributed to the improvement of basic design elements such as color harmony, composition and typography, enabling these elements to create more aesthetically effective and technically advanced designs.

In this context, it has been shown that artificial intelligence-supported tools cannot fully meet human emotional and aesthetic evaluations in the design processes. At this point, it has been concluded that integrating human-centered design approaches and designers' creativity with artificial intelligence technologies will further improve design processes (Wong and Li, 2023).

Principles, History and Contemporary Applications of Artificial Intelligence

Artificial intelligence (AI) is defined as the branch of computer science that refers to the ability of machines to perform certain tasks with human-like thinking and learning abilities

(Schroeder & Dean, 2019a). Artificial intelligence is a broad concept often used in the fields of computing and software engineering and is often considered a subfield of computer science (Tuffaha & Perello-Marin, 2023). Its main goal is to develop systems that mimic or simulate the processes and algorithms used by the human brain (Tian et al., 2022). It performs its tasks by analyzing and learning from large amounts of data. It is examined in two main categories, Weak and Strong, weak AI is designed for a specific task, while strong AI has the ability to perform a large number of different tasks and builds its data by leveraging its previous experience when faced with new tasks (Li, B. et al., 2022).

Artificial intelligence research involves many disciplines such as mathematics, computer science, statistics, psychology, philosophy, neurology, and its technology is used in many fields such as natural language processing, image recognition, voice recognition, recommendation systems, and autonomous vehicles (Haenlein & Kaplan, 2019). However, the rapid development of artificial intelligence has also brought serious debates on ethical and social dimensions.

When we look at its history. It has influenced people's imagination since ancient times, but modern works were embodied in it, for example, in the early 20th century. *"In this regard, importance has been given to making the watches made more detailed and precise."* (Uzun, 2019).

From another perspective, artificial intelligence is utilized across various sectors, ranging from automotive to health, finance to education. However, ethical concerns, security, and the protection of privacy remain critical issues in the application of this technology (Ruotsalainen & Blobel, 2020). In the future, artificial intelligence is expected to have a broader range of applications with the advancement of more intelligent and flexible systems. Yet, achieving a level equivalent to human intelligence, specifically reaching the stage of general artificial intelligence, is still seen as a significant challenge (Haenlein & Kaplan, 2019). Moreover, as the pace of artificial intelligence development accelerates, the importance of providing education tailored to gifted individuals becomes increasingly evident. When educational and practical programs are designed to meet the unique characteristics of gifted individuals, they can accomplish remarkable achievements due to their high cognitive and creative potential. On the other hand, if these individuals do not receive appropriate education, serious issues such as underachievement and social maladaptation may emerge (Oruç & Çağır, 2022). From a different perspective, ''*It is essential to consider Where its technology takes into*

account human physiology when integrating artificial intelligence into various domains'' (Bulut, 2023).

Therefore, the basic principles of AI cover areas such as machine learning and deep learning, and these principles determine the working principles and application methods of AI. Today, artificial intelligence is at the forefront of technological developments, increasing its importance in areas such as graphic design. It plays an important role in automating design processes, supporting creativity and providing personalized design experiences (Guo et al., 2021a).

Evolution and Basic Principles of Graphic Design

Graphic design encompasses the use of visual and typographic skills in visual communication and problem solving processes and is applied in various fields such as brand identity, advertising, web design and product packaging. Its main purpose is to effectively communicate messages through visual tools, which involves understanding the target audience, translating the message into a visual language and applying this visual language with technical skills.

The history of graphic design begins with cave paintings and ancient hieroglyphs and accelerates its development with the Industrial Revolution, advances in printing technologies and the increasing need for mass communication (Ruotsalainen & Blobel, 2020).

When we look at the basic principles of graphic design, these include balance, contrast, repetition (rhythm), proportion, hierarchy, emphasis, movement and unity (Satrinia et al., 2023). Balance refers to the equal or appropriate distribution of visual weight among the various parts of the design, while contrast enhances the visual difference between different elements in the design. Repetition involves the repetition of a particular element or elements within the design and lends coherence and rhythm to the design. Proportion refers to the size and spatial relationships between the various elements of a design. Hierarchy determines the visual importance and sequence between the various elements of a design. Emphasis makes a particular point or element stand out in a design. Movement creates a sense of dynamism and fluidity in design. Unity provides integrity and consistency in design (Kovačević et al., 2020). These principles have the potential to increase the aesthetic value and visual interactivity of graphic design and are used strategically to increase the comprehensibility and aesthetic value of design.

Integration of Artificial Intelligence and Graphic Design

Artificial intelligence (AI) refers to the process of imitating the characteristics of human intelligence and its functions such as learning, problem solving and perception through computers, robots and other digital devices (S. M. M. Rezk, 2023). This technological field aims to model the basic dynamics of human intelligence (Li, 2021b). In parallel, graphic design can be defined as the art and practice of creating and conveying messages using visual communication and aesthetic means of expression (Aydemir, D, 2023). These two disciplines are becoming increasingly integrated with the incorporation of artificial intelligence technologies into the creative process (Satrinia et al., 2023).

AI technologies have the potential to transform graphic design processes in several ways. First of all, thanks to the possibilities provided by graphical automation tools, designers have the opportunity to save time on routine tasks and direct their energies towards more complex and innovative projects (Liu, 2023). AI-powered tools have the capacity to automate many specific tasks, from logo design to typography selection, from optimization of color schemes to visual arrangements (Blazhev, 2023a).

However, AI also contributes to integrating innovative approaches to design processes. Advanced technologies such as deep learning and artificial neural networks allow designers to develop previously unexplored visual styles and forms of expression (Satrinia et al., 2023). This is especially critical in the creation of unique and original designs (Gerard, 2020).

This increasing integration marks the emergence of a new field of work at the intersection of artificial intelligence and graphic design, where creativity and technology merge (J. Yang et al., 2022). In this new field, designers' aesthetic and technical skills, as well as their ability to use artificial intelligence systems effectively, are of great importance. This both contributes to the development of creative processes and expands the boundaries of design practice (Satrinia et al., 2023).

Besides these. *''It is one of the ways people express themselves. The use of artistic expression method ensures that art is included within the scope of freedom of expression.''* (Elmas, 2021). Because it is seen as a means of conveying the thoughts and feelings of individuals in an aesthetic form.

Artificial Intelligence and New Dimensions of Graphic Design Innovation

AI-assisted graphic design encompasses key elements such as automatic content generation, personalized design and sentiment analysis. Automated content generation relates

to the ability of AI algorithms to generate visual content, which can range from illustrations to photographs (Schroeder & Dean, 2019b). Personalized design involves customizing the design according to the user's preferences and behaviors, which makes the design process more user-centered (Camarinha-Matos & Afsarmanesh, 2003). Sentiment analysis examines the effects of design elements such as color, composition and form on viewers.

Machine learning is the ability of artificial intelligence to learn from experience and is based on statistical and mathematical techniques used in learning to automatically extract patterns and relationships from data (Roy et al., 2021). Supervised learning involves machines that learn relationships between inputs and outputs by training with labeled data (Hundgeburth et al., 2021), while unsupervised learning works with unlabeled data and attempts to detect structures and patterns in data (Shallal, 2023a). Reinforcement learning is an approach in which a machine develops strategies to maximize positive outcomes and minimize negative outcomes based on feedback from the environment (Schroeder & Dean, 2019c). Deep learning enables AI to learn complex patterns using deep neural networks, which are multilayered structures inspired by the neural networks of the human brain (Camarinha-Matos & Afsarmanesh, 2003).

General artificial intelligence (AGI) refers to an artificial intelligence with human-like intelligence and includes the ability of a machine to be as flexible, versatile and capable of performing a wide range of tasks as human thought. However, AGI-level artificial intelligence has not yet been developed, and work in this area poses significant technical and ethical challenges (Gerards & Borgesius, 2022a). Areas such as machine learning, deep learning and AGI play a critical role in the advancement of AI, but ethical and societal implications need to be considered in the development and implementation processes.

The Effects of Artificial Intelligence and Data Mining on Graphic Design

Graphic design is a broad discipline that requires artistic creativity and strategic thinking. Designers use visual elements and design principles to communicate messages to specific target audiences, which makes graphic design indispensable for various industries such as advertising, marketing, web design and publishing. The historical development of graphic design helps us understand how the discipline took shape and how it is practiced today (Habovda, 2022).

Sub-disciplines of graphic design include corporate identity design, web design, illustration and typography. Corporate identity design includes visual elements that reflect a company's brand identity and values (Habovda, 2022). Web design involves user experience

and interface design (Z. Wang, 2022). illustration involves the creation of drawings and graphics, often to tell a story or illustrate a topic (Dianova and Dianov, 2022), and typography involves the design of fonts, sizes, and layout that improve the readability and aesthetic appeal of text (Habovda, 2022).

The role of data mining and artificial intelligence in graphic design is the process of extracting information from large datasets and is often accomplished through techniques such as artificial intelligence, machine learning and statistical analysis (Yan and Xin, 2022). Graphic design and data visualization make AI and data mining outputs understandable and effective, enabling them to reach a wider audience (S. Li, 2021).

AI can provide graphic designers with sources of inspiration, analyze color harmony and composition, guide typography choices, and help select the right images and graphics (Wong & Li, 2023). This integration leads to future research that will make data-driven information more accessible and usable for both technical and non-technical users (Guo et al., 2022). Although AI offers such advantages, it is essential to recognize that the mere retention of information in long-term memory does not necessarily imply comprehension. In other words, ''*Just because an individual can recall information does not mean they fully understand it*'' (Bulut, Ş, 2020). It merely indicates that they are prepared to process and potentially understand it at a later stage. This distinction is crucial in the context of AI-driven design processes, as the ability to access vast amounts of data does not guarantee that designers will inherently grasp the underlying principles required for effective visual communication. The cognitive readiness to understand a concept must be supported by deeper engagement with the material, which AI can facilitate by providing designers with tailored insights and suggestions that align with their level of expertise. from another perspective '' *In the brainstorming method with the graphic designer, the process is It is managed by a graphic designer.*'' (Ülger, 2020). This highlights how traditional methods still rely heavily on the expertise and control of a designer, whereas AI offers a supplementary approach that can enhance but not replace the designer's central role in decision-making.

The Potential of Artificial Intelligence Assisted Design Tools in Graphic Design

Today, AI-assisted design tools offer unique opportunities to designers, with examples such as Adobe Sensei, Canva's Magic Resize and Autodesk's Dreamcatcher (Satrinia et al., 2023). These tools can be used effectively in a wide range of fields, from logo design to web design and from user interface design to the creation of advertising materials, and can increase

the creativity of designers by automating design processes with technologies such as data analysis, image recognition and natural language processing (Satrinia et al., 2023). They provide advantages such as time savings, consistency, rapid prototyping and high quality design outputs thanks to their main features such as providing automatic design suggestions based on user inputs, learning user preferences and personalizing design processes (Satrinia et al., 2023). However, they can also bring limitations such as limiting creativity, reducing users' control in design processes and affecting the uniqueness of customized designs (Satrinia et al., 2023).

Research on user experiences shows that users are generally satisfied with such tools, but are concerned about potential constraints on creativity (Satrinia et al., 2023). Case study analyses detail how these tools can be used effectively in complex design projects, their potential to increase efficiency in design processes, and how users can get the most out of them (Satrinia et al., 2023). In this context, AI-supported design tools offer significant advantages and have the potential to revolutionize the field of graphic design by automating design processes and supporting creativity (Satrinia et al., 2023).

Innovation, Analytics and Personalized Design at the Intersection of Artificial Intelligence and Graphic Design

Graphic design and artificial intelligence (AI) play important roles in the disciplines of visual communication and emulating human-like intelligence capabilities of computer systems (Rezk et al., 2023b). AI, through machine learning algorithms, guides designers through various processes such as analyzing visual content, understanding user preferences, and visual editing (Li, 2021c). These technologies improve design processes while also enabling designers to create more effective and personalized visual communication tools.

Artificial intelligence, with its capabilities such as image recognition, classification and content analysis, plays an important role in graphic design, helping designers to select the right images and use visual elements appropriate for the target audience (Gelbukh & Reyes-Garcia, 2006). Furthermore, AI-assisted graphic design offers applications in areas such as similarity matching, recommendation systems, and sentiment analysis, allowing designers to mimic certain styles, provide personalized recommendations, and understand the emotional impact of designs (Okuno and Ali, 2007).

User feedback and AI form an important combination in graphic design analytics processes. By analyzing user feedback, advanced AI technologies enable designs to better adapt to user needs, thereby increasing user-centered design and satisfaction (Tian, 2022). Data

mining, visual analytics, and AI play an important role in the analysis and exploration of graphic design data, providing designers with valuable insights into user behaviors, preferences, and trends, and enabling better understanding, improvement, and personalization of designs (Yan, 2022).

In this context, artificial intelligence and related technologies have a significant impact on the graphic design discipline. While improving design processes, these technologies help designers create more effective, user-oriented and personalized designs. The combination of user feedback and AI provides a higher level of understanding and effective process management in design analytics processes, which encourages the creation of more successful and effective designs in the field of graphic design.

Integration of Artificial Intelligence and Creativity

Creativity and artificial intelligence (AI) are two important concepts that are increasingly being integrated today (Taluǧ et al., 2023). This integration is particularly evident in the role of AI-enabled systems in creative design processes (Wang et al., 2023). Using capabilities such as image recognition, natural language processing and machine learning, artificial intelligence systems offer new perspectives to designers, accelerate idea generation and become an important assistant in creative processes (Blazhev, 2023b). By analyzing complex datasets, these systems can reveal patterns and relationships that human designers may miss, thus expanding the boundaries of creativity (Petráková and Šimkovič, 2023).

The combination of artificial intelligence and human creativity is particularly prominent in co-creation processes (Pansoni et al., 2023). Such collaboration blends the intuitive and emotional intelligence of human designers with the processing power and pattern recognition capabilities of artificial intelligence, enabling the discovery of creative solutions that were previously unattainable (Ibrahim, 2023). AI-powered tools help designers push their conceptual boundaries and go beyond traditional design methodologies (Shi et al., 2023).

Examples of art and design produced by AI concretely demonstrate the creative potential of this technology (Moreira da Silva, 2023). Algorithmic compositions, digital paintings and even three-dimensional objects are evidence of the ability of AI systems to mimic, extend and even transform human creativity (Zheng, 2022). These artifacts are not only technical achievements, but can also have aesthetic and conceptual depth, thus demonstrating the contribution of AI to the fields of art and design.

Ethics, Security and Future Directions in Artificial Intelligence and Graphic Design

Artificial intelligence and graphic design emerge as important concepts at the intersection of technology and art. Artificial intelligence's goal of endowing computer systems with human-like intelligence and learning abilities and graphic design's process of providing visual communication through aesthetic values raise ethical and security issues for designers (Rezk et al., 2023c). The ethics and security of content produced by artificial intelligence brings issues such as forgery, misleading information transmission, discrimination, and privacy of user data (Zhao & Zhang, 2022).

It is suggested that graphic design education programs should raise awareness of future design professionals by emphasizing AI ethics and safety issues and organize continuous trainings for professionals working in the sector. While the automation of AI in the graphic design process may lead to unemployment issues, ethical issues such as reduced creativity, bias and discrimination, data privacy, and responsibility and accountability also come to the fore (Shallal, 2023b).

Security issues include data security, misleading content, misuse and imitation, and data privacy, and case studies are discussed. Data security measures and practices such as data encryption, authorization and authentication, secure data storage, continuous security audits and improvements are important (Thatikonda, 2023).

Advanced artificial intelligence and graphic design resources provide valuable information for those who want to learn more and conduct research in this field. Books such as Deep Learning, Artificial Intelligence: A Modern Approach and various online educational platforms provide in-depth information on artificial intelligence, while books such as Graphic Design: The New Basics and Design for Motion provide comprehensive information on the basics and techniques of graphic design (Nguyen & Voznak, 2024).

Advanced practices in graphic design include automated content creation, style adaptation and recommendations, image processing and editing, user experience design, and data visualization. These applications allow designers to create more creative and expressive work and offer potential opportunities for future innovative applications of the integration of artificial intelligence and graphic design (Tapeh & Naser, 2023).

The Impact of Artificial Intelligence on Graphic Design and Its Future

Graphic design is a branch of art and practice that communicates information and ideas through visual and textual content. The rapid development of artificial intelligence (AI)

technologies has led to significant changes in this field, transforming design processes, opening up new possibilities and making designers' work more efficient (Rezk et al., 2023d). In particular, AI plays a major role in automated design creation processes and the creation of personalized experiences (Xiang, 2023). However, ethical and privacy issues also arise with the application of AI, which can lead to data privacy concerns and the risk of misuse of users' personal information (Gerards & Borgesius, 2022b).

In the future, AI's role and influence in the field of graphic design will increase and more sophisticated and creative design tools and systems will be developed. These tools will facilitate the creation of complex designs and speed up the workflow by providing designers with more flexibility and freedom. Moreover, AI models can optimize designs by analyzing users' feedback and adapt them to better suit users' needs (Lu and Huang, 2022).

However, it is noted that despite AI's involvement in creative processes, it is not yet able to fully mimic the intuition and creativity of designers, and the contribution of designers is still important in creating original and meaningful designs (Shallal, 2023c). Future work should focus on exploring how AI technology can be further integrated into the graphic design process, how it can enhance creative processes, and how solutions to ethical and privacy issues can be found. These studies should aim for a future shaped by the collaboration of AI and designers, enriching the role of designers and enabling more original and personalized design solutions. from another perspective '*'Social memories into the system of signs or connotations to which they refer It is constructed with the aim of bringing it to the surface of consciousness by carrying it*'' (Mollaoğlu, 2023). Because This indicates that the integration of AI can also serve as a medium for reflecting and interpreting collective social memories within design, contributing to a deeper cultural connection in the creative process.

Artificial Intelligence and the Role and Effects of Technological Progress in the Future of Graphic Design

The rapid advancement of artificial intelligence (AI) technology is creating significant transformations in the field of graphic design. Emerging AI technologies enable computers to perform complex and creative tasks more effectively, thanks to advances in areas such as deep learning, natural language processing and general artificial intelligence (Choi et al., 2022). These advances allow AI algorithms to analyze user data and feedback to create more attractive and effective designs, while also improving the ability to identify and predict design trends (Guo et al., 2021b).

The future of graphic design is shaped by the integration of AI technologies. Artificial intelligence has the potential to automate design processes, improve user experience and support designers' creativity (Shallal, 2023d). Applications such as automated design tools, design analytics and personalized design highlight the impact of AI on graphic design processes and outcomes. These applications enable designers to work more effectively and efficiently, improve user experience and reshape design processes (Li, 2021d).

To make the most of the possibilities offered by AI, the graphic design industry must closely follow technological developments and constantly innovate its practices. This requires continuous research and development, while at the same time contributing to the continuous improvement of design processes and results (Shallal, 2023e).

New Tools, Approaches and Applications in the Design World Transformed by Artificial Intelligence

AI-assisted design tools bring innovative approaches to design processes and provide designers with new capabilities through technologies such as natural language processing and image processing. These tools can be used to understand user feedback, analyze visual data, and provide designers with creative ideas (Garg et al., 2018). For example, natural language processing algorithms can analyze user feedback, while image processing techniques can provide inspiration from visual data (Bao and Zhang, 2022).

Artificial intelligence supports designers in areas such as analyzing design parameters and evaluating aesthetic and functional features (Sood, Uniyal, Prasanna, & Ahluwalia, 2012). In addition, natural language processing helps designers better understand user expectations and optimize their designs, while image processing algorithms provide inspiring examples for designers (Zhang & Ma, 2021).

Composition and visual hierarchy refer to the organization of design and the highlighting of certain elements. By incorporating these artistic concepts into automated editing and content generation processes, AI technologies can automate the creation of visual arrangements and content (Huo & Wang, 2022). These algorithms can analyze the aesthetics and expressiveness of a work and perform automatic content generation (Li et al., 2022).

Color theory is a discipline that studies the perception, combination and interaction of colors and is applied in various fields, especially in graphic design, fashion and interior design (Wei et al., 2023). Artificial intelligence technologies can provide automatic color selection and matching based on color theory principles, which helps designers with color choices and

facilitates design processes (Pramkeaw et al., 2019). These technologies can also be used to predict color trends in the marketing and fashion industries by analyzing the trends and uses of colors.

Discussion and Results

In this study, the effects of Artificial Intelligence (AI) on graphic design are examined in detail. By addressing the advantages and challenges of AI-supported design tools, suggestions are developed on how AI can become an effective tool in graphic design and how it can improve designers' workflows.

The main aim of the research is to explore the current and potential state of AI-supported graphic design tools and to evaluate the effects of this technology on design processes. The findings show that AI-powered tools can speed up the design process, increase designers' productivity and enable them to produce more creative solutions. However, it is concluded that these tools cannot fully fulfill the aesthetic and emotional evaluations of designers, so human-centered design approaches are still of great importance.

In this framework, it is suggested that research on the development and improvement of AI-supported design tools should be continued. In addition to efforts to optimize the interaction of AI tools and designers in the design process, it is important to continue efforts to better understand the aesthetic and emotional evaluations of these tools. It is also important to encourage the use of AI tools in design education and to develop educational programs to understand the potential of these tools.

It is predicted that Artificial Intelligence-supported graphic design will develop further in the future and achieve more effective results. It has been concluded that more complex design problems can be solved and more creative solutions can be produced by using advanced Artificial Intelligence algorithms. However, the experience and aesthetic evaluations of designers are still of great importance in the AI-assisted design process. Therefore, in order to make the design process more efficient, the use of AI-based graphic design tools should be widespread, while the contributions and creativity of designers should be prioritized.

As a result, Artificial Intelligence-supported graphic design is gaining a place in our age by developing itself as a tool that provides significant benefits to designers and has the potential to transform design processes. It is envisaged that this technology working in harmony with designers and taking into account subjective aspects such as aesthetic evaluations will make it

possible to make the best use of the potential of Artificial Intelligence-supported graphic design and to offer innovative solutions in the field of design.

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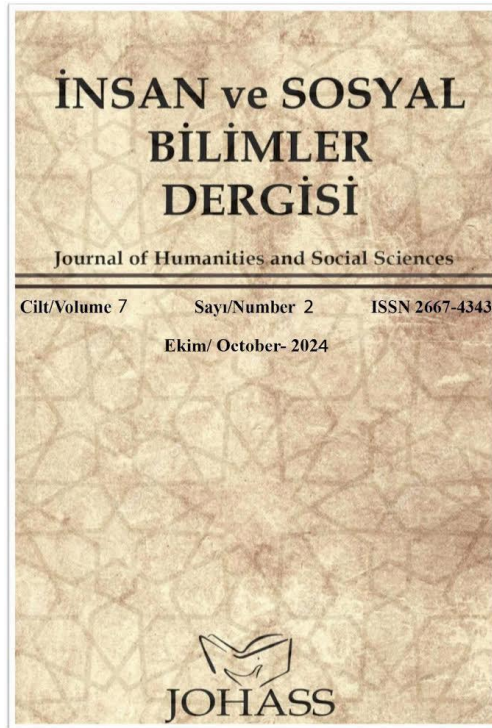
Earthquake Anxiety & Self-Compassion Skill: A Study on Their Demographic Differences & Relationships

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Earthquake Anxiety & Self-Compassion Skill: A Study on Their Demographic Differences & Relationships

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Abstract	Research Article

This study aims at analyzing the relationship between earthquake anxiety and self-compassion skill, while evaluating gender differences. Data from a total of 273 participants were used to assess the earthquake anxiety and self-compassion skill levels of the participants. The findings indicate that the earthquake anxiety is higher among women but the self-compassion skill is more apparent among men. In the reliability analysis performed for the earthquake anxiety and self-compassion skill measurements; Crohnbach's alpha coefficients were used. Accordingly, the coefficients were calculated as (0.98) for earthquake anxiety scale and (0.84) for self-compassion scale. It was revealed that both scales had high reliability coefficients. Correlation analysis results indicate that the individuals with high earthquake anxiety have lower self-compassion skill. In addition, it was observed that the earthquake anxiety increased according to the risk magnitude, that is to say, it was found that the earthquake anxiety were more apparent in the individuals residing in the areas at high earthquake risk. The regression model established between self-compassion scale and earthquake anxiety scale were also found significant. These findings shed a light to the further studies to be performed to better understand the complex relationship between earthquake anxiety and self-compassion skill. This study makes an important contribution to the fact that psychological support services and crisis intervention programs can reach to the individuals more efficiently, taking the relationship between earthquake anxiety and self-compassion skill.

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Introduction

The earthquake anxiety is addressed as an important topic among the psychological effects of the natural disasters on humans. Studies on this issue focus on understanding how the earthquakes affect the emotional reactions such as anxiety, fear and stress in humans and determining their strategies of coping with these reactions.

A study performed by Norris et al. (2002) shows that the post-earthquake traumatic stress can result in long-term psychological effects on the individuals. It is stated that this post-earthquake stress can cause serious psychological problems such as post-traumatic stress disorder (PTSD). The study emphasizes the importance of the post-earthquake psychological support services. It also emphasizes that these services are essential in order to provide the affected individuals with emotional and mental support, facilitate the post-traumatic recovery process and reduce the long-term negative effects.

A meta-analysis carried out by Wang et al. (2013) revealed clearly that the psychological resilience level of the individuals who stayed under the effect of the earthquake is an important protective factor on the earthquake anxiety. This finding underscores the efficiency of the psychological resilience improvement programs in order to cope with the earthquake anxiety. Psychological resilience refers to the individuals' ability to cope with the challenges more resiliently and increase their resistance against the negative situations. Thus, it is stated that the efforts to increase the psychological resilience of the society against the effects of the earthquake and other natural disasters must be an important part of the emergency management strategies.

A study carried out by Chang et al., in 2015 shows that the risk level perceived by the individuals before and after an earthquake plays a determinative role on the earthquake anxiety. This finding emphasizes that pre-earthquake preparation and risk perception is important in reducing the earthquake anxiety and that the societies' being prepared against natural disasters before an earthquake and taking precautions to increase the risk perception can reduce the psychological effects that may be suffered following the disaster.

It also put forward that the earthquake anxiety can vary depending on the demographic factors such as age, gender, educational background and socio-economic state. This finding is important to be able to understand how the earthquake anxiety varies between different groups (Çokgen et al., 2018).

Self-compassion takes love, compassion, empathy and tranquility as basis as one of the basic concepts of Buddhist teaching (Wallace and Shapiro, 2006). According to the Buddhist philosophy, sufferings and challenges are a natural part of human life and everyone can face such experiences (Rubin, 2013). What matters is to cope with such challenges in a healthy manner. A wise life requires coping with the challenges effectively (Thurman, 2006). Self-compassion stands out as a healthy way of coping with such challenges (Neff, 2003a).

Self-compassion consists of three main components, namely self-kindness, awareness of the common sharing and mindfulness, and each component contains positive and negative aspects (Costa et al., 2016). Self-kindness refers to the person's displaying a caring, kind and affectionate attitude against oneself (Neff, 2003b). On the contrary, self-judgment refers to a person's having a self-accusatory and self-judging attitude against oneself. The second component refers to the acceptance that the challenges and sufferings experienced are a natural part of being human (Neff, 2003a). This involves the understanding of the individual that s/he shares his/her own experiences with other people and such experiences are universal. Isolation, on the other hand, refers to an individual's consideration that s/he is going through such experiences only by him/herself. The third component, which is mindfulness, involves the instantaneous acceptance of feelings and experiences without judging them, and being mindful of this moment (Brown and Ryan, 2003; Neff, 2003a). Excessive identification refers to the individual's excessive identification with his or her emotions and considering these emotions as constant and unchanging.

The studies performed show that there is a positive relationship between self-compassion and life satisfaction (Bluth & Blanton, 2012), happiness and optimism (Neff, Rude & Kirkpatrick, 2007), need satisfaction, self-respect and self-acceptance (Neff, 2003b), and psychological resilience (Neff & McGehee, 2009). In the studies performed in our country, it was found that the self-compassion is in a positive relationship with the concepts predicting positive mental health such as life satisfaction (Tel & Sarı, 2016), self-improving humor and communication skills (Akyol, 2011), social support (Akkaya, 2011), mindfulness and bouncing power (Aydın Sünbül, 2016) as well as positive mother, father and self-perception (Andiç, 2013). However, it put forward that there was a negative relationship between self-compassion and depression, anxiety, worry, anger, stress (Andiç, 2013; Temel, 2015), negative Internet usage (Yiğit, 2015), emotion regulation difficulty (Aydın Sünbül, 2016), solitude (Akın, 2010b) and cognitive distortion (Akın, 2010a). The studies performed abroad also found negative relationships between self-compassion and depression (Reas, 2010), anxiety (Pauley &

McPherson, 2010), post-traumatic stress disorder (Thompson & Waltz, 2008) and eating disorders (Ferreira, Pinto-Gouveia & Duarte, 2013). Based on these findings, the self-compassion can be said to be a variable that determines the positive mental health (Neff, 2003a). Self-compassion skill plays an important role in psychotherapeutic processes, as well. The study by MacBeth and Gumley (2012) shows that the improvement of self-compassion especially in the therapy methods such cognitive-behavioral therapy improves the treatment results. In this context, improvement of the self-compassion skill in the therapy processes is an important goal of the therapists. The self-compassion skill was also associated with the relationship quality. A study performed by Yarnell et al. (2015) shows that the individuals with high self-compassion level have healthier and more satisfactory relationships. This finding suggests that the self-compassion skill contributes to the strengthening of the interindividual bonds and the formation of positive relationship dynamics. The self-compassion skill is an important ability that increases the emotional well-being of the individuals, supports the psychological resilience and facilitates the establishment of healthy bonds in the relationships.

Relationship Between Self-Compassion Skill and Anxiety

The relationship between self-compassion skill and anxiety is an important field of research in the psychology literature. The self-compassion is defined as a person's ability to develop an understanding, accepting and loving attitude towards oneself, while anxiety involves the worry and stress feelings related to the future uncertainties and negative events. The relationship between these two concepts may lead to important consequences in terms of emotional well-being, stress management and psychological resilience of the individuals.

A study performed by Neff and McGehee (2010) analyzed the relationship between the self-compassion skill among adolescents and young adults, and psychological resilience. The findings show that the high self-compassion level is associated with the increase in the psychological resistance. This suggests that the self-compassion skill can help to cope with the stress more efficiently.

In addition, a study performed in 2016 addressed the relationship between the self-compassion level between university students, and exam anxiety. The study shows that as the self-compassion skill increases, the exam anxiety decreases and the exam attitudes act as a mediator in this relationship. This finding indicates that the self-compassion skill can be an important factor in coping with significant stress sources such as exam anxiety (Körükçü and Ünal, 2016).

Another study examined the relationship between the self-compassion skill and the anxiety level of university students through mindfulness. These findings show that the relationship between self-compassion and anxiety is partially explained by the mindfulness skills. This suggests that the self-compassion skill can be an efficient strategy in reduction of anxiety levels along with mindfulness-based interventions (Zeller and Yuval, 2019).

In their studies in 2011, Raes et al. addressed the relationship between the self-compassion skill and various psychological symptoms. The findings suggest that the high level of self-compassion is negatively associated with the symptoms such as anxiety, depression and stress. This finding states that the self-compassion skill is an increasing factor for the general psychological well-being. Considering the positive consequences such as reduction of the anxiety levels and increase in the psychological well-being as the self-compassion skill increases, it is thought that the improvement and strengthening of the self-compassion skill may play an important role in increasing in the psychological well-being.

Relationship Between Self-Compassion Skill and Earthquake Anxiety

The relationship between self-compassion skill and earthquake anxiety is a gradually growing field of research in the psychology literature. The self-compassion is defined as an individual's ability to develop an understanding, accepting and loving attitude towards oneself, while earthquake anxiety involves the worry, fear and stress feelings related to the potential earthquake hazards in the future.

One of the studies performed on this subject examined the effect of the self-compassion skill on the earthquake anxiety. According to the findings of the study, it was observed that the individuals with high self-compassion level had lower levels of earthquake anxiety (Özdemir & Yıldırım, 2020).

However, the role of pre- and post-earthquake self-compassion skill on the earthquake anxiety was addressed. In a study performed, it was found that the earthquake anxiety reduced as the self-compassion skill increased and the psychological adaptation after earthquake was better (Göksu & Gençöz, 2017). Another study examined the relationship between the self-compassion skill and the earthquake anxiety through mindfulness skills. The findings show that the relationship between self-compassion and earthquake anxiety can partially be explained by the mindfulness skills (Zeller & Yuval, 2019).

- **H_1:** There is a relationship between earthquake anxiety and self-compassion.

- **H₂:** The earthquake anxiety and self-compassion skill vary in people with psychological diagnosis.
- **H₃:** The earthquake anxiety and self-compassion skill vary according to gender.
- **H₄**: The earthquake anxiety and self-compassion skill vary according to earthquake risk zone.
- **H₅:** The earthquake anxiety and self-compassion skill vary according to ages.
- **H₆:** The self-compassion skill predicts the earthquake anxiety.

Method

Model

In this study, without any intervention on the variables of the research. The "relational survey" model, which involves determining the existing situation, was used. For this study, online form was used for data collection process. The data collection process was performed through online platforms in order to ensure the comfort and easy access of the participants. The survey was prepared in accordance with confidentiality and reliability principles and was ethically approved.

Sample

The sample of the study is consisted of the participants invited via online form between March 2023 and April 2023. The power analysis was used to determine the sample of the study. Given the effect size ($|\rho|$) = 0.30, I. type error probability α = 0.05 and power of the test 1-β = 0.80, the sample size was calculated as 112. Considering the data loss, the survey study was performed with 273 people.

Data Collection Tools

Within the scope of the study, "Earthquake Anxiety Scale" was used to measure the earthquake anxiety, and "Self-Compassion Scale" was used to determine the self-compassion level. The earthquakes do not only cause physical injury, but also increase the risk of mental health issues by having a negative effect on the physical and psychological aspects of the survivors (Kotozaki & Kawashima, 2012). The psychological problems such as depression and anxiety are observed at a high rate among people exposed to earthquake (Zhang et al., 2011).

Measurement of such psychological problems is clinically important. There are many measurement tools for anxiety.

The earthquake anxiety scale used within the scope of the study was developed by Fatih Bal and Ömer Akgül in 2023 in Turkish. The Earthquake Anxiety Scale is consisted of 34 items and has 5-point Likert type rating consisting of the options "not agree at all, not agree, neutral, agree and strongly agree". The lowest score to be obtained from each item is 1 and the highest score is 5. The lowest score obtained in total items is 34, and the highest score is 170. According to the scale, the high scores show that the earthquake anxiety scores are high, and the low scores show that the earthquake anxiety scores are low.

The self-compassion appears as an alternative approach to self-respect addressed as a main criterion of psychological health (Neff, 2003a). The self-compassion that is associated with the positive outcomes of self-respect also draws attention of the researchers as it does not involve the criticized aspects of self-respect. For example, self-compassion was found to be significantly related to the positive psychological health variables whereas it was not found to be related to the narcissistic personality traits to which high level of self-respect is related (Neff, 2003b). The self-compassion skill scale was developed by Neff (2003b). The scale is consisted of 26 items and 6 factors.

These factors were determined as self-caring/self-kindness, self-judgment, being aware of the sharing, isolation, consciousness and over-identification. Turkish validity and reliability studies of self-compassion scale were carried out by Akın, Akın and Abacı (2007). The self-compassion scale was shortened as "Self-Compassion Scale Short Form" by Raes, Pommier, Neff and Van Gucht (2011), starting from the idea that it shall be more useful. In this short form, the total score to be obtained from the scale is used (Raes, Pommier, Neff and Van Gucht, 2011). The Self-Compassion Scale Short Form is consisted of the items taken from Self-Compassion Scale of 26 items (Neff, 2003b). While creating the short form, two items from each sub-component of self-compassion were taken. The positive ones among these sub-components are Self-Kindness, Awareness of Sharing, Mindfulness and the negative ones are Self-Judgment, Isolation and Over-Identification. The Turkish adaptation form of the scale is consisted of 11 items and one single factor (Yıldırım, M. & Sarı, T., 2018). For the answers given to the scale, 5-point Likert-type rating was used, with 1 meaning always and 5 meaning never. The high scores obtained from the scale show that the self-compassion skill is high.

Ethics Approval

The survey used for the research was granted ethics approval by the ethics committee of Istanbul Gelişim University with the decision dated 10-04-2023 and no. 2023-05-108.

Statistical Analysis

The data collected within the scope of the study were analyzed by version 24.00 of SPSS package program. Within the scope of the analysis, frequency distribution tables were prepared to describe the demographic characteristics. Correlation Analysis was used for the analysis of relationship between scales; and Regression Analysis was used to reveal the cause and effect relationship. In addition, t-tests and analysis of variance were applied for the analysis of the differences in earthquake anxiety and self-compassion skill according to the demographic characteristics.

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Findings

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Demographic Characteristics

Table 1

Demographic Characteristics of Participants

		N	% N
Gender	female	183	67.5%
	male	88	32.5%
Psychological Diagnosis	yes	39	14.4%
	none	232	85.6%
Earthquake Risk State	very high risk	126	46.2%
	moderate risk	18	6.6%
	high risk	90	33.0%
	low risk	6	2.2%
	very low risk	33	12.1%
Age Ranges	18 to 28	243	89.0%
	29 to 39	21	7.7%
	40 to 50	6	2.2%
	62 and above	3	1.1%

67.5% of the participants enrolled in the study were females. The number of the people who reside in very high risky areas is 127. The people with no psychological diagnosis constitute 85.6% of the sample. In addition, considering the age ranges, 89% are seen to be between 18 and 28 years of age.

Reliability and Internal Consistency

The validity of the scales refers to whether the behavior intended to be measured reflects the actual state, and reliability refers to the fact that the scale yields the same results in different times and under different conditions. Reliability can also be considered as an indicator of how consistently and consciously the questions in the scale are answered. (Özdoğan and Tüzün, 2007, p.644). Cronbach's Alpha coefficient was used for the reliability analysis in this study. Cronbach's Alpha value of 0.70 and above shows that the scale is reliable.

Table 2

Reliability Analysis of the Scales Used

	Scale	Number of items	Reliability Coefficient
1	Earthquake Anxiety	34	0.976
2	Self-compassion Skill	11	0.841

The reliability coefficients of the scales used in the study were given in Table 2. Accordingly, the "Earthquake Anxiety" scale consisting of 34 items was found to be highly reliably with a Cronbach's Alpha value of (0.976) and the "Self-Compassion Skill Short Form" scale was found to be highly reliably with a Cronbach's Alpha value of (0.841).

Correlation Analysis

Correlation analysis is used to examine the relationship between variables. The correlation coefficient determines the extent of the relationship between variables and whether this relationship is significant or not. It also gives insight into the direction of the relationship (Büyüköztürk, 2018). The correlation analysis results of the scales were shown in Table 3.

Table 3

Correlation Analysis Results

		WA	SD	1	2	3
1	Earthquake Anxiety	100.5275	35.90162	1		
2	Self-Compassion Skill	33.6287	8.55706	-.386	1	

*p<0.05 **p<0.01

According to the results of the correlation analysis performed for the scales used in the study, there is a significant (p<.05) relationship between earthquake anxiety and self-compassion skill (-.386). As the earthquake anxiety increases, the self-compassion skills of the

individuals decrease. As the self-compassion skill increases, the earthquake anxiety levels of the individuals decrease. Accordingly, the hypothesis "H1: There is a relationship between earthquake anxiety and self-compassion", which is one of the hypotheses of the study, is accepted.

Regression Analysis

Regression analysis characterizes the relationship of at least two variables as dependent and independent variable and describes the cause and effect relationship as mathematical model. If there is one dependent and one independent variable in the analysis, the method is simple regression analysis, and if the relationship between dependent and independent variable is linear, it is called as linear regression analysis (Büyüköztürk, 2018). The regression analysis results for the variables used in the study are shown in Table 4.

Table 4

Regression Model Between Variables

Model		U. Coefficients		S. Coefficients	t	p	
		B	Std. Error	Beta			R^2
1	Constant	154.486	8.132		18.997	.000	14.9%
	Self-compassion	-1.612	.234	-.386	-6.878	.000	

*p<0.05 **p<0.01

According to the analysis results in Table 4, it is seen that there is a significant result between self-compassion and earthquake anxiety. Model R2 value (14.9%) shows that the self-compassion variable accounts for about 14.9% of the variance of the dependent variable. This finding indicates that the self-compassion concept may have an important effect on the outcomes examined. The effect of "self-compassion skill" on the "earthquake anxiety" variable is negative (β=-1.612; p<0.01) and significant. As the self-compassion skill increases, the earthquake anxiety reduces. t-value of the self-compassion variable was found to be -6.878 and p-value was found to be 0.000. These values show that the self-compassion coefficient is statistically significant.

Regression model is Earthquake Anxiety= 154.486 – 1.612*Self-compassion. The analysis result supports the "H6: The self-compassion skill predicts the earthquake anxiety." hypothesis.

Difference Tests

t-tests and analysis of variance were used for the analysis of differences based on the variables used in the study. The independent sample t-test is a parametric test method used to evaluate the significance of the difference between two averages calculated among subgroups of a specific group (Büyüköztürk, 2017). ANOVA (analysis of variance) is a method used to determine the significance of the difference between mean values in two or more groups. If the difference between groups is found to be statistically significant as the result of ANOVA, Post-Hoc statistics can be used to determine the origin of this difference (Büyüköztürk, 2017).

Table 5

Difference Analyses Based on Gender

		N	WA	SD	t	p
Earthquake Anxiety	Female	183	107.0328	34.35383	4.609	.000
	Male	88	86.3068	35.29786		
Self-Compassion Skill	Female	183	34.8197	4.43825	-2.979	.000
	Male	87	36.6322	5.13111		

*p<0.05 **p<0.01

The gender-based difference tests of the scales used in the study (p<0.01) were found to be significant. Accordingly, the earthquake anxiety is higher among women. The women are more anxious. Regarding the self-compassion skills, on the other hand, men were found to have higher self-compassion scores than women. The hypothesis formed as "H3: The earthquake anxiety and self-compassion skill vary according to gender." was accepted.

Table 6

Difference Analyses Based on Psychological Diagnosis

		N	WA	SD	t	p
Earthquake Anxiety	Have psychological diagnosis	39	111.3846	36.03844	2.079	.039
	Have no psychological diagnosis	232	98.5172	35.72247		
Self-Compassion Skill	Have psychological diagnosis	39	33.3846	5.62707	-2.931	.004
	Have no psychological diagnosis	231	35.7706	4.53146		

*p<0.05 **p<0.01

Significant differences were found in the scales used in the study in terms of participants with and without psychological diagnosis. Accordingly, the earthquake anxiety scores of the participants with psychological diagnosis were found higher. The self-compassion skill is, on the other hand, higher in the participants with no psychological diagnosis. The hypothesis "H2: The earthquake anxiety and self-compassion skill vary in people with psychological diagnosis." was accepted.

Table 7

Difference Analyses Based on Earthquake Risk Zone

	Risk Zone	N	WA	SD	F	p
Earthquake Anxiety	very high risk	126	106.4048	35.78808	2.860	0.024
	moderate risk	18	96.8333	45.09369		
	high risk	90	99.1667	31.70342		
	low risk	6	70.5000	30.12474		
	very low risk	33	89.2727	38.55781		
Self-Compassion Skill	very high risk	125	36.0000	4.03213	7.239	0.005
	moderate risk	18	31.3333	6.73883		
	high risk	90	34.6333	4.64818		
	low risk	6	35.5000	1.64317		
	very low risk	33	37.9091	5.09512		

*p<0.05 **p<0.01

ANOVA results are shown in Table 7. Accordingly, a statistically significant difference is observed on the "Earthquake Anxiety" (F=2.860; p<0.05) based on the earthquake risk zone magnitude. According to Post-Hoc tests, the people residing in an area at a high risk of earthquake have a higher level of earthquake anxiety than the people residing in a very less risky area. According to the magnitude of the earthquake risk zone, significant differences were found in "Self-compassion Skill" levels, too (F=7.239; p<0.05). According to the post-Hoc tests; as the magnitude of the earthquake risk zone decreases, the self-compassion levels of the participants increase. However, the self-compassion levels of the participants in the very risky area were found to be the highest. According to these results, the hypothesis "H4: The earthquake anxiety and self-compassion skill vary based on the risk zone." was accepted.

Table 8

Difference Analyses Based on Earthquake Risk Zone

	Age range	N	WA	SD	F	p

Earthquake Anxiety	18 to 28	243	102.0617	34.12920	2.090	0.049
	29 to 39	21	90.1429	46.85327		
	40 to 50	6	95.0000	58.05859		
	62 and above	3	60.0000	.00000		
Self-Compassion Skill	18 to 28	243	35.1564	4.65862	3.244	0.023
	29 to 39	20	37.7000	5.69487		
	40 to 50	6	38.5000	3.83406		
	62 and above	3	39.0000	.00000		

*p<0.05 **p<0.01

ANOVA results are shown in Table 8. Accordingly, a statistically significant difference is observed on the "Earthquake Anxiety" (F=2.090; p<0.05) based on the age ranges. According to Post-Hoc tests, the earthquake anxiety of the people between 18 and 28 years of age was found higher than the ones at and above 62 years of age. According to the age range, significant difference was found in "Self-compassion Skill" levels, too (F=3.244; p<0.05). According to Post-Hoc tests, the self-compassion skill of the people at and above 62 years of age was found higher than the ones between 18 and 25 years of age. According to these results, the hypothesis "H5: The earthquake anxiety and self-compassion skill vary depending on the ages." was accepted.

Discussion and Result

This study examined the relationship between the earthquake anxiety and self-compassion skills and evaluated the effects of various demographic factors on these variables. The findings obtained show consistency with the similar studies in the literature. In the study performed by Biber and Ellis (2017), a negative relationship was found between anxiety levels and self-compassion, and the findings of this study verify this relationship. It was found that the self-compassion skills of the individuals reduce as the earthquake anxiety increases.

Cronbach's Alpha values indicating the high reliability of the scales used in the study emphasizes the robustness of the measurements (0.976 for Earthquake Anxiety Scale and 0.841 for Self-Compassion Skill Short Form). These results support the previous studies emphasizing the validity of the measurement tools (Neff, 2003; Lovibond & Lovibond, 1995).

The negative correlation between earthquake anxiety and self-compassion skill (r = -0.386, p < .05) shows that the self-compassion skills reduce as the earthquake anxiety increases. Likewise, it was seen that earthquake anxiety levels reduced as the self-compassion skills increased. This finding supports the hypothesis "H1: There is a relationship between earthquake anxiety and self-compassion". This result is consistent with Neff and Germer (2013), who

demonstrate the positive effects of self-compassion on the stress and anxiety. Similarly, the studies performed by Gilbert and Procter (2006) also showed that self-compassion played an important role in the management of anxiety disorders.

Regression analysis shows that the self-compassion skills have a negatively significant effect on the earthquake anxiety (β = -1.612, p < .05). This effect with the t-value of (-6.878) and p-value of (0.000) are statistically significant. Regression model: (Earthquake Anxiety = 154.486 – 1.612*Self-Compassion) verifies the hypothesis "H6: The self-compassion skill predicts the earthquake anxiety". This shows that the interventions to increase the self-compassion may be effective in reducing the earthquake anxiety. This result also supports the studies by Allen and Leary (2010), who research the positive effects of self-compassion on psychological well-being.

When the gender differences are analyzed, it was found that the earthquake anxiety of women was higher than that of men, and that men had higher self-compassion scores than women. This finding supports the hypothesis "H3: The earthquake anxiety and self-compassion skill vary according to gender". These results are consistent with Matud (2004) and Ben-Zur (2009) who state that women have higher anxiety levels in stressful cases. The higher anxiety levels of women can be accounted for by the social gender roles and the fact that they generally display higher empathy and emotional sensitivity (Tamres, Janicki, & Helgeson, 2002). The higher self-compassion levels of men, on the other hand, are supported by Yarnell and Neff (2013) studying the relationship of self-compassion with gender.

The individuals with psychological diagnosis were found to have higher earthquake anxiety and lower self-compassion skills. This finding supports the hypothesis "H2: The earthquake anxiety and self-compassion skill vary in people with psychological diagnosis". The increasing anxiety levels of this group emphasize the necessity of interventions to increase the psychological support and self-compassion skills. Likewise, Birnie, Speca and Carlson (2010) reported that self-compassion had an important healing effect in the individuals with psychological disorders. This finding reveals the importance of self-compassion-based interventions in the individuals with psychological disorders.

Post-Hoc tests revealed that there are significant differences in earthquake anxiety and self-compassion skills according to the earthquake risk level of the area where the participants reside in. It has been found that the people who live in areas at a very high risk have higher anxiety levels and their self-compassion levels increase as the risk severity decreases. Interestingly, the self-compassion levels of the participants in the areas at very high risk were

found to be the highest, which may suggest a potential adaptation mechanism. This findings support the hypothesis "H4: The earthquake anxiety and self-compassion skill vary according to earthquake risk zone". These results show parallelism with Bonanno, Galea, Bucciarelli and Vlahov (2007) studying the psychological resilience and self-compassion levels in the individuals who were exposed to natural disasters. The study performed by Bonanno et al. also found that high level of psychological resilience and self-compassion played an important role in reducing the stress and anxiety in the individuals who were exposed to traumatic events.

The differences between age groups are also noteworthy. The fact that the young adults have higher earthquake anxiety levels shows that the young individuals have more difficulty in coping with the uncertainty The fact that the old adults have higher self-compassion skills, on the other hand, shows that the life experiences may increase the self-compassion. This finding is consistent with the study performed by Neff and Germer (2013) on the relationship between self-compassion and age.

The findings of this study emphasize the complex relationship between earthquake anxiety and self-compassion skills within the context of gender, psychological diagnosis and earthquake risk levels. Negative correlation between these variables shows that increasing the self-compassion can be an efficient strategy in reducing the anxiety due to earthquake. The gender differences and the higher anxiety levels of the individuals with psychological diagnosis point out the necessity of special interventions. In addition, the fact that the individuals in the areas at high earthquake risk have higher anxiety levels and varying self-compassion levels reveals the importance of contextual factors in the psychological responses given against the natural disasters. The future studies should examine the mechanisms underlying these relationships more thoroughly and research the efficiency of the self-compassion-based interventions on different universes.

The information obtained from this study can contribute to the improvement of more efficient psychological support services and crisis intervention programs and help to obtain better mental health results against natural disasters.

Recommendations

Based on the findings of this study, various recommendations can be made to reduce the earthquake anxiety and increase the self-compassion skills. These recommendations may

contribute to the improvement of the feasible and more efficient psychological support services and crisis intervention programs at individual, social and corporate levels.

Firstly, given that the self-compassion plays an important role in reducing the earthquake anxiety, training programs should be organized to improve the self-compassion skills. Such programs should be designed especially for the individuals who reside in the areas at high earthquake risk. The people with high anxiety levels can be supported with cognitive behaviorist therapies, feeling-oriented therapies, mindfulness and self-compassion-oriented therapies. Especially the people who were exposed to earthquake and their relatives can be assisted via Eye Movement Desensitization and Reprocessing (EMDR) treatment.

In accordance with the finding that women have higher earthquake anxiety than men and men have higher self-compassion skills, gender-oriented interventions should be developed. The support programs for women should aim at reducing their anxiety levels and increasing their self-compassion skills. These programs may become more effective by addressing the additional stress factors brought by social gender roles of women.

Given that the individuals with psychological diagnosis have higher earthquake anxiety and lower self-compassion skills, personalized support programs should be created for such individuals. Such programs may include therapeutic interventions to improve the ability of individuals to cope with stress, and increase their self-compassion. In addition, it is important to provide such individuals with regular psychological support.

The social solidarity and support networks should be reinforced to reduce the anxiety levels of the individuals residing in the areas at high earthquake risk. The social support mechanisms such as neighborhood networks, community events and group therapies may be effective in reducing the anxiety levels of the individuals. The social solidarity may increase the psychological resilience of the individuals by making them feel that they are not alone.

Information and mindfulness campaigns should be organized in order to reduce the earthquake anxiety. These campaigns may reduce the anxiety levels of the individuals by providing comprehensive information on what to do before, during and after an earthquake. In addition, raising awareness about the importance and feasibility of self-compassion should also be part of these campaigns.

Early interventions and crisis management educations should be organized to reduce the post-earthquake traumatic effects. These educations should aim at providing a rapid and effective psychological support after an earthquake. Crisis management educations should address to a large audience by covering both professionals and community leaders.

The future studies should examine the mechanisms underlying the relationships between earthquake anxiety and self-compassion more thoroughly and research the efficiency of the self-compassion-based interventions on different universes. In addition, the policies to be developed according to these findings should encourage the integration of disease management and mental health services. These policies may ensure that the self-compassion-based support programs for the individuals residing in the disaster zones become widespread.

Various institutions such as schools, workplaces and healthcare institutions should initiate programs for encouraging self-compassion and making it widespread. The courses on the self-compassion and stress-coping skills can be included in the curriculum. Mindfulness and stress management educations can be organized in order for the employees at workplaces to be able to improve their self-compassion skills.

These recommendations offer an extensive approach to reduce earthquake anxiety and increase self-compassion skills. The interventions applied can contribute to obtain better mental health results against natural disasters by increasing the psychological resilience of the individuals.

Ethics Approval

The survey used for the research was granted ethics approval by the ethics committee of Istanbul Gelişim University with the decision dated 10-04-2023 and no. 2023-05-108

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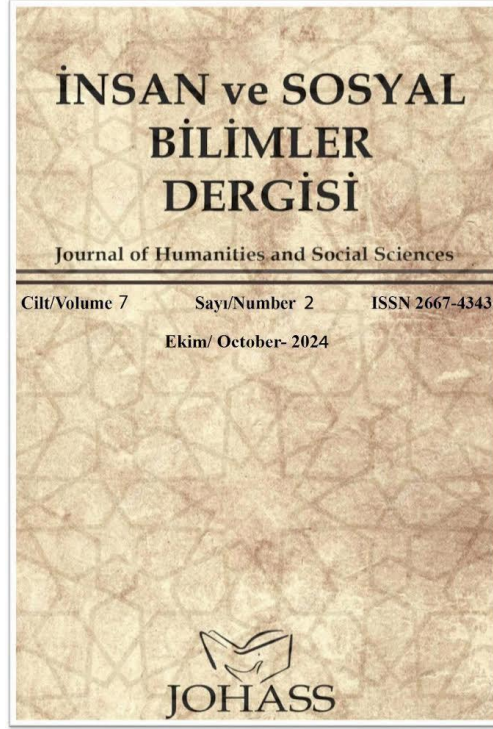
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Use of Artificial Intelligence in Fashion Sales Techniques

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Use of Artificial Intelligence in Fashion Sales Techniques

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Abstract	Research Article

This article discusses the prominent elements of artificial intelligence innovation in fashion sales techniques and details artificial intelligence-supported sales strategies such as virtual reality, augmented reality, virtual try-on rooms, smart mirrors, artificial intelligence-supported style consultants, visual search technologies and chatbot. This study was written with the compilation method. The compilation method is written with the aim of collecting the literature written so far on the research subjects from a scientific perspective and making a collective contribution to the literature. While virtual reality and augmented reality offer customers interactive shopping experiences and the opportunity to try products in their own environment without going to the store, virtual trial rooms and smart mirrors; Studies have shown that it has the potential to make online and face-to-face shopping easier, faster and more interactive. It has been stated that visual search technologies enable customers to easily find the products in the style they want, and artificial intelligence-supported style consultants and chatbots play an important role in optimizing the shopping experience by making personalized suggestions to customers. New and innovative solutions can be produced by conducting studies that encourage interdisciplinary collaboration between fashion designers, software developers and academicians. In this period when we live intertwined with technology, artificial intelligence-focused modules can be added to academic curricula for students studying in the field of design, and these modules will provide benefits for students to gain knowledge and skills on how to integrate artificial intelligence technologies into fashion design. The effective use of artificial intelligence in fashion sales techniques will provide a competitive advantage against competitors in the industry.

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Introduction

Clothing, one of the most basic needs of human beings, was first used to keep up with the environmental conditions in which people live. Although fashion and clothing are often thought of as the same thing, the word fashion; It comes from the Latin word "modus" and means style. (Tunalı, 2004; p. 108). According to Hakko, the definition of fashion is "the phenomenon of temporary tastes belonging to a certain period", which occurs when some objects become popular for a short time and for no reason (Hakko, 1983; p.1). When we look at the historical development of fashion, in the 18th century, when the concepts of craft and art different from each other, tailoring was accepted as a craft and thus separated from art. The emergence of the concept of Haute Couture in the 1860s enabled fashion to gain an artistic perspective. It is thought that British designer Charles Frederick Worth, who is considered the founder of Haute Couture, played an important role in the formation of this system (Swendsen, 2008; 88-89). The concept of 'Haute Couture' means "high fashion" in French. This concept; It is used for elite, specially designed clothing with high prices. Haute Couture clothes consist of clothing collections prepared by famous fashion designers in large fashion companies and fashion houses (Bilgen, 2002; p.18).

After the industrial revolution, there were rapid developments in the technologies used in the textile sector, as in many other sectors. In the first years of the 19th century, with the advances in printing and weaving machines and the discovery of aniline dye, the use of various colors and textures on textile surfaces increased. The sewing machine developed during this period was rapidly adopted in the fashion industry, thus creating a suitable basis for ready-made clothing (Iwagami 2010, p.154). The decrease in textile production costs after World War I, along with technological developments in the late 19th and early 20th centuries, made fashion products accessible to the public. In the light of these developments, the concept of ready-made clothing retailing emerged in the second half of the 20th century (Ertürk et al., 2013: 12). With the rapid progress of ready-to-wear retailing since the 20th century under the influence of the 4th Industrial Revolution, the concept of fashion marketing has become increasingly important. Fashion brands have begun to develop digital marketing strategies for purposes such as offering personalized suggestions to consumers, ensuring brand loyalty and making a difference in the competitive market.

Today, at the latest point of technological developments, the concept of artificial intelligence has emerged. Artificial intelligence; It is defined as "a computer or computer-aided system that has the potential to perform complex logical processes similar to human

competencies, such as generating solutions, perceiving, inferring meaning, generalizing and benefiting from past experiences" (Nabiyev, 2012). Artificial intelligence, which has started to be used in many sectors, also plays an important role in fashion sales techniques and brings transformation and developments in sales techniques. One of the first uses of artificial intelligence in fashion marketing was chatbots. With this system, customers' questions can be answered at any time of the day and personalized suggestions can be offered. With the increasing use of e-commerce, artificial intelligence offers very important usage opportunities for fashion retailers. For example, thanks to artificial intelligence, companies offer personalized suggestions to customers based on the customers' product preferences, searches on the internet and past shopping data, and thus increase sales rates. Another artificial intelligence-based application in the field of online shopping is applications that offer virtual try-on opportunities (3D Look, n.d.)

Although artificial intelligence is thought to be used mostly during online shopping, it is also used in in-store sales. For example, artificial intelligence can offer alternative products and make combination suggestions in the store environment, without the need for the sales representative to check the stock, in case there is no size or color left that the customer wants to buy. Another artificial intelligence technology applied in stores is smart mirrors. Thanks to these mirrors, customers are given the opportunity to try on clothes, find their size, and offer style suggestions for the product they are looking for, without the need for a dressing room. In this way, the customer can have a shopping experience without the need for a sales consultant (Fashion Retail Academy, 2023).

In light of this information, the integration of artificial intelligence applications and fashion sales techniques has the potential to provide a competitive advantage for brands in the sector. In today's world where consumer expectations are changing rapidly, how fashion brands can use technology to maximize customer satisfaction is a big question mark. Nowadays, as digitalization accelerates, many changes in sales techniques are observed in the fashion industry. Traditional sales approaches are no longer sufficient to meet customer expectations, and this necessitates the use of new technologies. However, although there are resources on the use of artificial intelligence applications in the fashion industry, the resources in the literature on how it can be used effectively in fashion sales strategies are limited. This research is based on the hypothesis that artificial intelligence-supported sales techniques will increase customer satisfaction and accelerate purchasing processes in fashion retailing. Research findings are expected to show that artificial intelligence strengthens personalized shopping experiences in

fashion retail and creates positive effects on consumer behavior. It is also predicted that it will be concluded that artificial intelligence-supported sales strategies such as virtual rehearsal rooms, smart mirrors, visual search engines and artificial intelligence-based style consultants accelerate consumer decisions and increase sales rates.

In this article, we will examine how artificial intelligence for fashion brands changes the way fashion brands sell clothing and fashion products both offline and online, examine the use of artificial intelligence technology in fashion industry sales techniques, comprehensively discuss the applications of artificial intelligence in the sales techniques of fashion brands, and develop emerging technologies. It aims to offer fashion brands a perspective for future technological developments with artificial intelligence technology and to create a qualified source for the literature.

Method

Model

This study was written with the compilation method in order to examine the development of artificial intelligence applications for sales techniques in the fashion industry and their effects on fashion sales techniques. The compilation method is written with the aim of collecting the literature written so far on the research subjects from a scientific perspective and making a collective contribution to the literature. Compilation articles, experiments on researched topics, etc. These are articles that lead to application studies.

Population and Sample

While the universe of this research consists of all sources containing the use of artificial intelligence in fashion sales techniques, the sample of this research consists of all written sources related to fashion sales techniques. In this research, since there are no scientific sources about fashion sales techniques yet, we included the written sources, which are not scientific research, in this research by passing them through a scientific filter.

Data Collection Tools

A comprehensive literature review on fashion industry and AI integration; It was done by scanning academic databases, Haliç University library, scientific journals, e-books, conference proceedings, promotional articles about artificial intelligence used in fashion sales techniques and current report sources regarding the sector.

Data Collection and Analysis

By systematically examining these sources obtained through the study, it is aimed to summarize and present together the existing information in the field. A review study contributes to summarizing the ideas and approaches of existing studies or preparing a synthesis study consisting of these studies (Herdman, 2006). One of the characteristics of a good review article is to analyze existing studies in the literature well and present new ideas and perspectives to the literature (Bolderston, 2008; Callahan, 2010; Hagger, 2012). In this context, this research study was created by examining all sources related to fashion sales techniques and artificial applications used in fashion sales techniques from a scientific perspective and filtering the information. Analyzes were made within the scope of the benefits they provide to people. This study will benefit new applications and research.

Findings

The concept of fashion marketing is defined as a business strategy and the use of various methods aimed at existing and potential customers by focusing on clothing-related products and services in order to achieve an organization's long-term goals (Easey, 2009). The first step for effective fashion marketing is to analyze the demographics and trends of the target audience in detail. Any step taken without understanding the target audience and identifying the factors that affect them may cause the prepared collection and fashion marketing strategies to fail (Duran, 2013).

Artificial intelligence applications that have emerged with technological developments are different from traditional sales strategies in the fashion world and bring many innovations to the industry. These groundbreaking technologies are not only improving the shopping experience of customers but also drastically changing the sales strategies of fashion retailers. It adds a new dimension to fashion sales strategies by combining disciplines such as artificial intelligence technology, big data analytics and machine learning in areas such as understanding customer preferences, providing personalized suggestions, chatbots, virtual reality and augmented reality. The transition from traditional sales methods to artificial intelligence-supported fashion sales techniques play an important role in determining the future potential of artificial intelligence applications in the fashion industry, bringing together customer satisfaction, efficiency and competitive advantages in the industry.

Chatbots (Chat Robots)

With the rapid development of technology, artificial intelligence applications are effective in fashion marketing as in every sector. One of the first applications where artificial intelligence is used in fashion marketing is chatbot applications. Chatbots are defined as chat robots that users interact with via messages on digital platforms as if they were talking to a human being and use them for purposes such as taking action on a subject, getting information, asking questions (Chatbot Ai, n.d.). Fashion chatbot technology is an important area of research due to its potential to revolutionize the retail industry (Murtarelli et al., 2022).

The use of chatbots in the fashion industry is increasing day by day due to the possibility of providing personalized shopping experiences and increasing customer engagement (Landim et al., 2022). Chatbots; It saves time for fashion retailers and customers, can remember customer preferences and past shopping experiences, and thus ensure customer satisfaction and loyalty (Murtarelli et al., 2022; Landim et al., 2022). The goal is to deliver a personalized and engaging shopping experience that increases customer loyalty and increases sales. Fashion chatbots can also be designed with specific features such as virtual wardrobe organization, outfit recommendations and product reviews.

Chung et al. (2020) state that fashion companies are using the latest technology to improve the personalization of shopping experiences. Chatbot technology in the e-commerce industry helps customers in their online shopping experiences by creating interaction between the brand and the customer (Pantano et al., 2022). Some of the popular fashion brands using chatbot technology in this way include Burberry, Tommy Hilfiger, and Victoria's Secret. Tommy Hilfiger company has advanced chatbot technology with chatbots on Facebook to answer customer questions. Chatbots have the ability to provide automatic customer service assistance and personalized recommendations, which contributes to increased customer satisfaction (Ruan & Mezei, 2022). Additionally, incorporating chatbots into business operations can provide significant cost savings by reducing the need to employ customer service representatives (Hsu & Lin, 2023; Ngai et al., 2021).

Chatbots use a combination of visual AI and machine learning to improve their insights and capabilities over time. The chatbot can initiate a conversation, ask the customer about their preferences, and suggest appropriate clothing for the customer. The customer can indicate which products he likes, and thanks to the chatbot fashion tagging technology, he can instantly select and display similar products carefully selected from millions of products. Nowadays, customers want to find what they want with the least amount of trouble when shopping online,

and chatbots can provide instant information, suggestions and assistance by switching between databases containing millions of clothing products in seconds (Aslam, 2023).

Fashfed Company Chatbot Application

Turkish fashion retailer Fashfed uses Intelistyle's chatbot to engage with its customer base. The bot can make style suggestions just like a stylist would. During the interaction, the chatbot asks the customer questions such as clothing style, body type and skin color in order to provide personalized recommendations for clothes in the Fashfed catalogue. Customers can also upload images of outfits to get suggestions on what to wear or find visually similar products (Intelistyle, n.d.).

Louis Vuitton Brand Chatbot Application

Louis Vuitton takes advantage of its 23 million Facebook page by integrating a chatbot into its Facebook page. The chatbot can answer customer questions, recommend an ideal product to the customer from the product catalog, provide information about Louis Vuitton, and allow customers to get a second opinion by sharing the products with their Facebook friends (Figure 1) (Intelistyle, n.d.).
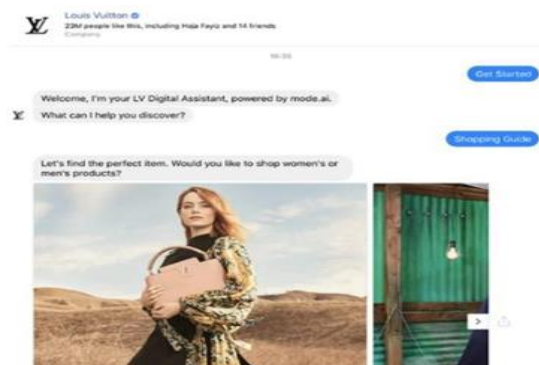
Figure 1. *Sample conversation with the chatbot of the Louis Vuitton brand (Intelistyle, n.d.).*

Tommy Hilfiger Brand Chatbot Application

Tommy Hilfiger, which started using chatbots in 2016, is one of the first brands to use chatbots. The company used a chatbot to launch its new TommyXGigi collection at New York Fashion Week. The chatbot named TMY.GRL was integrated with Facebook Messenger, providing customers with an online customer advisor experience. The chatbot recommended products from the collection, asked questions about customers' preferences, and then made personalized recommendations for each customer. The chatbot application, which is becoming

more developed today, acts as a stylist who brings together all the clothes, including accessories and shoes. If you like the recommended products, the chatbot quickly determines your size and shipping address before directing you to the website for the payment step. Additionally, the chatbot constantly offers new options by suggesting you try different styles or watch videos of the collection, thus spending more time on the site and increasing the likelihood of sales (Figure 2) (Intelistyle, n.d.).

Figure 2. *Sample conversation with the chatbot of the Tommy Hilfiger brand (Intelistyle, n.d.).*

Burberry Brand Chatbot Application

Luxury fashion brand Burberry chatbot offers customers looks and behind-the-scenes videos of models wearing Burberry clothes at fashion shows and similar products and accessories related to products the customer is interested in; recommends with prices and links to the Burberry website. The chatbot can also ask you for your location, give you directions to the nearest store or fashion show, and even help you book an Uber for transportation (Figure 3) (Intelistyle, n.d.).
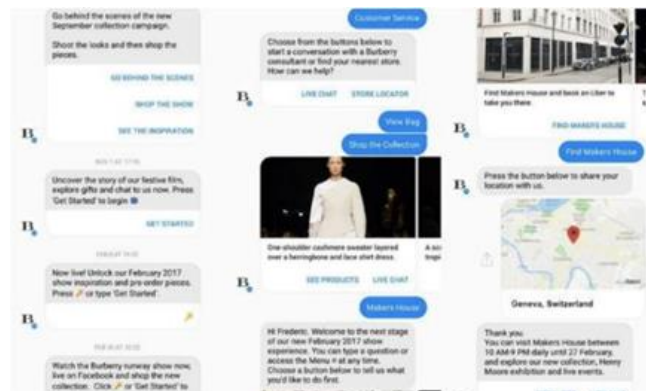

Figure 3. *Sample conversation with the chatbot of the Burberry brand (Intelistyle, n.d.).*

Virtual Reality (VR) and Augmented Reality (AR)

The concept of virtual comes from the word 'virtualis', which expresses the situation of creating an illusion as if something that does not actually exist by directing perception. The concept of Virtual Reality is based on the principle that the user is included in a created image space within an editable time frame and then interacts with this environment. Virtual reality includes various data input and output technologies; It is defined as an environment consisting of technological elements such as devices that imitate sensory effects such as movement and touch, sound devices and three-dimensional images (Kuruüzümcü, 2010, p. 94). Virtual reality is when the user enters a completely virtual world, can interact with this virtual world, and the real world can be imitated with this virtual world (Şahin & Kaya, 2019, 32).

Augmented reality is; It is a technology that combines virtual and real images, provides real-time interaction and integrates virtual elements into the real world (Azuma, 1997). By adding virtual content to the real world image, it provides the user with an experience without being separated from the real environment (Tuğal, 2018). Augmented reality, created through software and digital devices, allows digital content created on the physical world to coexist (Craig, 2013). Augmented reality technologies consist of adding audio, images, video, text, two- or three-dimensional animations produced by computer software simultaneously onto the real world image. Smart mobile devices, which are used by almost every individual today, make augmented reality applications accessible and widely used (İçten & Bal, 2017).

Virtual reality and augmented reality, which have started to be used in many sectors, are also frequently used in the fashion industry. It allows customers to try on clothes and accessories virtually without visiting the physical store.

SG and AR Technology Application Examples of Fashion Brands

Virtual Rehearsal Rooms

Fashion retailers frequently use virtual clothing fitting room applications. Virtual clothing fitting room is a technology that allows customers to try on clothes and accessories in a virtual environment, eliminating the need for physical try-ons. Using VR or AR, this technology offers a different experience by allowing customers to see how different clothes will look on their body. This technology creates the impression that the person is actually wearing the clothes or accessories he chooses, allowing him to examine details such as the fit of the outfit to his body, color, fabric and pattern (Audaces, 2023). Generally, the mechanism of use

of this technology is as follows; In order to create a model that represents the user's appearance, the user enters basic information such as height, weight and body measurements into the system. The user, whose virtual model is created, chooses the clothes and accessories they want to try on from the system and sees the product they have chosen on the virtual model they have created. In some more developed virtual clothing rehearsal rooms, the product worn on the model can be viewed from various angles in 360 degrees, the size of the selected clothing can be adjusted, different clothing combinations can be made, and the virtual try-on images can be shared with their surroundings and social networks (Audaces, 2023).

Today, many fashion brands have adopted virtual clothing fitting room technology. For example, the famous fashion retailer Topshop has established a virtual fitting room system via AG and Microsoft Kinect. With this application, customers can see themselves wearing an outfit in 3D on the screen. Another fashion brand, Tommy Hilfiger, used the AG virtual fitting room for its campaign called Prep World, allowing people who use mobile phones and are close to Tommy Hilger's pop-up store to contact the brand, so users can see the products in the collection on themselves through their phone cameras. (Aviso, 2023). Nike company helps users choose the most suitable shoes for them with its artificial intelligence-supported application called Nike Fit (Yılmaz, 2023).

Figure 4. *An example of an AR display for in-store shopping of the Tommy Hilfiger brand (Shaul, 2023).*

Gap brand's Virtual Dressing Room and Asos' See My Fit application give customers who shop online the chance to make conscious choices. These applications offer users the opportunity to view augmented reality versions of clothing products on avatars that reflect their own body measurements. Fashion luxury brands are also using augmented reality technology. For example, the Dior brand offers potential customers the chance to try DiorSoLight

sunglasses virtually. This application allows users to see their sunglasses in a virtual environment by using a special Instagram filter on their own facial images (Lloyd, 2022).

SG Showrooms

SG showrooms allow customers to try and purchase products online. With this technology, retailers can use high-resolution 3D images and videos, product descriptions, zoom features and customization options. For example, Alibaba Buy+, a virtual reality shopping platform from Alibaba, offers customers the opportunity to explore the store, browse and interact with products using VR glasses, and purchase (Aviso, 2023). Brands such as Uniqlo, Zara, Rebecca Minkoff, American Eagle have also started to use systems that make physical recommendations to consumers with artificial intelligence-based smart stores and fitting rooms (Yılmaz, 2023).

Smart Mirrors

Smart mirror technology is an interactive technology that simulates the actual dressing experience of trying on clothes without physically wearing them. This technology offers customers the opportunity to try on clothes practically and quickly thanks to the mirror's screen (Blázquez, 2014; Lee & Xu, 2020). Smart mirrors have the potential to revolutionize the fashion industry by providing a more efficient, personalized and interactive shopping experience for customers using information and communication innovation (Amendola et al., 2018). It provides access to many information such as stock status and customer evaluations on social networks (Kent et al., 2020). Giving customers access to such information through digital displays and interactive touch screens increases interaction with customers (Kent et al., 2018; Kim et al., 2020). Savastano et al. (2016) argue that information and communication devices connected to social networks enhance the in-store shopping experience by creating new arrangements and making products more identifiable and purchasable. With the integration of information and communication interfaces, the physical store customer experience becomes increasingly similar to that of an online shopping environment, resulting in a more seamless customer shopping experience.

Smart mirrors integrate passive technologies that are mostly invisible and have a significant impact on the in-store experience. RFID, an advanced identification technology, enables products to be tracked and located throughout the store by remotely reading the information on product labels (De Marco et al., 2014). Sensors in RFID can be used to collect

data on customer behavior. For example, it can provide data such as how much time customers spend in a particular store section, which products they interact with, and which products they purchase. These data can be used to optimize store layout and product placement and to develop targeted marketing campaigns to customers (Rallapalli et al., 2014). RFID technology provides retailers with benefits such as managing inventory, analyzing customers' consumption habits and patterns, reducing transaction errors and accelerating the payment process (Roussos, 2006). RFID benefits customer experience by allowing customers to optimize the payment process by scanning product codes instead of waiting in line at the checkout point, to check the availability of different sizes, and to easily find products in the store via the smart mirror touch screen (Roussos, 2006).

Swedish fashion retailer H&M Group offers its customers many shopping opportunities enabled by artificial intelligence technology, including smart mirrors that offer personalized style recommendations (Figure 5) and virtual try-ons, in its Cos stores in the USA. H&M Group officials say the launch of the new in-store technology-based shopping experience is part of their goal to build more interactive and meaningful relationships with consumers. Among the technology solutions in the first pilot store where smart mirror technology is used, it is equipped with smart mirrors that recognize the characteristics of the products brought to the dressing room, such as model, size and color, and offers customers the opportunity to offer personalized products and services and make style suggestions. Other types of smart mirrors can also be used in the store for virtual trials. In addition, H&M officials state that they are testing new payment method applications and developing the technologies they use for more sustainable delivery and returns (Wright, 2022).
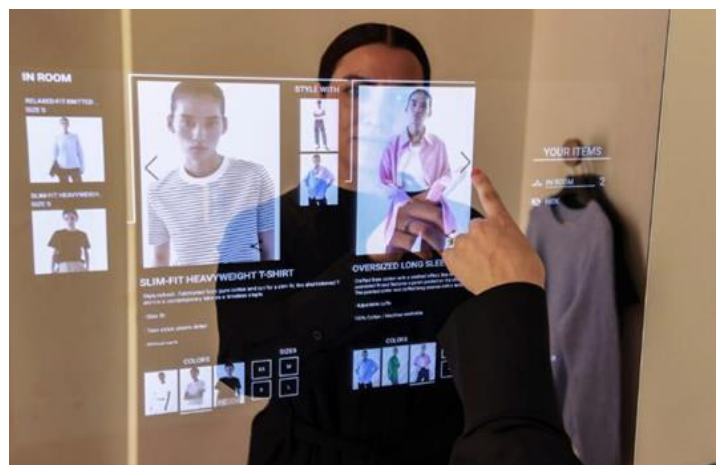
Figure 5. *Smart mirror used in COS store (Wright, 2022).*

Another company that uses smart mirror technologies is the world-famous sportswear company Adidas. The company's new store on London's Oxford Street also uses the 'Bring It to Me' application, which uses in-store location tracking to provide customers with a seamless navigation experience within the store. This Adidas app includes a lot of technology, including the ability for shoppers to scan items, check out the assortment, request sizes, and make their purchase immediately after purchase without the hassle of waiting in the checkout line. Interactive dressing room mirrors use RFID (Radio Frequency Identification) technology to identify products and provide information so shoppers can request different sizes and colors without leaving their location. There are more than a hundred digital touchpoints throughout the store (Figure 6) and each of these technologies aims to improve the customer experience or inspire creativity in visitors (Brown,2019).

Figure 6. *Smart mirror used in the Adidas store on Oxford Street in London (Brown,2019).*

Image Search

Visual search is an important part of personalized shopping using artificial intelligence applications. The fashion industry is one of the sectors that needs and uses visual search the most. Visual search refers to a process that uses images instead of text input. This process has been used in search engines such as Google since 2001. Reverse image search refers to a search method in which an image is used to find another image. For example, thanks to visual search, it is possible to find a similar product when searching with the image of a popular product. While computer vision enables seeing the object, machine learning and neural networks enable the recognition of objects. The combination of computer vision and neural networks is leading to interesting applications of artificial intelligence in the fashion industry (Luce,2018).

Online fashion retailer ASOS has developed a visual search app that turns a customer's smartphone camera into a product search tool (Figure 7). The customer takes a photo of a product and the ASOS app can identify the shape, color and pattern of the product, match it with its own inventory and find similar products. For an online-only fashion platform like ASOS, this app is an extremely important e-commerce tool (Boyd, 2017). Many fashion retail brands such as John Lewis, Nordstrom, Hook and Urban Outfitters use visual search technology to enhance customers' shopping experience.
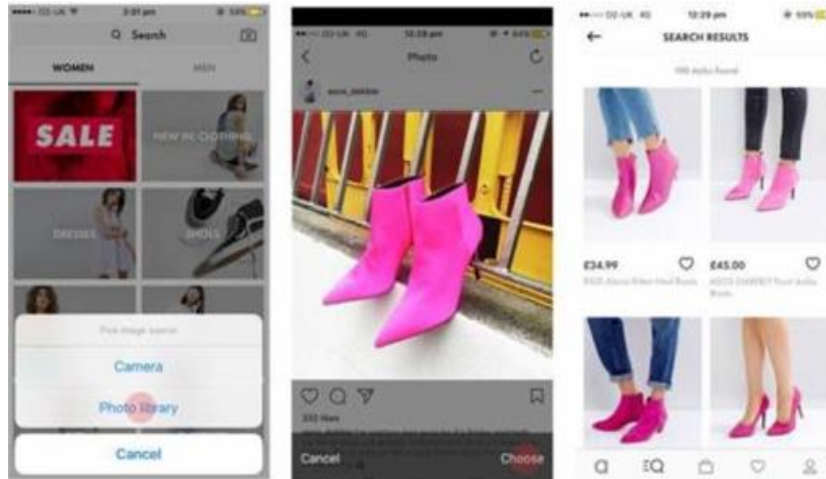
Figure 7. *Visual search application of ASOS company (Boyd, 2017).*

Artificial Intelligence-Powered Personal Style Assistants

Having a personal style consultant is one of the most advanced applications of personalized recommendation systems in fashion sales techniques. These applications are a combination of natural language processing, natural language understanding, computer vision, neural networks, and various types of machine learning technologies introduced so far. Virtual assistants that use automatic speech recognition, such as Apple's virtual assistant Siri, Google's virtual assistant Google Assistant, and Amazon's virtual assistant Alexa, are technologies that have been used for a long time. But the virtual style assistant emphasizes the use of images, having photo-taking, image recognition and visual search capabilities, as well as access to recommendation engines and fashion products.

For example, Amazon's virtual style assistant called Echo Look is the most well-known example (Figure 8). The hands-free camera technology in this virtual style assistant aims to provide users with feedback on their clothing choices. Using voice commands, Echo Look takes a photo of the outfit and provides reviews of the outfit based on trends and professional stylist opinions. It can also make personalized suggestions for better combinations based on clothes in the user's personal wardrobe or products available on Amazon. This service is offered by the

Style Check feature, which allows the wearer to show the better one of different style examples (Figure 9) (Luce, 2018).

Figure 8. *Amazon Echo Look device image (Lievendag ,2017).*
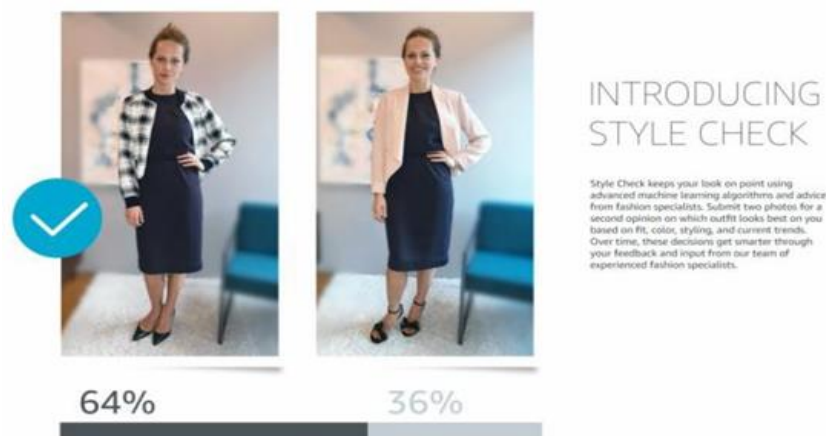
Figure.9 *Amazon Echo Look Style Check (Style Control) properties (Lievendag ,2017).*

AI-Powered Virtual Fashion Influencers

The concept of artificial intelligence-supported virtual influencers dates back to the early 2000s and was first used in video games and movies with the emergence of computer-generated characters. These virtual characters are created using various advanced technologies and are often used to promote products and brands in the virtual world. The use of virtual characters as influencers has become a rapidly rising trend with the rise of social media platforms such as Instagram and Facebook. Brands have created virtual influencers by taking advantage of the wide reach and interaction opportunities provided by these platforms, enabling them to establish innovative connections with their potential customers and followers (Chitrakorn, 2021).

The role of virtual influencers in fashion marketing is evolving in parallel with the evolution of technology and digital culture. First, the emergence of these influencers has

presented brands with the opportunity to develop innovative and interactive marketing strategies.

Today, the rapid advancement of AI technology has increased the influencing power of virtual influencers and made these interactions more important. AI algorithms are used to assign unique personalities, styles, and voices to virtual influencers, making virtual influencers closer to reality indistinguishable from human influencers in many cases (Chitrakorn, 2021).

Compared to traditional influencers, virtual influencers provide brands with the advantage of greater control and flexibility. While minimizing the risk of error compared to traditional influencers increases brand security, the unlimited potential in creative content production allows brands to create original campaigns in terms of sales and marketing strategies. In this context, the role of virtual influencers in fashion marketing is not only an innovative marketing strategy but also a phenomenon that reshapes brand and consumer relations. While fashion brands' collaboration with these digital characters strengthens their marketing strategies, it also enriches the customer experience and creates brand-loyal customers. The rise of virtual influencers creates new opportunities in the fashion industry, allowing brands to gain a competitive advantage.

The development of AI-powered virtual fashion influencers has had a significant impact on the fashion industry, influencing trends, shaping consumer habits and reshaping the concept of brand collaborations. Virtual influencers have become an important marketing and sales method for brands thanks to their large follower bases and high engagement rates. İnsanlardan farklı olarak bu sanal etkileyiciler özgünlük ve yaratıcılık sunarak moda ve sanatsal alanlarda sınırları zorlamakta, takipçilerine stilleri konusunda ilham kaynağı olmaktadır. Bunların yanısıra sanal etkileyicilerin markalarla yapmış oldukları iş birlikleri ile öne çıkmaktadır ve geleneksel pazarlama stratejilerinin çok etki edemediği, teknoloji kullanımının yaygın olduğu genç tüketicilere ulaşmanın etkili bir yolu oldukları değerlendirilmektedir (Allal-Chérif et al., 2024).

Sanal etkileyiciler, reklam ve pazarlama alanında sadece sosyal medya paylaşımları yapmakla kalmayıp aynı zamanda Instagram, Tiktok, Twitter gibi sosyal medya hesaplarından kampanya önerileri, markaların sosyal medya hesaplarına ve internet adreslerine yönlendirmeleri ve hashtag stratejileri ile etkileyici pazarlama ve satış yöntemlerine yeni bir soluk getirmektedir (Rasmussen, 2021). Unlike humans, these virtual influencers push the boundaries in fashion and artistic fields by offering originality and creativity, inspiring their followers with their style. In addition, virtual influencers stand out with their collaborations with brands, and they are considered to be an effective way to reach young consumers, where

traditional marketing strategies cannot have much impact and where technology use is common (Allal-Chérif et al., 2024).

Virtual influencers not only share on social media in the field of advertising and marketing, but also bring a new breath to influencer marketing and sales methods with campaign suggestions from social media accounts such as Instagram, TikTok, Twitter, directing brands to social media accounts and websites, and hashtag strategies (Rasmussen, 2021).

AI-Powered Virtual Influencers Used in the Fashion Industry

Imma Gram

Aww Inc. in Japan. Imma, the first virtual influencer and model in Japan produced by the company in 2018, collaborates with fashion brands. He has appeared in the campaigns of many high-end fashion brands such as Dior, Puma, Nike, Calvin Klein and Valentino (Figure 10)(Virtual Humans,n.d.)

Figure.10 *Imma Gram's Sharing Air Jordan model shoes for her collaboration with the Nike brand (Imma Gram,2022).*

Figure.11 *Imma Gram's sweatshirt sharing for her collaboration with the Hugo Boss brand (Baklanov, 2022).*

Lil Miquela

Lil Miquela is a 19-year-old Brazilian-American virtual influencer created by American AI company Brud. One of the most popular virtual influencers in the fashion industry, the influencer collaborates with brands such as; There are many brands such as Alexander McQueen, Hugo Boss, Calvin Klein, Prada (Storyclash,2024).

Figure.11 *Lil Miquela's collaboration with the Prada brand (Crouch, 2019).*

Kim Zulu

Kim Zulu is a virtual influencer created by the team at Avatar Company, a company based in Johannesburg, South Africa. Kim Zulu, South Africa's first virtual influencer, has increased her global fame with her appearances in Forbes USA and Elle China magazines, as well as Fashion TV, and her appearance at Mercedes-Benz Russia Fashion Week in 2020 (Mungadze,2021). He has collaborations with Kangol and Puma brands. Within the scope of the Kosmo Rider campaign prepared by the Puma brand, Kim Zulu took part in the futuristic photo shoot surrounded by the shoe model they called Kosmo Rider (Figure 12) (Rasmussen,2022).

Figure.12 *Kim Zulu's fashion shoot with Puma brand for the Kosmo Rider campaign*
(Virtual Humans, 2019)

Discussion and Result

This article aims to evaluate the contributions of artificial intelligence technology to the fashion industry in terms of fashion sales techniques and the emerging new sales strategies by examining the use cases of artificial intelligence in fashion sales techniques in detail. The findings show that artificial intelligence offers potential advantages in improving customer experience, optimizing sales strategies and providing personalized service. The literature studies examined and the practices of fashion companies reveal that artificial intelligence in fashion sales techniques may play an even more effective and efficient role in the future, thanks to rapidly developing technology. In this context, it is important for fashion brands and the retail industry to integrate artificial intelligence-based sales techniques into their strategic planning in order to gain a competitive advantage in the sector.

Artificial intelligence-supported style consultants, chatbots and visual search technologies provide personalized recommendations by thoroughly analyzing the consumer's shopping habits. This allows consumers to have a more interactive and efficient shopping experience during the purchasing process. In particular, the use of virtual style consultants, augmented reality and virtual reality simulates the physical store experience during online shopping, facilitating consumers' purchasing decisions, which provides the advantage of increasing sales for fashion brands. Such applications increase customer interaction and create a stronger bond between the brand and the consumer. However, in order to establish this bond, artificial intelligence must be prepared in a more friendly and understanding way with the customer. In fact, it should be in line with cultural values as much as possible. In this way, even if customers know that they are not dealing with a human being, customer satisfaction will increase and a brand-customer bond will be established, as they will see that their own cultural values and the brand's culture are compatible.

Artificial intelligence-based sales systems also increase operational efficiency by automating in-store sales processes. In particular, smart mirrors and virtual fitting rooms offer customers the opportunity to shop faster and more effectively by reducing the need for sales consultants. These technologies eliminate the need for stock control in stores and make in-store experiences more efficient by recommending alternative products to consumers. Consumers have the opportunity to see the products they like on smart screens without having to physically try them on. In this context, it is seen that artificial intelligence increases operational efficiency in fashion sales techniques and makes sales processes faster. The only disadvantage of smart

mirrors is that they do not provide the feeling of touch. Therefore, especially kinesthetic customers still need to try the products. Smart mirrors accelerate sales even for people who are difficult to buy, as they give the garment's volume effect in terms of fabric and material.

Artificial intelligence technologies have become a strategic issue in fashion retailing, radically transforming traditional sales strategies. Especially the use of applications such as chatbots and visual search; It provides the advantage of providing fast and effective solutions to consumers' needs, questions and problems. In this context, the findings of the research reveal that artificial intelligence-based sales techniques have the ability to analyze consumer behavior and provide suggestions and answers accordingly. While these technologies increase the sales of fashion brands, they also make the shopping process easier and more efficient for consumers. Leading fashion brands adopt artificial intelligence innovation as a strategic element and integrate artificial intelligence-based technologies into their sales techniques. The fact that global fashion brands such as Burberry, Tommy Hilfiger and Louis Vuitton increase customer interactions by using chatbot and augmented reality applications and provide faster and personalized responses to customer demands reveals the wide-ranging impact of these technologies in the industry.

Artificial intelligence-supported virtual influencers, another sales and marketing strategy preferred by fashion brands, provide many advantages for brands. Unlike traditional influencers, these AI-based influencers are under the control of brands and have the opportunity to constantly interact with their target consumer base. It is thought that these virtual influencers can create a meaningful impact on the target audience of brands by producing brand-related, interesting and inspiring content, and this interaction has the potential to increase brand awareness and sales. Unlike traditional influencers, virtual influencers do not have the risk of making personal mistakes or damaging the brand image. These virtual influencers, who can work uninterruptedly 24/7, can bring high efficiency and sustainability to brands' marketing strategies. With these aspects, virtual influencers become not only a strategic marketing tool for brands, but also an element that can constantly strengthen the brand image. For this reason, the number of collaborations between fashion brands and virtual influencers is increasing day by day.

The literature studies examined and the practices of fashion companies reveal that artificial intelligence in fashion sales techniques may play an even more effective and efficient role in the future, thanks to rapidly developing technology. In this context, it is important for fashion brands and the retail industry to quickly integrate artificial intelligence-based sales techniques into their strategic planning in order to gain a competitive advantage in the sector.

Based on this important point, studies that encourage interdisciplinary collaboration between fashion designers, software developers and academics can be carried out. By bringing together different perspectives, these studies can enable the production of multidisciplinary, new and innovative solutions. In this period when we live intertwined with technology, artificial intelligence-focused modules can be added to academic curricula for students studying in the field of design, and these modules will provide benefits for students to gain knowledge and skills on how to integrate artificial intelligence technologies into fashion design. In addition, in order to encourage closer cooperation between software developers and fashion designers, internship and workplace training programs can be organized in the sector, thus allowing students to gain practical experience in the fashion industry integrated with technology before entering the sector. Ethical training and guides can be created for software developers and fashion designers, and the responsible and conscious use of artificial intelligence in the sector can be supported by emphasizing the compliance of artificial intelligence applications with ethical values.

The effective use of artificial intelligence in fashion sales techniques has the potential to provide competitive advantage to stakeholders in the industry. However, in order for these advantages to be sustainable, it is necessary to understand the responsibilities brought by technology and adopt a strategic approach in this context. However, in order for this technology to be implemented successfully, important issues such as ethical issues, customer privacy and data security should not be ignored. It is an issue that should be given great importance for companies in the fashion industry to adopt standards regarding the use of artificial intelligence and to harmonize their applications with these principles.

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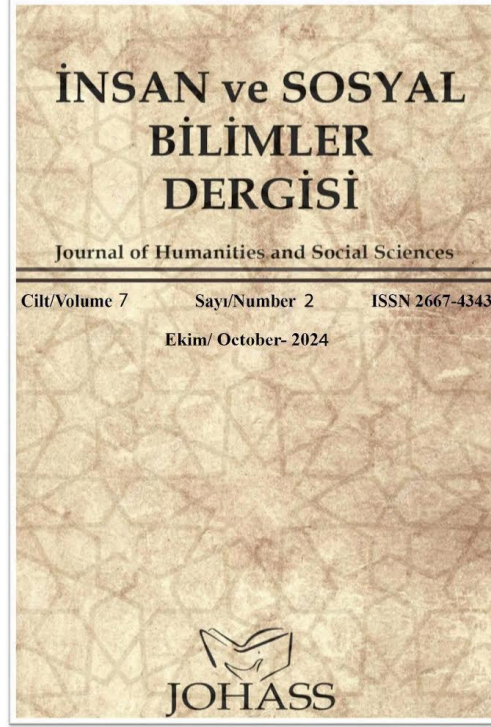
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The Use of Geographic Information Systems and Multi-Criteria Decision-Making Methods in the Creation of Forest Fire Susceptibility Maps: A Literature Review

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The Use of Geographic Information Systems and Multi-Criteria Decision-Making Methods in the Creation of Forest Fire Susceptibility Maps: A Literature Review

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Abstract	Research Article

Forest fires are natural disasters that cause significant environmental, economic, and social damage worldwide. This study provides a literature review examining how Geographic Information Systems (GIS) and Multi-Criteria Decision-Making (MCDM) methods are utilized in the prevention of forest fires and the identification of high-risk areas. GIS, as a system used for the collection and analysis of spatial data, enables the consideration of various factors influencing fire risk, such as climate change, topography, vegetation, and weather conditions. The spatial analysis capabilities offered by GIS play a critical role in identifying regions with high fire susceptibility when generating fire risk maps. Additionally, MCDM methods contribute significantly to the decision-making process by allowing the evaluation of multiple criteria in fire risk analysis. Logistic Regression and Frequency Ratio, which are frequently employed in the literature, are widely used in fire risk analysis and improve the accuracy of susceptibility maps. Furthermore, MCDM methods have been proven effective in estimating the likelihood of forest fire occurrences and identifying fire-prone areas. The integration of GIS and MCDM methods allows for more precise identification of risk zones and supports the development of fire prevention strategies. This literature review highlights the advantages of utilizing GIS and MCDM in the production of forest fire susceptibility maps and suggests that these methods may have broader applications in future research. The effective use of technology in combating forest fires enhances the accuracy of fire risk assessments, contributing significantly to environmental protection efforts.

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Introduction

Forest fires are among the most devastating natural disasters, causing severe environmental, economic, and social damage worldwide. As climate change continues to increase the frequency and intensity of these events, there is an urgent need for more effective tools and methodologies to predict and manage forest fire risks. Geographic Information Systems (GIS) and Multi-Criteria Decision-Making (MCDM) methods have emerged as powerful tools in this regard, offering the ability to analyze spatial data and assess multiple risk factors simultaneously. This paper presents a comprehensive literature review examining how GIS and MCDM methods are employed in the creation of forest fire susceptibility maps, which are essential for identifying high-risk areas and informing fire prevention strategies.

GIS is a system designed to collect, manage, and analyze spatial data, making it a critical tool in assessing the factors that contribute to forest fire risk. These factors include climate change, topography, vegetation types, and weather conditions, all of which can significantly influence the likelihood of fire outbreaks. GIS enables the spatial visualization of these variables, helping decision-makers to identify regions with high fire susceptibility. This spatial analysis capability is particularly valuable in forest fire risk management, where accurately predicting the areas most vulnerable to fire is crucial for effective prevention and mitigation efforts (Hicks, 1993; Longley et al., 2001).

In addition to GIS, MCDM methods play a significant role in enhancing decision-making processes by allowing for the evaluation of multiple criteria in fire risk analysis. MCDM methods such as Logistic Regression and Frequency Ratio are widely used in the literature and have been shown to improve the accuracy of forest fire susceptibility maps. These methods enable decision-makers to integrate diverse datasets, assign weights to different risk factors, and generate more precise predictions of fire-prone areas. By providing a structured framework for analyzing complex risk factors, MCDM methods contribute to more informed and reliable fire risk assessments (Eastman et al., 1995; Aydin et al., 2019).

The integration of GIS and MCDM methods represents a significant advancement in forest fire management. The combination of these tools allows for the precise identification of high-risk zones and supports the development of targeted fire prevention strategies. This is particularly important in a context where environmental conditions are rapidly changing due to global warming, making fire risk assessments more complex and dynamic. As such, the use of GIS and MCDM in fire risk management is not only timely but also essential for enhancing

the accuracy of fire risk assessments and improving the effectiveness of fire prevention measures.

This study aims to provide a detailed examination of the current applications of GIS and MCDM in forest fire risk management. By reviewing the existing literature, this paper highlights the advantages of these methods in producing accurate fire susceptibility maps and offers insights into their broader applications in future research. The integration of technology in combating forest fires is crucial, as it allows for more precise risk identification and contributes significantly to environmental protection efforts. Given the increasing threat posed by forest fires globally, the effective use of GIS and MCDM methods has the potential to significantly reduce the impact of these disasters, safeguarding both natural ecosystems and human communities.

The primary objective of this research is to investigate the integration of GIS and MCDM methods in creating forest fire susceptibility maps, with a focus on their effectiveness in improving fire risk analysis. This paper aims to provide a comprehensive review of the methodologies used in the field, evaluate the strengths and limitations of these approaches, and propose recommendations for their future application. The research also seeks to emphasize the importance of GIS and MCDM in developing more accurate fire prevention strategies, which are critical in the context of increasing fire risks due to climate change.

The significance of this study lies in its potential to contribute to the ongoing efforts to mitigate forest fire risks. By offering a detailed review of the literature, this paper underscores the value of integrating GIS and MCDM methods in fire risk management and highlights their potential to enhance the resilience of ecosystems and communities to fire-related disasters. As forest fires continue to pose a significant threat, the development of more accurate and effective risk assessment tools is essential for preventing and managing these destructive events.

Background

Risk Analysis in Geographic Information Systems

Risk management, designed as a systematic process, comprises the identification, analysis, and assessment of risk factors. In the event of a fire, minimizing the loss of life and property, as well as mitigating the adverse effects of the fire, can only be achieved through effective risk management in areas prone to fire hazards. Risk management activities include

identifying hazards and risks, preparing risk scenarios, selecting protective and mitigation measures, presenting results using updated maps and graphs, identifying available resources and opportunities, making decisions on the most appropriate alternatives and priorities, and selecting and implementing disaster prevention and response methods (Özcan et al., 2009).

Globally, various methods and tools have been developed for fire risk management, with Geographic Information Systems (GIS) being one of the most important tools. It is evident that the use of GIS, particularly in analyzing risk scenarios, has been steadily increasing. The combined use of remote sensing and GIS technologies across broad geographical areas makes GIS a highly attractive tool.

The growing use of GIS worldwide by individuals and institutions involved with spatial information has led to new studies and applications. From this perspective, GIS is both a scientific concept that encompasses all spatial information systems and a computer-based tool and database management system that digitizes spatial information (Yomralıoğlu, 2002). This system enables the collection, storage, classification, updating, synthesis, and generation of alternative strategies related to geographical events within a short period. All studies prepared from different perspectives are essential for recognizing and expanding the use of GIS.

One of the key functions of GIS today, which serves various disciplines, is identifying and solving environmental problems. One such issue is determining and measuring risk. Financial risk, for example, refers to the possibility that an investment may not yield a return, or that the actual return may differ from the expected return (Jones, 1998). In financial theory, risk is classified according to its sources into systemic risk, systematic risk, and unsystematic risk. Systemic risk refers to risks that arise from the system itself and affect all securities in the market, beyond the control of the organization (Okka, 2010). Since market actors are the primary sources of systematic risk, neither countries nor organizations have direct control over it. Many factors related to systematic risk also encompass financial risk factors. Additionally, changes in a country's financial management and economy can significantly impact that country's trade (Hoti and McAleer, 2005).

Country-specific risks primarily consist of financial, economic, and political risk factors, with financial risks being particularly important for both countries and businesses. Financial risks encompass all types of risks related to money, including uncollectible receivables, declining income, inability to repay debts, unemployment, inflation, and many other variables (Altan et al., 2016). Examining these risk factors on a more granular level,

rather than as a whole, offers significant benefits. For example, when defining financial risks for a country, regionally differentiating these risk values from a geographical perspective allows for a more dynamic analysis from both the investor and national perspectives.

In the relevant literature, several studies focus on creating financial risk maps. Cecchetti et al. (2010), for example, developed a risk map of countries exposed to systematic risk by using data from the international banking sector. Pegion et al. (2008) developed a risk assessment study using GIS, while Colletaz et al. (2013) created a risk map by employing value-at-risk. Altan et al. (2016) mapped the financial risk in Turkey by using average financial risk factors. In these studies, risk maps were generated not only using GIS methods but also through graphical analyses. Additionally, there are studies that employ spatial regression and GIS analysis. Çelik (2017) conducted a spatial regression analysis to assess the effectiveness of incentive policies in Turkey, while Baktemur and Özmen (2017) analyzed unemployment convergence in developed EU countries using spatial econometrics, finding a spatial effect on unemployment. Akıncı et al. (2017) used geographically weighted regression analysis to investigate the socio-economic determinants of terrorism.

In conclusion, GIS provides a comprehensive framework for risk management and analysis across various disciplines, with a particular emphasis on environmental and financial risk assessment. The ability of GIS to combine spatial and attribute data, along with advanced analytical tools such as spatial regression, enhances the capacity for effective decision-making in managing risks. By integrating remote sensing data and employing methodologies like MCDM, GIS plays a crucial role in developing risk scenarios, enabling informed choices on prevention and mitigation strategies in the face of both environmental and financial risks.

Geographic Information Systems (GIS) and Forest Fire Susceptibility Assessment

Geographic Information Systems (GIS) are computer-assisted tools essential for transforming the structure of the world and its events into maps and performing various analyses. GIS also functions as an integrated system that can combine common databases. In other words, GIS technology offers users the ability to conduct queries, visualize data, and perform statistical and geographical analyses. Due to these capabilities, GIS is widely used to identify public and private sector projects and develop practical plans for the future (Yomralıoğlu, 2000).

Using GIS, it is possible to perform standard tasks such as generating slope and aspect maps with a digital elevation model, creating 3D visualizations using elevation data, obtaining

statistical information about objects, calculating distance and area values, and overlaying various thematic maps (Bektaş, 2003).

In Turkey, GIS plays a crucial role in mitigating or eliminating the impacts of forest fires. Through GIS technology, forest fire risks and hazards in fire-prone forests can be mapped, and fire-prone areas can be identified in advance. This allows managers responsible for fire prevention to focus on areas with high fire risks and take the necessary precautions (Özşahin, 2014). GIS can also be employed in various aspects of forest fire management, such as public awareness campaigns, education, modeling, planning, analysis, firefighting activities, identifying at-risk locations, and rehabilitation efforts (Şahin, 2006).

By integrating spatial data and enabling the visualization of fire-prone regions, GIS facilitates more informed decision-making in forest fire management. It provides a comprehensive platform for evaluating susceptibility, enabling authorities to plan effectively and allocate resources to minimize the impact of potential forest fires. The use of GIS in these processes helps improve the efficiency of fire prevention strategies and response efforts, thereby contributing significantly to environmental and public safety.

Related Studies

In a study conducted by Karabulut et al. (2013), Geographic Information Systems (GIS) were used to identify forest fire risk areas in the Başkonuş Mountains in Kahramanmaraş. Weights were assigned to each layer based on their sensitivity to causing fires, and fire risk areas in the region were identified. The analysis revealed that areas with high fire risk were concentrated around settlements and the roads connecting these settlements.

Hacısalihoğlu (2018) aimed to determine the spatial distribution of 123 forest fires that occurred within the Karabük Forest Management Directorate (FMD) between 2012 and 2016, based on their starting points. For this purpose, a unique forest fire inventory map was created. The weight of each factor influencing the occurrence of the fires was determined using the Analytical Hierarchy Process (AHP). Based on these weights, analyses were conducted, and forest fire susceptibility maps were produced. These maps were categorized into four classes: low, medium, high, and very high fire susceptibility. To assess the accuracy of these maps, they were compared to the forest fire inventory map, and a 92% compatibility rate was found using the multi-criteria decision-making (MCDM) method.

In a study by Dilekçi (2019), the goal was to identify the factors influencing forest fires in the Zonguldak and Ereğli FMD regions and to create a forest fire risk map. Forest fires that occurred between 2008 and 2018 were marked on satellite images. Factors such as proximity to roads, settlements, elevation, aspect, slope, and land cover type were determined as the most significant contributors to forest fires. The AHP method was used to assess the impact of each factor. Land cover types were classified using Landsat 8 satellite imagery, and forest fire-related classes were identified. Using ArcGIS 10.5, maps were created for each factor influencing forest fires, and their relative importance was determined through spatial queries. The maps were converted into raster format with 30x30 meter resolution for further analysis. The resulting forest fire risk map showed that 18% of the total area was in the low-risk category, 43% in the medium-risk category, and 39% in the high-risk category.

Gayır (2019) aimed to conduct a spatial statistical analysis of forest fires that occurred between 2011 and 2015 in the Muğla forest region and to create risk maps. A clustering/pattern analysis was conducted based on the locations of the fires. Regression studies were performed to determine risk parameters, using the least squares regression and geographically weighted regression models. The accuracy of these models was tested, and the results will serve as a foundation for future studies. The models also provide recommendations for preventive measures, potentially reducing the budget needed for future project planning.

Karadeniz (2020) conducted a study in which topographic, vegetative, meteorological, and landscape characteristics were assessed to evaluate the forest fire that occurred in Urla, İzmir in 2019. Based on the study findings, a fire simulation was created. According to the fire risk map, 2% of the area had low risk, 28% had moderate risk, and 70% had high risk. The study also found that the areas with the highest risk corresponded to actual fire locations in 2008, 2009, and 2019, confirming the model's accuracy.

In a study by Özenen Kavlak, Kurtipek, and Çabuk (2020), GIS tools were used to assess the forest fire risk in the Kütahya-Ören Forest Management Directorate. The study found that 128 fires occurred in the region between 2005 and 2009, damaging 99.18 hectares of land. A GIS-supported fire risk map was created to contribute to minimizing material and physical damage caused by fires and to prepare for future fires. Additionally, a visibility analysis was performed to assess the coverage of fire watchtowers in the area. Recommendations for preventing and managing fire risks were provided based on the results of the GIS-based risk maps and visibility analysis.

In a study by Baltacı (2021), forest fire risk analysis was conducted as part of decision support systems used in forest fire prevention efforts. Eleven criteria, including canopy cover, tree species, slope, age classes, altitude, aspect, and distances to settlements, roads, power lines, wetlands, and agricultural lands, were considered in calculating forest fire risk. GIS analyses were performed to determine the range of criteria values, followed by field studies to verify the accuracy of the data. Unlike previous studies, it was found that fire risk decreases as altitude and slope increase. The study concluded that the highest risk areas were within 0-25 meters of human activity. The findings from GIS analyses and fieldwork showed strong alignment with areas where fires were likely to occur.

Finally, in a study conducted by Dilekçi, Marangoz, and Ateşoğlu (2021), 126 forest fires that occurred between 2008 and 2019 in the Zonguldak and Ereğli FMD regions were analyzed using fire registry forms. The study identified the land use classes, topographic factors, and human factors that contributed to the fires. Vector data on road and settlement networks were extracted from Google Earth, while Landsat 8 satellite imagery and a Digital Elevation Model were used for land use and topographic data, respectively. Using the AHP method, suitability scores were calculated for each factor. Based on these scores, a GIS-based forest fire risk map was created, dividing the area into low, medium, and high-risk categories. The analysis showed that 39% of the area was in the high-risk category, 43% in the medium-risk category, and 18% in the low-risk category.

Types of Forest Fires

Forest fires are classified into different types based on the area they affect. According to this classification, there are three main types of forest fires: surface fires, crown fires, and ground fires (OGM, 1995).

Surface fires, also known as understory fires, are fires that burn the dead plant materials covering the forest floor, such as dry branches, logs, and slash, as well as living vegetation like seedlings, shrubs, moss, grass, and leaves (Bilgili, 2014). These fires typically affect the organic materials that cover the forest soil and are the most common type of forest fire encountered in wooded areas. The development of a surface fire depends on the condition of the dead and living vegetation that covers the forest floor. Almost all forest fires start as surface fires and then develop further depending on environmental conditions (Küçük et al., 2009). Although surface fires generally do not cause significant damage to the main forest trees, they can harm these trees if there is a high accumulation of combustible materials on the

forest floor (Bahadır, 2010). To prevent this damage, it is crucial to monitor and control the affected area effectively after the fire has been extinguished (OGM, 1995).

Crown fires occur when surface fires spread to the treetops, igniting the crowns of trees and shrubs (Küçük et al., 2009). These fires can develop into crown fires due to the effects of high temperatures and gas emissions in coniferous forests, or when combustible materials such as lichen, moss, and dry branches on tree trunks are ignited (Kula, 2018). As a result, crown fires are more commonly observed in coniferous forests. Crown fires are the fastest-growing and most dangerous type of forest fire. They spread rapidly through the tree canopy, making them challenging to control and extinguish. Crown fires have a detrimental effect on the development of trees and shrubs, often resulting in the loss of vitality in forest stands (OGM, 1995).

Ground fires burn thick organic materials below the surface, such as peat and humus (Bilgili, 2014). These fires usually begin in dried-up marshlands where decaying plant material releases combustible gases, which ignite and burn through the thick, soil-like layer (Özdemir & Çelik, 2020). Ground fires spread slowly beneath the surface but can sometimes emerge above ground and transition into surface fires. Due to the scarcity of thick humus and peat layers in Turkish forests, ground fires are relatively uncommon in Turkey (OGM, 1995). Ground fires are characterized by flameless combustion within the soil, making them extremely hot and destructive. By consuming all organic matter in the soil, ground fires transform it into mineral ash, making them one of the most damaging fire types to the environment. In areas affected by ground fires, the regrowth of vegetation is often impossible (Şakar, 2018).

Factors Influencing Forest Fire Formation

While forest fires cannot be predicted with absolute certainty, several factors can increase the likelihood and risk of fire. These factors include climate change, weather conditions, and human activities.

Weather is the most dynamic element influencing fire conditions and is the dominant factor in determining the degree of fire danger on a given day. It is important to distinguish between climate, which refers to long-term atmospheric conditions, and weather, which pertains to daily fluctuations. Atmospheric conditions that affect forest fires include precipitation, temperature, humidity, and wind (Calda et al., 2020).

Humidity is an indicator of the percentage of water vapor saturation in the air at a given temperature. High relative humidity indicates a large amount of moisture in the air, which in turn influences the moisture content of the fuel. Moist fuels are more difficult to ignite (Santiago & Kheladze, 2011). Fire risk is especially high when relative humidity drops below 30%, and the risk increases further when humidity falls below 60% (Karadeniz, 2020).

Surface temperature directly affects fire risk by regulating the temperature of combustible materials. Higher temperatures mean that the material is closer to its ignition point, which accelerates the spread of fire (Çolak & Sunar, 2018).

Wind is one of the most critical factors in determining fire behavior. It influences the pre-heating and drying of fuels and increases the oxygen supply. Strong winds can also cause embers to spread, igniting new fires (Küçük & Sağlam, 2004). High wind speeds can significantly accelerate the spread of a fire, while strong wind pressure can create convective effects that preheat and dry fuels, promoting faster fire propagation (Santiago & Kheladze, 2011).

Precipitation can either reduce ignition risks by moistening fuels or extinguish already burning fires. Moisture absorbed by plants and soil increases fuel moisture content, which reduces ignition chances (Erdem, 2018). Prolonged droughts, however, can increase fire occurrences and cause significant damage in affected areas.

Weather conditions play a significant role in the formation of forest fires (Flannigan et al., 2005). The relationship between forest fires and climate is evident globally. The number of fires and the total burned area are closely associated with maximum and absolute maximum surface temperatures, which correlate with sunlight exposure (Koutsias et al., 2013). Droughts and environmental effects increase the likelihood of large fires, with various weather components having a relative influence on fire (Avcı & Korkmaz, 2021). In Portugal, for example, burned areas are closely linked to seasonal rainfall and fuel moisture (Carvalho et al., 2008). In California, USA, large fires are more influenced by wind patterns than by precipitation (Freedman, 2008).

Topography significantly influences fire behavior both directly and indirectly (Alkayış, Karslıoğlu, & Onur, 2022). Terrain features such as "channels" and "valleys" contribute to fire expansion, while the presence of lakes, bare soil, or rocks can hinder the spread of fire. In this sense, topography can either facilitate or impede fire spread. Key topographic factors affecting fire include aspect, elevation, and slope (Yılmaz et al., 2021).

Aspect refers to the direction a slope faces. It is measured in degrees, ranging from 0° (north) to 180° (south) and 360° (north). In the Northern Hemisphere, south-facing slopes receive more sunlight, resulting in lower relative humidity and higher temperatures, which increase fire risk (Burgess, 2011; Heyerdahl et al., 2001). In contrast, north-facing slopes have higher humidity and lower temperatures, reducing fire risk. In Turkey, fires spread more rapidly on south and southeast-facing slopes due to increased sunlight exposure (Dilekçi, Marangoz, & Ateşoğlu, 2021).

Elevation begins at sea level and influences the overall climate of a region (Baltacı & Yıldırım, 2020). Lower elevations are typically characterized by higher temperatures and lower relative humidity, while higher elevations experience higher fuel moisture and relative humidity due to orographic rainfall, limiting the likelihood and spread of fires (Cüce et al., 2020).

Slope refers to the steepness of the terrain. The steeper the slope, the faster the fire spreads. Slope is usually measured in degrees or percentages and directly affects the length of flames and the rate of fire spread (Kavlak, Kurtipek, & Çabuk, 2020). As the slope increases, the fire spreads uphill more rapidly due to the increased heat transfer to the fuel ahead of the fire (Baltacı & Yıldırım, 2020). Slope is the most significant topographic factor influencing fire behavior. Depending on wind speed and the angle of the slope, slope can sometimes be more effective than wind in determining the rate at which a fire spreads (Rawat, 2003).

In addition to climate change, weather conditions, and topography, the sources of combustible materials, the combustion of these materials, fire behavior, and the fire hazard index also play critical roles in the formation of forest fires. The sources of combustible materials in a forest are formed as a result of the growth, development, and eventual death of living plants, species, and other forest components. These materials vary in their distribution within the forest. Combustible materials in a forest can be categorized into three groups based on their general characteristics and vertical distribution: subsurface combustible materials, surface combustible materials, and tall combustible materials (Çanakçıoğlu, 1993). These include all combustible materials within the upper soil layer, such as fertilizers, peat, decaying organic matter, tree roots, and humus. These include both living material and dead debris. Surface combustible materials cover all flammable material on the topsoil, such as thin and decayed branches, fallen leaves, grass, bark, cones, seedlings, short shrubs, small saplings, logs, and thick branches on the ground. These are generally located above 1.5 meters from the ground, within the forest canopy, and may consist of both living and dead materials. This

category includes tall shrubs, lower canopy trees, branches, leaves, standing dead trees, climbing plants, tall shrubs, lichen, and moss. When materials in a forest begin to burn, a chemical reaction occurs between the resins, wood, and other flammable materials and the oxygen in the air. Forest fires progress through several stages: the initial spark, the smoldering phase, and the eventual ignition of combustible material. At times, forest fires can manifest with great intensity. Events such as thick smoke, flames jumping, sporadic explosions, loud noises, and extreme heat occur in accordance with the natural laws and principles governing fire behavior. Understanding the effects of various environmental factors on these laws and principles is crucial for decision-making during firefighting efforts (Bilici, 2008). Fire behavior refers to how a fire moves and reacts to the factors influencing it, such as combustible materials, weather conditions, and topography. For those combating a fire, predicting the fire's current actions and potential future behavior is a critical concern. Adequate knowledge of fire behavior makes it easier to effectively combat the fire and achieve successful outcomes (Castillo et al., 2021). The fire hazard index (FHI) refers to the potential of a fire occurring under existing conditions, based on factors that influence fire risk (Şenyaz, 2000). Fire hazard is the result of both constant and variable fire factors, determining the likelihood of a fire starting, the difficulty of firefighting, the rate of fire spread, and the damage caused. The fire hazard index is an element of firefighting planning and involves the organization and application of selected fire hazard factors in the form of indices, based on current protection needs (Coşkuner & Bilgili, 2020).

As an environmental factor, the effects of fires initiate a process of ecological restructuring, leading to the recovery of ecosystems post-fire (Doussi & Thanos, 1994). Fires can also result in the degradation of ecosystems, often driven by human activities, causing a shift away from the existing floristic composition and structural characteristics (Moreira & Vallejo, 2009). Anthropogenic changes (Pausas & Keeley, 2014) and climate change (Pausas, 2004) have led to significant changes in regional fire regimes (Tavşanoğlu, 2017). Thus, when combined with human activities and other factors, forest fires can become catastrophic events that should be assessed outside the context of natural cycles.

Methods Used in the Production of Forest Fire Susceptibility Maps

Forest fires are defined as fires that burn combustible materials found in forests, such as logs, trees, needles, grass, dry wood, and leaves, either partially or completely. Due to the open environment, these fires tend to spread freely (Hacısalihoğlu, 2018). The General

Directorate of Forestry (OGM) defines a forest fire as a fire that can destroy both living and non-living entities within the forest ecosystem and has a tendency to spread uncontrollably (OGM, 1995). Similarly, in regulations, forest fires are described as "fires that destroy all living and non-living entities within the forest ecosystem by burning and that tend to spread freely" (OGM, 2008).

For a forest fire to ignite, three key components—known as the "fire triangle"—must be present: combustible materials, oxygen, and ignition temperature (Bahadır, 2010). If any of these three components are absent or insufficient, a fire cannot occur. Thus, in fire prevention and control, eliminating one of these components is crucial. The amount and quality of these three components also determine the intensity and spread of a forest fire (Turnalı, 2020). Specifically, the temperature of combustible materials must exceed 260-400ºC, the oxygen concentration must be above 15%, and sufficient combustible material must be available for a fire to ignite and spread (OGM, 2008).

In this context, the methods used to create forest fire susceptibility maps focus on assessing these three elements and other environmental factors to predict and mitigate the risk of forest fires.

The Role of GIS in Forest Fires

Forest fires can cause significant loss of life and property, particularly during the summer months, both globally and in Turkey. Predicting the occurrence, intensity, and spread of forest fires is crucial to minimizing these losses. However, obtaining such information through ground-based measurements can be time-consuming, costly, and labor-intensive (Yavuz & Sağlam, 2011).

To effectively combat forest fires, it is essential to take all necessary precautions and utilize resources efficiently. In addition to this, the use of advanced technologies at every stage of the process is critical. One of the most important technologies in modern fire management is Geographic Information Systems (GIS) (Tecim, 2008). GIS, which provides valuable data across various fields, has one of its most significant applications in forestry (Karabulut et al., 2013). Today, GIS technology is employed in forest management, operations, transportation, fire prevention, and many other forestry-related applications (Akay et al., 2008; Gümüşay & Şahin, 2009; Sivrikaya et al., 2007; Yüksel et al., 2008; Wing et al., 2010). GIS allows for fast, easy, and cost-effective access to the necessary information

(Küçük & Bilgili, 2006). As a result, GIS provides valuable data not only during fires but also in pre-fire and post-fire research (Şahin, 2006).

As a decision-support system, GIS enables optimal planning, transportation, and coordination of first response and firefighting teams (Akay & Şakar, 2009; Varol et al., 2010; Akay et al., 2011). GIS helps monitor the structure of the atmosphere, the detailed topography of fire-prone areas, and the properties of combustible materials, allowing for safe and effective fire management.

GIS also helps fire managers better understand and visualize the physical factors and relationships that influence fire behavior. Factors such as slope, aspect, and vegetation can be analyzed to predict where the fire will occur and where it will be most intense (Gayır & Arslan, 2018). This information can be used to view and compare cultural resources, critical infrastructure, important facilities, and wildlife habitats. Additionally, historical forest fires can be mapped alongside potential sources of ignition, such as power lines, roads, factories, and settlements, allowing fire-prone areas to be identified. Furthermore, key assets, highly flammable forests, and areas with a high likelihood of fire ignition can be visualized together, facilitating the planning of fundamental forest fire management activities (ESRI, 2000).

Methods Used in the Preparation of Forest Fire Maps

In the production and analysis of forest fire susceptibility maps, which require consideration of multiple human and natural factors such as topography, modern methodologies like decision tree analysis, support vector machines, heuristic algorithms based on artificial neural networks, probability-based methods like the "frequency ratio," and statistical methods like the "logistic regression method" are recommended (Hacısalihoğlu, 2018). Additionally, one of the widely adopted and developed approaches, particularly with technological advancements in GIS, is the "Multi-Criteria Decision Analysis" (MCDA) method (Şahin, 2012).

Multi-Criteria Decision-Making Analysis

In decision-making, individuals or institutions rarely rely on a single criterion. Multiple criteria are often considered, especially when aiming for long-term benefits. However, in many decision problems, finding an ideal solution that satisfies all criteria simultaneously is often not possible. Therefore, the goal is to evaluate all criteria and reach the most suitable solution from the available alternatives (Ishizaka & Nemery, 2013).

Responses required in situations demanding action are decisions (İmrek, 2003), and determining the best course of action among available alternatives is decision-making (Saat, 2000). The fact that decision-making is a process distinguishes it from decisions (Tuncer et al., 2009). Decision-making involves selecting the most appropriate option from available choices to achieve a desired goal or solve a specific problem (Doğramacı, 2009).

Decision problems vary greatly depending on the methods used and the circumstances under which solutions are sought. Decisions made under the presence of multiple conflicting criteria are known as multi-criteria decisions. The process of determining the most suitable decision based on predefined criteria is called "multi-criteria decision-making" (Bazzazi et al., 2011). Since criteria often conflict with one another, no solution can satisfy all criteria simultaneously. In such cases, the decision is typically a compromise solution or a set of solutions based on the decision-maker's preferences (Sayadi et al., 2009). The compromise solution to a problem with conflicting criteria allows the decision-maker to find the solution closest to the ideal or desired outcome. A typical MCDA problem generally includes three fundamental components: "alternatives," "criteria," and the "relative importance" (weights) of each criterion. The ability to evaluate numerous criteria and alternatives simultaneously is one of the greatest advantages of MCDA methods (Chatterjee, 2010).

Decision analysis is the process of solving a complex decision problem through mathematical modeling, systematic procedures, and statistical analysis (Malczewski, 1999). In this process, the decision-maker seeks either to select the best alternative from a set of options or to rank all alternatives from best to worst (Kaya, İpekçi Çetin & Kuruüzüm, 2011).

In decision analysis, problems are broken down into smaller, meaningful combinations to integrate them logically and provide realistic solutions. Evaluating complex problems with multiple, conflicting criteria and finding solutions based on these criteria is known as multi-criteria decision analysis (Malczewski, 1999). In other words, MCDA is a method or technique designed to help make decisions when faced with problems characterized by conflicting and non-uniform criteria (Gökbek, 2014).

Multi-criteria decision analysis consists of three stages: understanding (intelligence), design, and choice (Demirtaş, 2009).

- **Understanding**: In this stage, raw data is collected, processed, and opportunities and challenges are identified. The decision-maker conducts research and scanning to assess the gap between the current and desired situations to make the correct decision.

- **Design**: In this phase, a fundamental model is used to convert complex documents into simple and understandable structures, and potential solutions for identified problems are developed and analyzed. This stage makes it easier for decision-makers to identify various options.

- **Choice**: At this stage, the alternatives developed in the design phase are evaluated. All available alternatives are assessed, and their relationships are analyzed based on defined decision rules to determine which alternative is the most appropriate.

- Decision-making is a dynamic process enriched by feedback, involving complex methods, information research, data collection, filtering, and feedback loops. Whether decisions are simple or complex, they follow the same fundamental processes (Demirtaş, 2009).

- **Problem Definition**: Every decision-making process begins with understanding and defining the decision problem. The first step is identifying the differences between the current state of the system and the desired state (Doğramacı, 2009). In this stage, the conditions for solving the problem are analyzed, data is collected, and processed (Malczewski, 1999). This step concludes with establishing clear, realistic, agreed-upon, and understandable goals or objectives (Doğramacı, 2009).

- **Determination of Evaluation Criteria**: This is the next stage after problem definition, where the evaluation criteria are determined. The criteria must be clear and consistent with the objectives of the task. By sourcing the criteria from a single source, the exclusion or inclusion of certain criteria can be avoided. Additionally, to avoid complexity, the number of criteria should be kept to a minimum (Majumder, 2015).

- **Alternatives**: These are the viable options that remain after narrowing down the choices in the decision space using various regions or criteria in the area of analysis. The alternatives are evaluated based on how well they fit the objectives of the study, categorized as unsuitable, moderately suitable, or suitable (Zardari et al., 2014).

- **Criteria Evaluation/Decision Matrices**: At this stage, the performance of each criterion is evaluated for each alternative. The result of the decision matrix serves as the foundation of multi-criteria evaluation (Arca, 2015).

- **Criteria Weights**: The importance of the differences between criteria is determined by assigning weights to each criterion. Since the assigned weights can significantly influence the overall evaluation, the decision-maker's preferences should be

considered. In other words, decision-makers and groups must be involved in the MCDA process (Doğramacı, 2009; Sarımehmet et al., 2020).

- **Decision Rules**: These are the basic elements that help determine which alternative to select by ranking them based on numerical quality scores assigned according to how well they meet the criteria in question (Deniz & Topuz, 2018).

- **Sensitivity Analysis**: Sensitivity analysis is conducted to assess the reliability of a decision and to demonstrate the effect of errors in the data included in the analysis. This step makes it easier to understand which values most influence the decision (Şahin, 2012; Özşahin, 2013).

- **Priority/Recommendation**: At the end of the MCDA process, one or more alternatives are ranked, and a single alternative or multiple recommended options are suggested to the user (Şahin, 2012).

GIS-Based Multi-Criteria Decision Analysis

The growing capabilities of Geographic Information Systems (GIS) have been significantly influenced by the needs of environmental management and spatial decision-making analyses. Over time, GIS has integrated with Multi-Criteria Decision Analysis (MCDA), creating what is now known as GIS-based MCDA, or G-MCDA (Selçuk et al., 2016). G-MCDA is a decision-making process that evaluates both geographic and non-geographic information (Malczewski, 1999).

In G-MCDA, GIS handles data collection, storage, organization, and analysis, while MCDA combines the preferences of decision-makers with spatial data to facilitate decision-making (Ünaldık, 2019). By allowing decision-makers to identify and evaluate multiple criteria and the relationships between them, GIS and MCDA make spatial decision-making easier and more effective (Malczewski, 1999).

The steps in the G-MCDA process include defining the decision goal, identifying the criteria, determining the value of indicators, normalizing the values of the criteria, assigning weights to the criteria, combining normalized criteria values with their assigned weights, ranking the preferences, conducting sensitivity analysis, and finally, making a decision (Jankowski, 1995). Once the problem is defined and the evaluation criteria are determined for the G-MCDA process, these criteria are prepared as layers within the GIS to enable comparison. However, since the criteria may have different units of measurement, they need to be normalized to allow for comparison. The main normalization methods include the

"Value/Benefit Function," "Linear Scale Transformation," and "Fuzzy Logic" approaches (Malczewski, 1999).

One of the commonly used statistical methods in GIS-based analyses is logistic regression (LR). This probabilistic statistical method is preferred to establish the relationship between multiple independent variables and a categorized dependent variable (Alkevli, 2015; Lee, 2005). Dependent variables are influenced by other variables and change when these influencing variables change. Independent variables, on the other hand, are not affected by other variables and change independently (Altural, 2012).

Logistic regression is often used as an alternative approach when the dependent variable is binary. When other statistical techniques for classification do not meet the required assumptions, logistic regression can produce more reliable results. Even when assumptions are met, many researchers prefer logistic regression because it resembles the linear regression model (Baş & Çakmak, 2012).

Logistic regression models can be applied as either binary logistic regression, where the independent variable is categorized, or multinomial logistic regression, where multiple categorical variables are included (Alkevli, 2015).

The reasons for preferring logistic regression include (Baydemir, 2014):

- The dependent variable is categorical.
- There are no restrictions on the independent variables being continuous or discrete.
- The model can be linearized, making it easier to interpret.
- Widely used statistical packages like SPSS and SAS can easily perform logistic regression analysis.
- There is no risk of encountering negative probabilities.
- The relationship between the dependent and independent variables does not need to be linear. It can be polynomial or exponential.

Frequency Ratio Method

The frequency ratio is defined as the ratio of the probability of an event occurring to the probability of it not occurring (Erener et al., 2010). The frequency ratio method examines the relationship between each factor affecting the event and past events. This method, which is simple to understand and apply, is frequently used in the literature due to its ease of use (Hacısalihoğlu, 2018).

The frequency ratio method, also referred to as conditional probability or statistical index in the literature, is based on density analysis. Its primary principle involves transferring all relevant parameters into a GIS environment, linking them with a fire inventory map, and conducting density analyses (Lee & Talib, 2005).

The conditional probability assessment of forest and grassland fires is based on an independent evaluation of the factors contributing to the fire. These factors are classified according to fire density, with each class being weighted. The classes are then scored according to the fire's intensity, and an index is calculated. The area in each class is the total area being considered (Üzel Gününi, 2019). One of the advantages of the frequency ratio method, a bivariate statistical technique, is that it allows experts to draw conclusions, while its disadvantage lies in the use of situational assumptions (Arca, 2015). The sensitivity mapping that uses the frequency ratio method takes into account the frequency ratios of each factor influencing forest fires in the subcategory (Altural, 2012).

Discussion and Result

This study aimed to investigate the role of Geographic Information Systems (GIS) and Multi-Criteria Decision-Making (MCDM) methods in the creation of forest fire susceptibility maps, and to evaluate their effectiveness in forest fire risk management. The findings indicate that these technologies play a pivotal role in improving the accuracy of fire risk analysis, enabling more effective prevention and mitigation strategies.

GIS has proven to be an essential tool in forest fire management, primarily due to its ability to integrate various types of spatial data and perform detailed analysis. In the context of this study, GIS was used to assess the fire susceptibility of the Manavgat region, resulting in the identification of approximately 44,384 hectares (49.32% of the total area) as high or very high risk for forest fires. These high-risk areas were found to be concentrated in regions with specific topographic and environmental characteristics, such as red pine forests, southern-facing slopes, and areas with elevations ranging from 0 to 750 meters. Furthermore, the study found that the lack of adequate watchtowers in high-risk areas contributed to the vulnerability of these regions, making early detection and prevention more challenging.

GIS enables forest managers to visualize fire-prone areas based on topographic features, vegetation types, and proximity to human activities. The integration of such data into GIS systems allows for a more comprehensive understanding of fire dynamics, enabling

decision-makers to predict where fires are likely to occur and how they might spread. This predictive capability is particularly important in areas like Manavgat, where environmental conditions such as steep slopes and dry vegetation increase the likelihood of fire outbreaks.

The combination of GIS with MCDM methods has further enhanced the ability to manage forest fire risks. MCDM techniques, such as Logistic Regression and the Frequency Ratio method, are widely used to assign weights to various fire risk factors, such as slope, aspect, and proximity to roads, allowing for a more accurate assessment of fire-prone areas. By integrating multiple criteria into the analysis, MCDM methods provide a structured approach to evaluating complex environmental conditions, enabling forest managers to prioritize areas for fire prevention and allocate resources more efficiently.

The study's use of MCDM methods revealed that topographic features such as slope and aspect play a critical role in determining fire susceptibility. In particular, southern-facing slopes, which receive more sunlight and have lower humidity levels, were identified as the most fire-prone areas. Additionally, regions with high road density and proximity to human settlements were found to be at higher risk, underscoring the need for more focused fire prevention efforts in these areas.

The integration of GIS and MCDM methods represents a significant advancement in forest fire risk management. The ability of GIS to handle large datasets and visualize spatial relationships, combined with the decision-making capabilities of MCDM, allows for more precise identification of high-risk zones. This integration enables forest managers to develop targeted fire prevention strategies that take into account multiple risk factors, such as vegetation type, topography, and weather conditions.

For instance, the findings from the Manavgat case study highlight the importance of focusing fire prevention efforts on areas with steep slopes and southern-facing hillsides. The ability to overlay fire risk maps with data on watchtower locations also revealed that many high-risk areas lacked adequate fire monitoring infrastructure, suggesting a need for better spatial planning in fire prevention efforts. This level of detail, made possible by GIS and MCDM integration, allows for a more proactive approach to forest fire management.

The insights gained from this study have significant implications for forest fire management policies in Turkey and beyond. The findings underscore the importance of taking a proactive approach to fire prevention by identifying high-risk areas before fires occur. By integrating GIS and MCDM methods into forest fire management plans,

policymakers can develop more effective strategies for preventing fires and minimizing their impact.

Key preventive measures identified in this study include the need for public awareness campaigns to educate citizens about the risks of forest fires and the importance of early reporting. In addition, there is a need to revise legal frameworks, such as the constitutional provisions that allow for the allocation of previously forested lands to rural communities, which may contribute to intentional forest fires. Strengthening these legal frameworks in line with modern forestry principles can help reduce the incidence of human-induced fires.

Moreover, the study recommends that fire-prone areas be continuously monitored for changes in weather conditions, such as wind speed, temperature, and humidity, which can significantly affect fire risk. The use of fire risk maps, updated regularly through GIS and MCDM analysis, will allow for better resource allocation and faster response times during fire events.

GIS and MCDM methods also play a crucial role in post-fire recovery efforts. After a fire has been extinguished, these tools can be used to assess the extent of the damage and guide reforestation efforts. The creation of post-fire recovery maps allows forest managers to determine which areas require immediate replanting and which species of trees are best suited for the affected regions. In high-risk areas, fire-resistant species should be prioritized to reduce the likelihood of future fires.

The integration of GIS and MCDM methods in post-fire recovery also enables a more strategic approach to reforestation. By aligning reforestation efforts with fire risk maps, forest managers can ensure that new plantings are done in a way that minimizes the risk of future fires. This approach not only helps restore the natural ecosystem but also enhances the resilience of the forest to future fire events.

In conclusion, the integration of GIS and MCDM methods in forest fire management has proven to be highly effective in improving the accuracy of fire risk assessments and guiding preventive measures. The findings of this study highlight the critical role that these technologies play in identifying high-risk areas, optimizing resource allocation, and informing fire prevention strategies. By leveraging the capabilities of GIS and MCDM, forest managers can take a more proactive approach to fire prevention, ultimately reducing the impact of forest fires on both the environment and human communities.

Moving forward, the continued development and application of GIS and MCDM methods will be essential for enhancing forest fire management efforts. As climate change

continues to increase the frequency and intensity of forest fires, the need for more accurate and dynamic fire risk assessments will become even more critical. By integrating these technologies into forest management plans, policymakers can develop more effective strategies for mitigating the devastating effects of forest fires and ensuring the long-term sustainability of forest ecosystems.

Recommendations

Based on the findings of this review, several recommendations can be made to enhance the implementation and research:

- **Enhance Public Awareness**: Implement extensive educational campaigns, particularly targeting younger generations, to raise awareness about forest fire risks and prevention strategies.

- **Improve Legal Frameworks**: Review and update legal provisions that may indirectly encourage human-induced fires, such as land allocation policies, to prevent intentional forest burning.

- **Strengthen Early Detection Systems**: Increase the number and strategic placement of watchtowers and integrate advanced monitoring technologies, such as drones and satellite imagery, for faster detection and response to fires.

- **Develop Comprehensive Fire Risk Maps**: Regularly update GIS-based fire risk maps incorporating real-time data on weather conditions and topography to support proactive fire management and resource allocation.

- **Promote Fire-Resistant Reforestation**: After fires, prioritize the planting of fire-resistant tree species in high-risk areas, using GIS and MCDM methods to guide reforestation and recovery efforts effectively.

- **Optimize Resource Allocation**: Use MCDM methods to ensure that firefighting resources, including equipment and personnel, are allocated efficiently to the most vulnerable regions.

- **Climate Change Mitigation**: Develop long-term strategies to address the growing threat of forest fires driven by climate change, integrating GIS and MCDM tools to adapt fire management practices accordingly.

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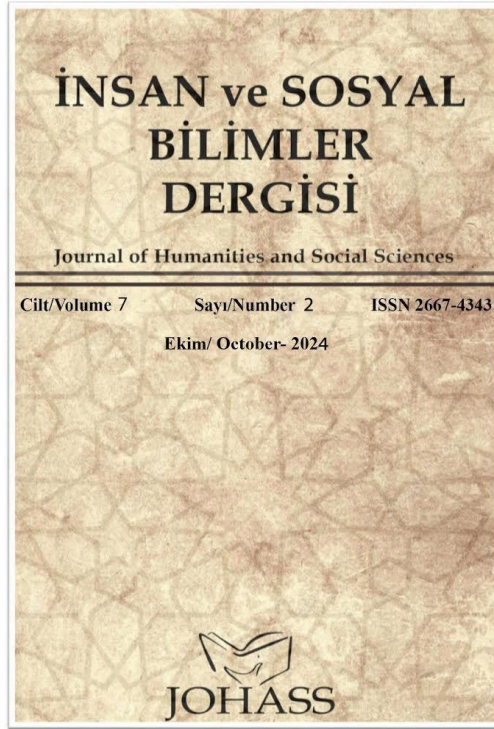
Research on Mobile Learning (M-Learning) in Higher Education:

A Systematic Review (2016 to 2023)

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Abstract	Research Article

This study investigates the evolution of mobile learning (M-Learning) applications in higher education between 2016 and 2023. This period marks an era of significant technological innovations and the profound impacts of the COVID-19 pandemic on education. The purpose of this research is to delineate how M-Learning applications are represented in the academic literature during this time and to identify research trends within this field. The research is based on a systematic review of 161 academic articles related to M-Learning, published between 2016 and 2023 in the Scopus and Web of Science databases. The study utilizes the TCCM (Theory, Context, Characteristics, Methodology) framework to conduct an in-depth analysis of theoretical approaches, research contexts, learning characteristics, and methodological strategies in the literature. The findings reveal that M-Learning positively impacts areas such as collaboration, skill development, and self-assessment among students. The effective use of mobile devices as educational tools by instructors and students is identified as crucial for the success of M-Learning applications. Moreover, the success of M-Learning is closely linked to users' attitudes toward technology and the integration of technological and pedagogical supports into the learning processes. This systematic review provides significant insights into how M-Learning can transform learning and teaching practices in higher education. It suggests strategic planning and further research for educators, policymakers, and researchers on integrating mobile technologies into learning processes. Specifically, there is a need to explore the long-term effects of M-Learning on student achievement and its applicability in various learning contexts.

Keywords: Mobile learning, higher education, systematic review, educational technologies, academic achievement

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Introduction

The widespread adoption of mobile phones has significantly reshaped daily life across the globe. By 2025, the number of mobile users is projected to increase from 7.26 billion in 2022 to 7.49 billion (Statista, 2022). This technological ubiquity has opened new opportunities in various sectors, including education. The COVID-19 pandemic further underscored the need for flexible and accessible learning solutions, as approximately 1.5 billion students worldwide were impacted by school closures, marking the most significant disruption in education history (UNICEF, 2021). In this context, mobile learning (M-Learning) has emerged as a critical educational tool, offering learners the ability to access educational resources from any location at any time (Crompton, 2013; Keegan, 2002).

M-Learning is defined as "learning that occurs across multiple contexts through social and content interactions using personal electronic devices" (Crompton, 2013). This approach has revolutionized higher education by enabling more dynamic and interactive learning experiences. For instance, M-Learning fosters real-time collaboration through platforms that support discussion boards, group projects, and shared documents (Kukulska-Hulme, 2010). Additionally, it supports microlearning, which involves delivering educational content in small, manageable segments (Buchem & Pérez-Sanagustín, 2013). Higher education institutions (HEIs) have capitalized on these capabilities by developing specialized mobile applications and platforms that integrate advanced technologies such as Augmented Reality (AR) and Virtual Reality (VR), thereby offering immersive and engaging learning environments (Merchant et al., 2012). Gamification techniques, including educational games and simulations, create interactive and engaging learning experiences that increase student motivation and participation (Deterding et al., 2011). M-Learning platforms also offer seamless assessment and feedback mechanisms, enabling students to track their progress and identify areas for improvement.

The primary aim of this study is to conduct a systematic review of M-Learning applications in higher education from 2016 to 2023. This period has seen rapid technological advancements and significant changes in educational practices due to the pandemic. This research seeks to analyze how M-Learning has been represented in academic literature during this timeframe and to identify key research trends.

The significance of this research lies in its comprehensive analysis of the transformative potential of M-Learning in higher education. By systematically reviewing a

broad range of academic articles, this study aims to provide a detailed understanding of the theoretical foundations, research contexts, learning characteristics, and methodological approaches associated with M-Learning. Utilizing the TCCM (Theory, Context, Characteristics, Methodology) framework, this research conducts an in-depth examination of the critical factors that influence the success of M-Learning initiatives.

Understanding the impact of M-Learning is crucial, particularly in light of the educational disruptions caused by the COVID-19 pandemic. The flexibility and accessibility of M-Learning make it a vital tool for continuing education in challenging circumstances. This study aims to highlight the positive outcomes of M-Learning, such as enhanced student collaboration, improved skill development, and opportunities for self-assessment (Crompton, 2013; Kukulska-Hulme, 2010).

Furthermore, the research emphasizes the importance of user attitudes towards technology and the integration of pedagogical and technological supports in the successful implementation of M-Learning applications (Alrasheedi, Capretz, & Raza, 2015). By identifying gaps in the current literature and suggesting areas for future research, this study aims to contribute to the strategic planning efforts of educators, policymakers, and researchers.

In conclusion, this research not only advances the understanding of M-Learning in higher education but also provides a foundation for future studies. It stresses the need for continuous exploration of the long-term effects of M-Learning on student outcomes and its applicability across different educational contexts. This comprehensive review underscores the potential of M-Learning to revolutionize higher education, offering valuable insights into how mobile technologies can be effectively integrated into educational practices to create flexible, engaging, and accessible learning environments.

This study aims to address the following research questions:

1. What major theories are explored in the M-Learning literature?
2. What are the commonly used contexts in the M-Learning literature?
3. What characteristic factors affect the usage of M-Learning in higher education?
4. What are the commonly used research methodologies in the M-Learning literature?

Method

Model

This study adopts a systematic literature review (SLR) methodology to thoroughly investigate the evolution and application of mobile learning (M-Learning) in higher education between 2016 and 2023. The SLR approach is recognized for its rigorous, structured method of identifying, evaluating, and synthesizing existing research, making it ideal for comprehensively understanding the current state of knowledge in a specific field and highlighting gaps for future research (Kitchenham, 2004).

Data Sources and Search Strategy

The primary data sources utilized for this review are the Scopus and Web of Science databases, chosen for their extensive collections of high-quality academic publications. In January 2024, a keyword search was conducted to ensure a comprehensive capture of relevant studies. The search terms included "M-learning" OR "Mobile Learning" AND "factors" OR "adoption factors" OR "Critical Success Factors" OR "CSF" OR "Influencing Factors" AND "Higher Education" OR "University Education" OR "University." This search strategy was designed to cover a broad spectrum of articles related to the adoption and impact of M-Learning in higher education (Okoli & Schabram, 2010).

Inclusion and Exclusion Criteria

To maintain a focused and relevant selection of studies, specific inclusion and exclusion criteria were established:

Inclusion Criteria:

- Studies published in peer-reviewed journals.
- Studies focusing on M-Learning in higher education.
- Studies published in English.
- Studies providing empirical data or significant theoretical insights.

Exclusion Criteria:

- Studies not related to higher education.
- Studies published in languages other than English.
- Studies without full-text access.
- Studies focusing on primary or secondary education.

Study Selection Process

The selection process involved several stages to ensure a rigorous and unbiased review. Initially, the titles and abstracts of the identified papers were screened to exclude irrelevant studies. In the next phase, the full texts of the remaining papers were examined in detail to confirm their relevance based on the inclusion criteria. This methodical approach ensured that only the most pertinent and high-quality studies were included in the final analysis.

The PRISMA flow diagram in Figure 1 shows that 161 studies were identified and selected for review. The initial keyword search identified 394 studies across different databases, out of which 102 were removed for irrelevance. After removing 68 duplicate studies, 224 studies remained for consideration. After checking these studies against the inclusion/exclusion criteria, 161 studies were selected for detailed reading.
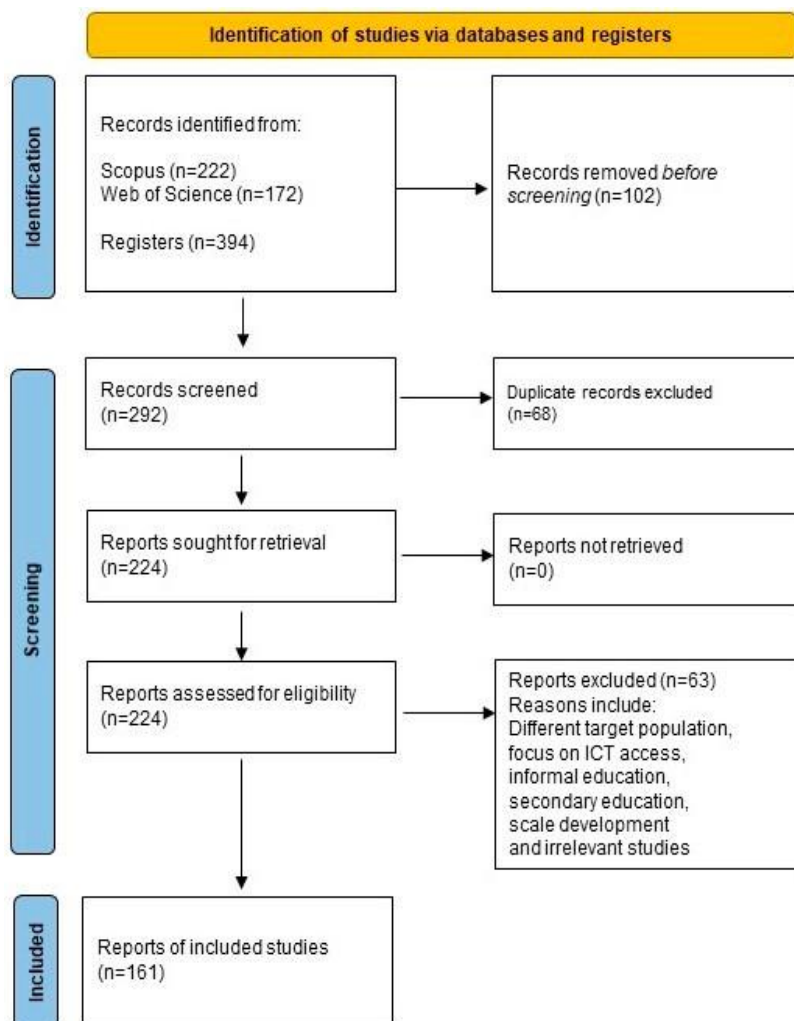

Figure 1. *PRİSMA Framework*

Quality Assessment

The quality of the selected articles was assessed using a comprehensive checklist, focusing on criteria such as the clarity of research goals, citation frequency, and the credibility of results supported by empirical data. This assessment was essential to ensure that the review included only studies with robust methodologies and significant contributions to the field (Kitchenham, 2004).

Data Extraction and Synthesis

A detailed data extraction form (DEF) was developed to systematically collect and organize information from each selected study. The DEF included fields for the study's title, abstract, country of origin, study participants, variables considered, research design, analysis method, sample size, and other relevant details. This structured data collection process facilitated consistent and accurate extraction across all studies.

The extracted data were synthesized using the TCCM (Theory, Context, Characteristics, Methodology) framework. This framework provided a systematic approach to categorize and analyze the literature, enabling an in-depth examination of the theoretical foundations, research contexts, learning characteristics, and methodological strategies in M-Learning studies (Paul & Rosado-Serrano, 2019).

Analysis and Interpretation

The analysis involved categorizing the studies based on the TCCM framework to identify common themes, trends, and research gaps. The TCCM framework is particularly effective in highlighting research gaps and guiding future research directions by focusing on four key dimensions: theory, context, characteristics, and methodology. This thematic evaluation provided valuable insights into the state of M-Learning research and underscored areas requiring further investigation.

Through a systematic and rigorous methodology, this study offers a comprehensive overview of M-Learning in higher education. The SLR approach ensures the reliability and validity of the findings, making significant contributions to understanding the impact of M-Learning and identifying critical areas for future research. This methodology section outlines the structured process followed to achieve these aims, ensuring transparency and replicability in the review process.

Findings

This section presents the findings of the systematic literature review on mobile learning (M-Learning) in higher education from 2016 to 2023. The results are organized according to the research questions, focusing on the theories explored, contexts used, characteristic factors, and research methodologies.

RQ1: What Major Theories Are Explored in The M-Learning Literature?

The analysis identified several key theories that underpin research on M-Learning. The most frequently cited theories include the Technology Acceptance Model (TAM) proposed by Davis (1989) and further extended by Venkatesh and Davis (2000). This model is instrumental in explaining how users come to accept and use technology. The Theory of Planned Behavior (TPB) by Ajzen (1991) is another significant theory that focuses on the influence of attitudes, subjective norms, and perceived behavioral control on individuals' intentions and behaviors regarding technology use. The Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2003) integrates elements from various acceptance models to provide a comprehensive framework for understanding user intentions and subsequent usage behavior.

Constructivist theories, as discussed by Piaget (1964) and Vygotsky (1978), emphasize the importance of learners constructing their own understanding and knowledge through experiences and interactions. The Innovation Diffusion Theory (IDT) by Rogers (2003) explains how, why, and at what rate new ideas and technology spread through cultures. The Self-Determination Theory (SDT) by Deci and Ryan (1985) highlights the role of intrinsic motivation in technology adoption.

Other significant theories include the Task-Technology Fit Theory (TTF) by Goodhue and Thompson (1995), which examines the fit between technology and the tasks it supports, and the Use and Gratification Theory (U&G) by Katz, Blumler, and Gurevitch (1974), which explores how individuals use media to fulfill specific needs. The Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975) and the Information System Success Model (ISS) by DeLone and McLean (1992) also provide foundational insights into user behavior and technology success.

The Social Cognitive Theory by Bandura (1986), Motivational Theory by Herzberg (1966), Theory of Consumption and Altruistic Values by Schwartz (1992), DeLone and

McLean's Model (D&M) updated in 2003, and Expectation Confirmation Theory by Oliver (1980) are also frequently referenced in the literature to explain various dimensions of M-Learning adoption and use.

RQ2: What Are The Commonly Used Contexts in The M-Learning Literature?

The context analysis revealed a diverse range of geographical and demographic settings in which M-Learning research is conducted. A significant portion of the studies have been carried out in developing countries, accounting for approximately 70.8% of the reviewed literature (Alrasheedi, Capretz, & Raza, 2015). Countries like Malaysia, Jordan, Taiwan, and China have made substantial contributions to the body of research on M-Learning. In contrast, developed countries accounted for 29.1% of the studies, indicating a relatively lower but still significant engagement with M-Learning research in these regions.

The user groups primarily studied include students, faculty, and higher education management staff. These groups have been the focal point of research due to their direct involvement in the educational process and the implementation of M-Learning technologies. Studies have explored various settings, such as classroom environments, distance education, and blended learning scenarios, to understand the impact and effectiveness of M-Learning across different educational contexts (Crompton, 2013; Keegan, 2002).

RQ3: What Characteristic Factors Affect The Usage of M-Learning in Higher Education?

The review identified numerous factors that influence the adoption and usage of M-Learning in higher education. These factors can be categorized into several broad themes:

- **Personal Factors:** These include demographic variables such as gender, age, marital status, family size, occupation, education level, language background, income level, nationality, ethnicity, race, religion, and geography (Ajzen, 1991; Venkatesh et al., 2003). Personal characteristics significantly affect individual preferences and attitudes toward M-Learning.

- **Intention and Attitude:** Factors like behavioral intention, continuous intention, intention to adopt, perceived behavioral control, and overall attitude towards technology play a crucial role in determining the acceptance and use of M-Learning platforms (Davis, 1989; Venkatesh & Davis, 2000). Positive attitudes and strong intentions are predictive of higher adoption rates.

- **Usage and Utility:** Actual use, frequency of use, and perceived usefulness are critical in assessing the effectiveness of M-Learning tools (Fishbein & Ajzen, 1975; DeLone & McLean, 1992). Satisfaction, learning expectancy, and the perceived academic relevance of M-Learning also contribute to its continued use (Deci & Ryan, 1985; Herzberg, 1966).

- **Ease of Use and Learnability:** Perceptions of effort expectancy, performance expectations, ease of use, comfortability, convenience, and self-control are essential for user adoption (Goodhue & Thompson, 1995). The facilitating conditions, such as organizational support and task-technology fit, enhance learnability and encourage sustained use (Bandura, 1986; Schwartz, 1992).

- **Social and Technological Factors:** Social influences, peer pressure, and sense of community, along with technological factors like system functionality, user interface, interactivity, service quality, security, privacy, and compatibility, significantly affect the adoption and implementation of M-Learning (Rogers, 2003; Katz, Blumler, & Gurevitch, 1974).

- **Pedagogical Factors:** Content quality, feedback from teachers, interactivity, instructor readiness, and timely guidance are pivotal in shaping the pedagogical effectiveness of M-Learning (Crompton, 2013; Merchant et al., 2012).

- **Anxiety and Enjoyment:** Mobile anxiety, resistance to change, hedonic motivation, perceived enjoyment, and gratification are also influential in determining user engagement with M-Learning technologies (Deterding et al., 2011; Crompton, 2013).

- **Accessibility and Knowledge:** Device access, connectivity, internet speed, phone competence, digital readiness, and technical skills influence the feasibility and effectiveness of M-Learning (Alrasheedi, Capretz, & Raza, 2015).

- **Experience and Trust:** Previous experiences with technology and the level of trust in the technology's reliability and privacy measures play crucial roles (Venkatesh et al., 2003; Davis, 1989).

- **Price and Habit:** Cost considerations and habitual use patterns further influence the adoption and sustained use of M-Learning platforms (Goodhue & Thompson, 1995; Katz, Blumler, & Gurevitch, 1974).

RQ4: What Are The Commonly Used Research Methodologies in The M-Learning Literature?

The analysis revealed a predominance of quantitative research methodologies in M-Learning studies. Survey-based primary data collection is the most prevalent method, with researchers employing descriptive analysis, correlation, and regression methods to analyze data (Lee, 2010; Liu et al., 2010; Wang et al., 2009). These quantitative approaches are favored for their ability to provide measurable and statistically significant results.

Qualitative research methodologies, such as participant observation, interviews, and focus group discussions, are also employed to gain in-depth insights into user experiences and contextual factors (Creswell, 2013; Denzin & Lincoln, 2011; Merriam, 2009). These methods allow researchers to explore the nuanced aspects of M-Learning adoption and use that quantitative methods might overlook.

Mixed-methods research, which combines both quantitative and qualitative approaches, is increasingly used to provide a comprehensive understanding of M-Learning phenomena. This approach allows for the triangulation of data, enhancing the reliability and validity of the research findings (Creswell & Plano Clark, 2011; Tashakkori & Teddlie, 2010).

Overall, the review highlights that while quantitative methods dominate the field, qualitative and mixed-methods approaches are essential for providing a holistic view of M-Learning adoption and use.

Summary of Findings

1. **Theoretical Foundations:** Major theories such as TAM, TPB, UTAUT, and Constructivist Theory are widely applied to understand M-Learning adoption and use.

2. **Contextual Analysis:** M-Learning research is predominantly conducted in developing countries, with significant studies focusing on students, faculty, and higher education management.

3. **Characteristic Factors:** Numerous factors, categorized into personal, social, technological, pedagogical, and other dimensions, influence the adoption and use of M-Learning.

4. **Research Methodologies:** Quantitative research designs are the most prevalent, with surveys being the primary data collection tool. Qualitative and mixed-methods approaches also contribute valuable insights.

5. These findings provide a comprehensive overview of the current state of M-Learning research in higher education and identify key areas for future exploration. The systematic review underscores the multifaceted nature of M-Learning and the need for continued research to fully understand its potential and challenges.

Discussion and Result

The findings from this systematic literature review offer a comprehensive overview of the current state of mobile learning (M-Learning) in higher education from 2016 to 2023. The integration of M-Learning into higher education has been significantly influenced by various theoretical frameworks, contextual factors, characteristic factors, and research methodologies.

Theoretical Foundations: The frequent use of models such as the Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), and the Unified Theory of Acceptance and Use of Technology (UTAUT) underscores the importance of understanding user acceptance and behavior in the adoption of M-Learning. These models provide valuable insights into the psychological and behavioral aspects that influence technology adoption (Davis, 1989; Ajzen, 1991; Venkatesh et al., 2003; Troussas, Krouska, & Sgouropoulou, 2020; Alenezi, 2023; Okoye et al., 2023; Boud, & Bearman, 2024; Juera, 2024; Zamiri, & Esmaeili, 2024). For instance, TAM emphasizes perceived ease of use and perceived usefulness as key determinants of technology acceptance (Venkatesh & Davis, 2000). Similarly, TPB highlights the role of attitudes, subjective norms, and perceived behavioral control in shaping intentions and behaviors towards technology use (Ajzen, 1991). UTAUT integrates elements from these and other models to offer a comprehensive framework for understanding user intentions and subsequent usage behavior (Venkatesh et al., 2003; Jie, & Sunze, 2023; Quvvatov, 2024).

Constructivist theories, as discussed by Piaget (1964) and Vygotsky (1978), emphasize the importance of learners constructing their own understanding and knowledge through experiences and interactions. The Innovation Diffusion Theory (IDT) by Rogers (2003) explains how, why, and at what rate new ideas and technology spread through cultures. The Self-Determination Theory (SDT) by Deci and Ryan (1985) highlights the role of intrinsic motivation in technology adoption (Naciri, Baba, Achbani, & Kharbach, 2020; Shen, & Ho, 2020).

Other significant theories include the Task-Technology Fit Theory (TTF) by Goodhue and Thompson (1995), which examines the fit between technology and the tasks it supports, and the Use and Gratification Theory (U&G) by Katz, Blumler, and Gurevitch (1974), which explores how individuals use media to fulfill specific needs. The Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975) and the Information System Success Model (ISS) by DeLone and McLean (1992) also provide foundational insights into user behavior and technology success (Al-Emran, Arpaci, & Salloum, 2020; Bernacki, Greene, & Crompton, 2020).

The Social Cognitive Theory by Bandura (1986), Motivational Theory by Herzberg (1966), Theory of Consumption and Altruistic Values by Schwartz (1992), DeLone and McLean's Model (D&M) updated in 2003, and Expectation Confirmation Theory by Oliver (1980) are also frequently referenced in the literature to explain various dimensions of M-Learning adoption and use (Bernacki, Greene, & Crompton, 2020; Coman, Țîru, Meseșan-Schmitz, Stanciu, & Bularca, 2020).

Contextual Analysis: The context analysis revealed a diverse range of geographical and demographic settings in which M-Learning research is conducted. A significant portion of the studies have been carried out in developing countries, accounting for approximately 70.8% of the reviewed literature (Alrasheedi, Capretz, & Raza, 2015; Mahyoob, 2020). Countries like Malaysia, Jordan, Taiwan, and China have made substantial contributions to the body of research on M-Learning. In contrast, developed countries accounted for 29.1% of the studies, indicating a relatively lower but still significant engagement with M-Learning research in these regions (Elfirdoussi et al., 2020).

The user groups primarily studied include students, faculty, and higher education management staff. These groups have been the focal point of research due to their direct involvement in the educational process and the implementation of M-Learning technologies. Studies have explored various settings, such as classroom environments, distance education, and blended learning scenarios, to understand the impact and effectiveness of M-Learning across different educational contexts (Coman, Țîru, Meseșan-Schmitz, Stanciu, & Bularca, 2020; Crompton, 2013; Keegan, 2002; Scherer, Howard, Tondeur, & Siddiq, 2021).

Characteristic Factors: The adoption and usage of M-Learning are influenced by a complex interplay of personal, social, technological, and pedagogical factors. Personal factors such as age, gender, and educational background significantly affect attitudes towards M-Learning (Ajzen, 1991; Venkatesh et al., 2003). Social influences, including peer pressure and

community support, also play a crucial role (Katz, Blumler, & Gurevitch, 1974). Technological factors such as ease of use, accessibility, and system quality are critical determinants of user satisfaction and continued usage (Davis, 1989; Goodhue & Thompson, 1995). Pedagogical factors, including content quality, feedback mechanisms, and instructional design, are essential for the effective implementation of M-Learning (Abbad, 2021; Crompton, 2013; Díaz, Saldaña, & Avila, 2020; Merchant et al., 2012).

These findings highlight the need for a multidimensional approach to M-Learning implementation that considers all these factors. Effective M-Learning strategies must address personal and demographic variables, leverage social support mechanisms, ensure technological robustness, and focus on high-quality pedagogical practices.

Research Methodologies: The predominance of quantitative research methodologies in M-Learning studies indicates a strong focus on measurable outcomes and statistical analysis. Survey-based primary data collection is the most prevalent method, with researchers employing descriptive analysis, correlation, and regression methods to analyze data (Lee, 2010; Liu et al., 2010; Wang et al., 2009). These quantitative approaches are favored for their ability to provide measurable and statistically significant results.

Qualitative research methodologies, such as participant observation, interviews, and focus group discussions, are also employed to gain in-depth insights into user experiences and contextual factors (Creswell, 2013; Denzin & Lincoln, 2011; Merriam, 2009; Guo, Saab, Post, & Admiraal, 2021). These methods allow researchers to explore the nuanced aspects of M-Learning adoption and use that quantitative methods might overlook. Mixed-methods research, which combines both quantitative and qualitative approaches, is increasingly used to provide a comprehensive understanding of M-Learning phenomena (Creswell & Plano Clark, 2011; Tashakkori & Teddlie, 2010; Hofer, Nistor, & Scheibenzuber, 2021).

1. The review highlights several key conclusions about the state of M-Learning in higher education:

2. **Adoption and Acceptance:** Theories such as TAM, TPB, and UTAUT are critical in understanding the adoption and acceptance of M-Learning. These models emphasize the importance of user attitudes, intentions, and perceived ease of use in determining technology adoption. However, there is a need for integrating newer theories that focus on motivation and engagement to better understand the long-term impact of M-Learning.

3. **Global Implementation:** M-Learning research is predominantly conducted in developing countries, indicating a recognition of mobile technology's potential to bridge educational gaps in these regions. However, more research is needed from developed countries to provide a comprehensive global perspective on M-Learning.

4. **Multifaceted Influences:** The adoption and effectiveness of M-Learning are influenced by a combination of personal, social, technological, and pedagogical factors. Effective M-Learning implementation requires addressing all these dimensions to create a supportive and engaging learning environment.

5. **Research Approaches:** Quantitative research designs dominate M-Learning studies, providing valuable data on adoption rates and effectiveness. However, qualitative and mixed-methods research are crucial for understanding the contextual and experiential aspects of M-Learning.

Recommendations

Based on the findings of this review, several recommendations can be made to enhance the implementation and research of M-Learning in higher education:

1. **Expand Theoretical Frameworks:** Future research should explore and integrate newer theoretical frameworks that focus on motivation, engagement, and self-regulation to provide deeper insights into the long-term impact of M-Learning. The inclusion of theories such as Self-Determination Theory (SDT) by Deci and Ryan (1985) and Social Cognitive Theory by Bandura (1986) can offer a more comprehensive understanding of the factors that drive sustained use of M-Learning technologies.

2. **Balance Geographical Representation:** There is a need for more research from developed countries to balance the geographical representation in M-Learning studies. This will help in understanding the global impact of M-Learning and identifying region-specific challenges and opportunities. Research should also consider cross-cultural studies to compare the effectiveness and adoption of M-Learning in different cultural contexts.

3. **Adopt a Multidimensional Approach:** Implementing M-Learning requires a comprehensive approach that addresses personal, social, technological, and pedagogical factors. Institutions should consider these dimensions to create an

effective and supportive M-Learning environment. For example, addressing technological barriers such as device accessibility and internet connectivity is crucial for ensuring that all students can benefit from M-Learning (Goodhue & Thompson, 1995).

4. **Enhance Research Methodologies:** Future studies should adopt mixed-methods research to combine quantitative data with qualitative insights. This approach will provide a more holistic understanding of M-Learning phenomena. Longitudinal studies that track changes in M-Learning adoption and effectiveness over time can also provide valuable insights into the long-term benefits and challenges of M-Learning.

5. **Focus on Pedagogical Design:** Effective instructional design is crucial for the success of M-Learning. Educators should focus on developing high-quality content, providing timely feedback, and designing interactive learning experiences that engage students. Incorporating gamification techniques and leveraging AR and VR technologies can enhance the learning experience and increase student motivation and participation (Deterding et al., 2011; Merchant et al., 2012).

6. **Address Technological Challenges:** Ensuring ease of use, accessibility, and system quality is essential for user satisfaction and continued usage of M-Learning platforms. Institutions should invest in reliable and user-friendly technology to support M-Learning. This includes providing technical support and training for both students and faculty to ensure they can effectively use M-Learning tools (Davis, 1989; Venkatesh & Davis, 2000).

7. **Promote Social Support:** Social influences play a significant role in the adoption of M-Learning. Creating a supportive community of learners and encouraging peer interactions can enhance the learning experience and promote the adoption of M-Learning. Institutions should facilitate collaborative learning opportunities and create platforms where students can share their experiences and support each other (Katz, Blumler, & Gurevitch, 1974).

8. **Evaluate Long-Term Impact:** Future research should focus on evaluating the long-term impact of M-Learning on student outcomes, including academic performance, engagement, and retention. Understanding how M-Learning affects these outcomes over time can provide valuable insights for improving its implementation and effectiveness.

In conclusion, M-Learning holds significant potential to transform higher education by providing flexible, accessible, and engaging learning experiences. By addressing the identified gaps and following the recommendations, educators, policymakers, and researchers can enhance the effectiveness of M-Learning and contribute to the advancement of education in the digital age. The integration of comprehensive theoretical frameworks, balanced geographical representation, multidimensional approaches, robust research methodologies, effective pedagogical design, and strong social support systems will be crucial for the successful implementation and sustained impact of M-Learning in higher education.

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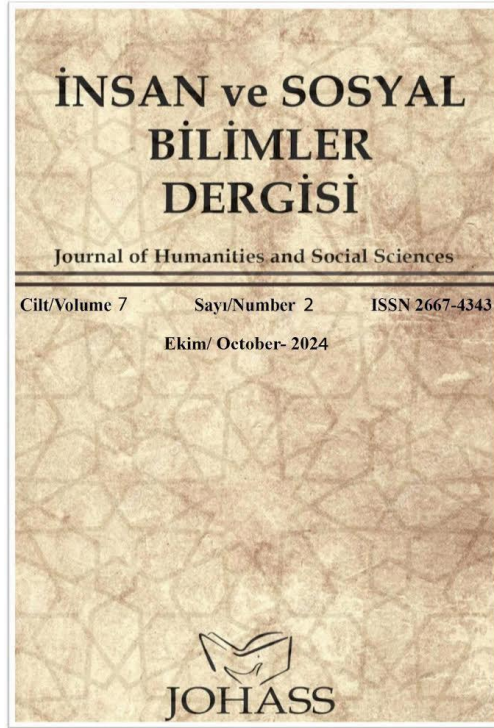
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Social Studies Teachers' Opinions on the Use of Augmented Reality in the Education of Gifted Students[*]

This article is derived from the master's thesis titled "Social Studies Teachers' Opinions on the Use of Augmented Reality in the Education of Gifted Students".

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Social Studies Teachers' Opinions on the Use of Augmented Reality in the Education of Gifted Students

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Abstract	Research Article
The aim of this study is to reveal social studies teachers' opinions on the use of Augmented Reality in the education of gifted students. As part of the research, a qualitative study was conducted with teachers experienced in the education of gifted and talented students working in BİLSEM and various schools in Istanbul regarding the use of Augmented Reality. Due to the qualitative nature of the study, semi-structured interviews were conducted with 20 Social Studies teachers. The research was conducted within the scope of Social Studies and gifted and talented education during the 2023-2024 academic year. A descriptive content analysis was used to thoroughly examine the data. According to the findings from the interviews, the teachers are knowledgeable about augmented reality. Additionally, the results indicate that the use of augmented reality in the education of gifted and talented students strengthens skills such as permanent learning, capturing attention, increasing motivation, rapid learning, critical and creative thinking, developing perspective, and problem-solving.	

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Introduction

Gifted students exhibit cognitive development distinct from their peers with their quick comprehension, analytical thinking, creativity and strong memory. It is accepted that gifted children have significant physical, mental, social, personality, moral, learning, sensitivity and professional differences from children with normal intelligence (Güçin & Oruç, 2015, 117).

"Gifted children's extreme interest in their environment requires a strong power of observation and reasoning. These children quickly establish connections between seemingly unrelated events and generalize from the clues given" (Özbay, 2019, 35). The social studies course supports students to develop skills in history, culture, geography and social structure. "Social studies, which centers on concepts such as good and responsible citizenship, human and society, adopts an interdisciplinary approach due to its structure" (Kaymakçı & Ata, 2012, 37). Social studies develop critical thinking, analysis and source analysis skills. Gifted students have the potential for success in social studies with these competencies. "It has been stated that the education of gifted children in accordance with their potential will provide a high level of development and benefit to society. However, this will only be possible if gifted children receive education appropriate to their abilities" (Tulum, 2022, 11). "Standard educational environments are not sufficient for gifted children because they have a limiting effect on their potential. In other words, children with these characteristics need to be supported with different educational programs that develop their potential" (Levent, 2011, 26). In this way, these individuals can contribute both to themselves and to society. Tosunoğlu (2021, 54) states that education services for gifted students are generally organized through acceleration, classification and enrichment methods. In addition, the main function of education is to activate the talents of the individual and ensure that these talents are used in appropriate fields (Bozgeyikli & Doğan & Işıklar, 2010, 134).

Gümüşhan and Yel (2023, 145) are of the opinion that educational activities can be more interactive and interesting by integrating technological tools and equipment into the educational environments. In this context, interactive technologies such as augmented reality increase students' positive view and effective participation in the lesson. Augmented reality is a system that integrates digital content into the real world. İçten and Bal (2017, 402), emphasize that augmented reality creates an interactive environment between the digital environment and the real world. "We can define Augmented Reality applications as animated QR codes. It is the reflection of the shape or any object displayed on smartphones as an augmented reality to the

user on the screen by translating it into information, content, surveys or visuals such as photographs and pictures" (Çakal & Eymirli, 2012, 4). Akgün & Üstün (2023, 365) think that teaching with augmented reality technology provides students with authentic learning opportunities. In addition, in order for all these elements to be realized effectively, brains that are suitable for this field are needed. In this context, gifted students and advanced minds in this field are included in the process.

"Augmented reality system supports "situational learning, authentic learning and constructivist learning" approaches in students' lesson activities" (Gümüş & Boydaş, 2021, 325). "However, thanks to the fact that augmented reality technologies allow textbooks, boards in classroom environments and static objects in learning environments to be converted into multimedia possibilities, the functional richness of the environment increases and enables different cognitive channels to work in learning" (Önder, 2016, 1). The efficiency of cognitive channels enables brain processes to function faster and more effectively. Since gifted students have the ability to receive and process more than one information at the same time, their learning processes take place faster than other individuals. In order to develop these abilities, augmented reality environments are offered to these students. These environments are transferred to students by teachers within the framework of specific content, thus aiming to further accelerate the cognitive functioning of gifted students. It is this ability that distinguishes gifted students from other individuals.

Augmented reality is widely used for students today. Experiential learning has always been an important method and learning involving many senses is more effective and permanent. In this respect, augmented reality technology stands out as a developing tool in education (Tosunoğlu, 2021, 58). This study aims to reveal social studies teachers' opinions about the use of augmented reality (AR) technology in the education of gifted students. In addition, the study aims to understand the effects of AR technology on the learning processes of these students and to provide information on how this technology can be used more effectively in education. Since gifted students have different cognitive abilities and learning speeds compared to other students, they require more than standard educational programs. Innovative teaching methods are needed to engage and motivate these students in social studies courses. AR technology is considered as a tool that can maximize the potential of these students by enriching and deepening their learning processes. In this context, knowledge components and orientations reveal the student's overall knowledge network and enable teachers to guide students' learning more efficiently.

The main questions to be addressed in the current study are as follows: What is the level of teachers' relationship with augmented reality technology? How do teachers use and present augmented reality? What is the level of social studies teachers' knowledge about augmented reality? What is the state of application of augmented reality in the field of social studies? To what extent can social studies teachers help gifted students through augmented reality?

In today's world, the role of technology in education is constantly increasing. Especially interactive and innovative technologies such as AR can make significant contributions to the educational life of gifted students. The importance of this study is that it focuses on analyzing the effects of AR technology on gifted students and providing insights on how the technology can be used more effectively in education. At the same time, the study aims to evaluate the effects of AR on the education of gifted students and to provide guidance to educators on how to use this technology in the most efficient way. Finally, this study will examine the role of AR in education in depth, thus aiming to provide valuable contributions to the literature in this field and to support the development of innovative teaching strategies.

Method

Model

In order to examine the opinions of social studies teachers on the use of augmented reality in the education of gifted students, qualitative research method and semi-structured interview form were preferred in the data collection process.

Sample and Population

The population of the study consists of social studies teachers working in Istanbul. The sample consists of 20 randomly selected social studies teachers working with gifted and talented students in secondary schools and BİLSEMs (Science and Art Center) in various districts of Istanbul during the 2023-2024 academic year. These teachers have different levels of experience and age groups and use various educational methods. The distribution of years of professional experience of the social studies teachers who contributed to the study is as follows: 1 teacher with 1-5 years of experience, 14 teachers with 6-15 years of experience, 3 teachers with 16-20 years of experience, and 2 teachers with 21 years or more of experience.

Data Collection Tools

In this study, a semi-structured interview form developed by the researcher was used to collect qualitative data. During the form development phase, research based on the literature was conducted. The form, which consisted of 10 questions in total, was updated in line with the feedback of experts. All questions were grouped under the title of "Interview Questions for Thesis Research on Social Studies Teachers' Use of Augmented Reality in the Education of Gifted Students".

Collection of Data and Analysis

The teachers participating in the study were informed about the purpose, rationale and scope of the study before the form was applied. A semi-structured interview form was prepared to understand the teachers' perspectives and views on the subject more comprehensively. The information obtained during the interviews was analyzed in detail and in depth using descriptive content analysis and then quantified.

Ethical Committee Approval

This study was prepared as a master's thesis on " Social Studies Teachers' Opinions on the Use of Augmented Reality in the Education of Gifted Students " at Bahcesehir University, Institute of Education Sciences, with the ethics committee decision numbered E-85646034-604.01-85866

Findings

In this part of the study, the information collected from the teachers was analyzed and presented in accordance with the order in the interview form. Some of the participants' opinions are also included.

Social Studies Teachers' Opinions on the Use of Augmented Reality in the Education of Gifted Students

Participants expressed more than one and different opinions in response to this question, What are the opinions on the use of augmented reality applications for educational purposes?" Among the issues that the participants mainly emphasized are facilitating understanding and learning, concretizing concepts, and creating positive and efficient course content. In addition,

it was stated that augmented reality applications can be effective in areas such as activating students who are far away from the lesson, gaining experience and developing empathy skills.

When the answers to the question "Do you have information about augmented reality (AR) applications? Can you share your thoughts on this field with us?" are analyzed, it is seen that 60% of the participants used the expression "I have information about augmented reality applications". On the other hand, 30% said "I have little knowledge about Augmented Reality Applications" and 10% said "I have no knowledge about Augmented Reality Applications". These results reveal that the majority of the participants have a certain level of knowledge about AR technology, but some of them have limited or no knowledge about it. Some of the responses of the teachers through the interview form are as follows:

F10   *"It is a type of experience that enriches the existing reality. This technology is formed by combining the physical elements we perceive around us with computer-generated video, audio and data. It is a reality in which the real and virtual worlds are not completely separated from each other, but on the contrary, become more intertwined."*

M4   *"Although I have come across a few studies on this field before, I have not personally participated in the studies and conducted a study. It is inevitable that the recently developing technology has spread to every field from social life to education."*

In response to the question "What are your thoughts on how augmented reality applications can be used in education?", participants expressed multiple and different opinions. Among the issues that the participants mainly emphasized are facilitating understanding and learning, concretizing concepts, and creating positive and efficient course content. In addition, it was stated that augmented reality applications can be effective in areas such as engaging disengaged students, enhancing experiential learning and developing empathy skills. Some of the responses of the teachers through the interview form are as follows:

F7   *"As augmented reality technology becomes widespread, it will take an active place in educational technologies. In augmented reality applications, students will have the opportunity to develop different skills when they take part as active participants in the augmented reality application design phase according to their levels, and to develop their experience and empathy skills when they experience augmented reality applications."*

M7   *"I think that by integrating it into the education system, students' social relations will decrease. However, the process of learning academic knowledge will develop faster."*

How augmented reality applications can affect the motivation of gifted students", all participants (100%) shared the view that this technology will positively affect the motivation

of students. When the teachers' responses to this question were analyzed, the impact of developing science and technology on students was emphasized. The fact that students are intertwined with technology and can quickly adapt to such innovations has led them to express the opinion that the use of augmented reality (AR) technology, especially in the education of gifted students, will increase their motivation. Some of the responses of the teachers through the interview form are as follows:

F1 *"I believe that augmented reality applications can increase the motivation of gifted students because I observe that these students largely like to interact with technology and try innovative ways of learning."*

M6 *They will be positively affected. Since gifted students have the ability to understand and comprehend quickly, they can quickly become distracted and bored. By supporting education with augmented reality, students are actively engaged and attention is drawn by presenting different content. This is a factor that increases their motivation.*

How can we use augmented reality technology in social studies courses to support the creativity and critical thinking skills of gifted students? When the answers of the participants to the question are evaluated, it can be said that thanks to augmented reality technology, gifted and talented students develop their creative and critical thinking because they have the chance to propose solutions to social problems, design projects, create new course content and evaluate events from different perspectives. Some of the responses of the teachers through the interview form are as follows:

F4 "It can be integrated into appropriate units and subjects to develop design and creativity skills such as creating new ideas, problem solving and project development."

F7 *"Students who encounter problematic scenarios planned through augmented reality can have the opportunity to develop and criticize more original solution projects against the society and the environment by using the intelligence area they are in regarding the subjects included in the current and active learning area of social studies such as population problem, migration problem, energy use and ecological problems, and have the opportunity to keep themselves in the subject in the most active way."*

How can we support gifted students to develop their fast-learning potential in social studies course with augmented reality technology? The following main findings regarding the effects of augmented reality (AR) technology on gifted students stand out: AR technology increases students' active participation through learning by doing and experiencing; it also allows them to learn at their individual pace by providing an independent learning environment

and increases the role of students through self-designed content. In addition, it is stated that it enables students to learn the subjects or fine points that they have difficulty in conceptualizing in a practical and fast way. Some of the responses of the teachers through the interview form are as follows:

F1   *AR technology can help gifted students develop their potential for fast learning in social studies. Thanks to this technology, we can create the opportunity to learn more independently at their own pace. We can also create challenging and developmental environments suitable for their learning abilities.*

M4   *Since gifted students have a mind that is open to many stimuli at the same time, they can react better to the stimuli around them with augmented reality technology and produce different opinions and thoughts in these areas. Children will be able to participate more actively and more efficiently as they will be out of their own tempo. This will also increase the efficiency of education for children.*

When you think about the use of augmented reality in the education of gifted students in the social studies course, which subjects do you think you can teach more effectively? Participants indicated that AR technology could be used more effectively in the areas of geography, history, culture, and science and technology. They also stated that AR could be useful in the areas of economic activities and society. These views indicate that AR technology can offer a wide range of applications on different themes and topics in the social studies course. Some of the responses of the teachers through the interview form are as follows:

F8   *"Many subjects in the Social Studies course can be adapted to augmented reality. I especially think that subjects such as climate, economic activities, civilizations can be taught more effectively and permanently. It can be used in intercultural interaction subjects, historical subjects, geography subjects.*

What are the advantages of augmented reality applications for gifted students?", it was determined that the advantages of using this technology are mostly in the direction of active learning, motivation, creative thinking, fast learning and entertainment. At the same time, teachers stated that augmented reality offers advantages such as versatile learning, critical thinking, problem solving, in-depth understanding, efficient learning, learning by doing-living, increasing imagination, using technology, school adaptation, classroom management, concretization, simulation, permanent learning, curiosity and visual learning.

Some of the responses of the teachers through the interview form are as follows:

F9   *"Topics can be made engaging, in-depth understanding can be ensured, the learning experience can be personalized according to the student's own pace and preferences, and an interactive learning experience can be offered."*

M4   *"In general, these children learn quickly in the classroom but also become bored quickly leading to disengagement. Technological developments that include a lot of stimuli such as augmented reality will allow children to participate more efficiently in the lesson and get higher efficiency from the lesson. Producing original content will enable them to produce realistic approaches to events that are difficult and difficult to encounter in life."*

In response to the question "What do you think about the potential risks and limitations that gifted students may experience when using augmented reality?", participants expressed multiple and different opinions. The participants mainly emphasized addiction, distraction and technical problems. In addition, opinions such as not being able to distinguish reality from virtual, distancing from group work, going beyond the acquisition, classroom noise, distraction, not following the rules, cost, and not being able to socialize attracted attention.

Some of the responses of the teachers through the interview form are as follows:

F11   *"They can get bored the rest of the time because they will learn fast. They usually get bored quickly from the subjects they learn fast, they can get distracted."*

M1   *"The dangers of overuse, overachievement and cyberspace."*

What kind of resources or trainings are needed for teachers to use this technology effectively? When the answers to the question were evaluated, most of the participants emphasized the need for in-service trainings on augmented reality technology and stated that the need for resources related to this technology is important. Some of the responses of the teachers through the interview form are as follows:

F1   *"Teachers will definitely need technical trainings to use this technology effectively. I think they may also need pedagogical guidance on the use of AR technologies. They will also need resources to access AR content."*

F3   *"In-service trainings can be provided. However, these trainings should be composed not only of theoretical content but also of content that allows for practice."*

When the answers to the question "Is there any point you would like to add about the use of augmented reality applications in education?" were analyzed, it was seen that 60% of the participants answered this question. When the opinions were evaluated, it was stated that teachers want to use augmented reality actively in the classroom, and that sharing examples of

activities implemented through encouraging activities will contribute to the effective use of this technology. Some of the responses of the teachers through the interview form are as follows:

F5   *"I think that using augmented reality in education can align with 21ˢᵗ-century standards and provide an opportunity to develop a different educational method. However, I believe that making this approach popular should not be solely focused on teachers' own professional development. I think it would be beneficial for the Ministry of National Education to easily integrate augmented reality applications into the curriculum and facilitate access to students."*

M6 *"Since education will take place interactively, studies supported by the Ministry of National Education should be carried out for its active use. In our technologically advanced age, augmented reality should be used effectively in lessons."*

Discussion and Result

When the answers given by the teachers through the interview form were evaluated, it was seen that the same opinions were expressed that AR technology would provide permanent learning for gifted students, increase motivation, strengthen fast learning, provide remarkable and enjoyable course content, facilitate comprehension, and encourage learning by doing and experiencing different experiences.

When the process is analyzed, in the light of the data obtained, according to the results obtained within the scope of this study, teachers have knowledge about AR, but very few of them have attended a seminar or received a training in this field. The use of augmented reality, which is considered as a reflection of developing technology, is considered as an element that increases the motivation of gifted students by supporting their multifaceted development.

According to the participant teachers, AR technology can be used in every unit of the Social Studies course. In addition, it was seen that AR technology can be utilized in different subjects such as history, geography, economy, citizenship awareness, science and social structure. It was determined that augmented reality contributed to the rapid learning of gifted students, and it was concluded that it could create the opportunity for gifted students to learn more independently at their own pace, as well as create challenging and developmental environments suitable for their learning abilities.

Francesca Baccassino and Stefania Pinnelli (2023), while emphasizing the need for the development of classroom-wide, prosocial models of education to support gifted students, also

point to the importance of developing holistic approaches to meet students' basic needs such as social recognition and emotional support. A comprehensive model of technology can play an active role in meeting such needs. Özden Çınar (2022), in her study with gifted students, stated that augmented reality has positive effects on the learning process such as providing permanent learning, eliminating the monotony of the lesson and providing easier understanding. Despina Dimitriadou, Neslisah Emin, Parthena- Marina Kiremitsidou and Stavroula Mpouzelou (2024) emphasized that education for gifted students includes programs and support systems to meet their specific learning needs and that the effective integration of technologies offers significant opportunities for digital age readiness by promoting personalized learning. Del Siegle (2018) stated that virtual and augmented reality technologies expand the learning opportunities of gifted students and offer them safe learning experiences, and that the use of these technologies, which are still in the developmental stage, is rapidly increasing for educational purposes and offers more opportunities. In this study, it was revealed that not only the students but also the Social Studies teachers who teach gifted students shared this view. Dr. Purificacion Toledo-Morales and Dr. Jose Manuel Sanchez-Garcıa (2018) emphasized that augmented reality (AR) applications significantly improved students' academic performance and motivation to learn, but technical infrastructure, special materials and software support for teachers should be provided for augmented reality technology to become an effective tool in education. Değirmenci and İnel (2022), suggest that in order to increase the use and impact of augmented reality (AR) technology in education, in-service trainings should be provided and AR teaching should be added as a course. Dan Roy and Iulian Radu (2021) emphasize the importance of teachers and designers keeping pace with rapidly evolving immersive learning technologies. They suggest that teachers should take a leading role in their organizations or seek collaboration in this process, while content designers have the opportunity to create innovative learning content that will gain traction. The current findings reveal that teachers do not receive sufficient training on this subject; however, when asked for their suggestions, they demanded training on AR. Özgürbüz (2023), examined the views of pre-service Social Studies teachers and found that mobile augmented reality technology supported geography subjects both visually and aurally and provided a realistic and interactive learning environment, which positively affected their motivation. According to the current findings of the study, participant teachers also share that it would be appropriate to use AR technology in geography.

According to the participant teachers, the use of AR technology in the education of gifted students has advantages as well as limitations and risks. While the active use of this

technology in the lesson is considered to be an advantage in that it encourages permanent learning, plays a role in the concretization of the subject, is attention-grabbing, supports the level of comprehension and perception, makes the learning process fun, strengthens creative and critical thinking skills, provides in-depth learning, and offers a rich and versatile experience, it is also concluded that there are risks such as technical problems, addiction risk, and distraction. However, when the opinions were analyzed, it was concluded that the majority of the teachers agreed that using AR technology has more advantages than risks.

Recommendation

- In order to fully exploit the potential of augmented technology, teachers should be given the opportunity to receive training in this area, with an emphasis on the integration of AR technology into education. During this training, attention should be paid to understanding and planning the pedagogical component of AR technology for gifted students.
- Sample applications can be made on the effective and qualified use of augmented reality technology in the education of gifted students and encouraging studies can be directed.
- Studies and guidelines supported by the Ministry of National Education on the use of AR technology in the education of gifted students can be created to guide educators during implementation.

Ethical Committee Approval

This study was prepared as a master's thesis on " Social Studies Teachers' Opinions on the Use of Augmented Reality in the Education of Gifted Students " at Bahcesehir University, Institute of Education Sciences, with the ethics committee decision numbered E-85646034-604.01-85866

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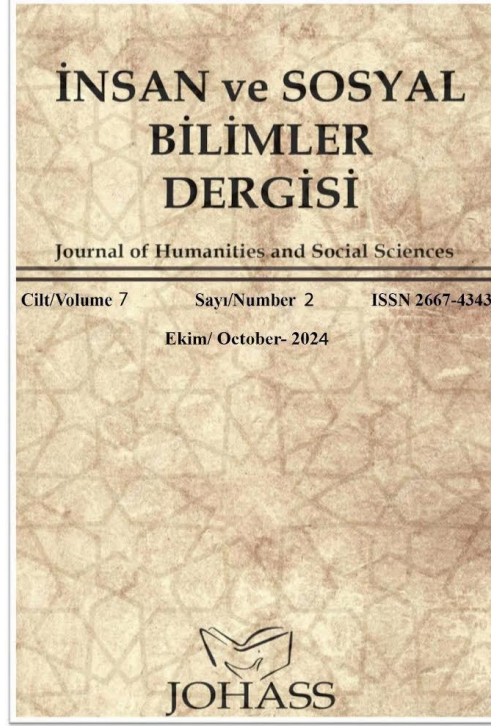
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The Effectiveness of Feedback Provided by Middle School Mathematics Teachers and Preservice teachers on Student Solutions: An Evaluative Study

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The Effectiveness of Feedback Provided by Middle School Mathematics Teachers and Preservice teachers on Student Solutions: An Evaluative Study

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Abstract	Research Article
The aim of this study is to reveal the suggestions of middle school mathematics teachers and preservice mathematics teachers that can both correct errors in students' incorrect solutions and contribute to the advancement of students who have provided correct solutions. The study is based on the case study method. Initially, six problems related to proportional reasoning were posed to middle school students in a public school, and the solutions obtained from the students were classified according to their proportional reasoning strategies. These solutions were then examined by the students' mathematics teachers and by preservice mathematics teachers. Two questions were asked to mathematics teachers and preservice mathematics teachers during these examinations. After the examination, interviews were conducted to discuss the suggestions made to (1) correct the errors in incorrect solutions and (2) advance the proportional reasoning skills of students who obtained correct solutions. The findings indicate that both mathematics teachers and preservice mathematics teachers were adequate in providing suggestions to correct errors in students' incorrect solutions. However, it was also found that both groups had difficulties in making suggestions to further the advancement of students who provided correct solutions.	

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Introduction

In contemporary education, the primary aim of mathematics instruction is to develop individuals who can generate knowledge, think critically, and make informed decisions in various situations (Ministry of National Education [MoNE], 2018). Achieving this goal requires effective mathematics instruction. For mathematics education to be effective, teachers must have a deep understanding of their students' prior knowledge, common misconceptions, learning challenges, and cognitive processes in mathematics (Shulman, 1986; Marks, 1990; MEB, 2018). Therefore, mathematics teachers need to develop and refine the skill of noticing. (Kaiser et al., 2016).

The skill of noticing encompasses the ability to "pay attention to significant interactions or events in a teaching environment and interpret these interactions and events using existing knowledge" (Sherin et al., 2011, p. 5). Van Es and Sherin (2002) added that in addition to noticing and interpreting interactions or events, teachers should also adapt their teaching methods to improve instruction based on what they notice and interpret. This is because simply noticing and interpreting students' learning is not enough to address the difficulties and misconceptions they may have (van Es, 2011, p. 138; Miller, 2011). Therefore, it is vital for teachers to decide how to provide feedback to students regarding their learning errors and misconceptions (Jacobs et al., 2010). Consequently, the skill of noticing allows teachers to offer suggestions to address students' learning errors and misconceptions and to plan their lessons accordingly (van Es, 2011, p. 138; Miller, 2011, p. 51; Choy, 2014; Taylan, 2018; Şermetoğlu & Baki, 2019; Birinci and Baki, 2019).

Jacobs et al. (2010) identified three essential components for effective noticing in mathematics education: attending to children's strategies, interpreting children's mathematical understanding, and deciding how to respond on the basis of children's understandings

1. Attending to Students' Mathematical Strategies: By attending to students' solutions, mathematics teachers can assess the level of their students' mathematical knowledge (Jacobs et al., 2007). This allows teachers to identify what is correct and what is incorrect in the solution strategies used by their students.

2. Interpreting Students' Mathematical Understanding: Through interpreting their students' mathematical understanding, teachers can assess the correctness and incorrectness of the students' solutions and draw conclusions about their learning in mathematics (Sherin et al., 2011, p. 81). This enables teachers to

form ideas about their students' misconceptions and incomplete learning in mathematics.

3. Deciding How to Respond on the basis of Children's Understanding: After evaluating and interpreting their students' learning in mathematics, teachers decide on how to provide feedback. This allows them to develop instructional methods that address students' learning difficulties and misconceptions in mathematics (Jacobs et al., 2010; Miller, 2011, p. 55). Therefore, it is crucial that mathematics teachers have a strong background in both mathematical and pedagogical content knowledge. (Dick, 2013; Tunç-Pekkan and Kılıç, 2015). Moreover, many mathematics teachers assume that once students provide correct solutions, their mathematical learning is complete and do not offer further suggestions for improvement (Özel, 2019). However, providing suggestions to correct errors in incorrect solutions alone is not sufficient for effective noticing; mathematics teachers must also offer suggestions that contribute to the advancement of students who provide correct solutions (Jacobs et al., 2010).

This study examines the decision-making skills of mathematics teachers and pre-service teachers on how to provide feedback on the solution strategies used by students in problems related to proportional reasoning. Proportional reasoning forms the foundation for algebraic topics related to ratio and proportion, as well as for advanced mathematical topics (Lesh et al., 1988). Proportional reasoning involves identifying proportional situations, representing these situations, distinguishing proportional situations from non-proportional ones, and solving problems related to proportional situations (Cramer et al., 1993). Mathematical topics related to ratio and proportion include slope, fractions, percentages, congruence and similarity, probability, histograms, trigonometry, etc. (Van De Walle et al., 2013, p. 348; Dougherty et al., 2016). Thus, proportional reasoning plays a crucial role in mathematical achievement (Ünsal, 2009). However, it is observed that many adults struggle to acquire this skill (Lamon, 2006, p. 3). Among those struggling with proportional reasoning are also mathematics teachers and preservice teachers (Çıkla and Duatepe, 2002; De la Cruz, 2008; Benson, 2009; Bahar, 2016; Kasemsukpipat, 2016; Johnson, 2017; Arıcan, 2018; Boyacı, 2019; Brown, Weiland and Orrill, 2019).

In the literature, it is known that different types of problems are used to develop proportional reasoning skills (Cramer et al., 1993; Lamon, 1993). Cramer and Post (1993) identified three types of problems: problems involving numerical comparisons (quantitative

comparison), problems that require reasoning without numerical values (qualitative comparison), and problems where three out of four quantities are given and the fourth is to be found (finding the unknown value). Lamon (1993) classified proportional situations into four types of problems based on their content: unite rate, part-part whole, related sets, and scaling problems. Unit rate problems involve creating a ratio between two quantities and deriving a new unit or concept from that ratio. Part-part-whole problems involve creating ratios either between two or more quantities within a whole or between the quantities and the whole. Related sets problems are those where the relationship between two quantities is not explicitly stated in the problem and there is no common relationship independent of the problem. Finally, scaling problems involve two quantities that are in a continuous relationship and increase or decrease by a certain ratio. These problems involve the use of multiplicative relationships (Lesh, Post, & Behr, 1988). Dooren et al. (2010) noted that after learning the concept of ratio, students tend to apply multiplicative reasoning even in non-proportional situations. Consequently, additive relationship problems are also used to help students distinguish between situations that require additive reasoning and those that require multiplicative reasoning (Langrall and Swafford, 2000). All these problems can be solved using different strategies. As proportional reasoning develops, students can use both correct strategies and multiple strategies to solve problems, whereas students with underdeveloped proportional reasoning skills may use incorrect strategies. For this reason, the feedback that mathematics teachers give to their students regarding their students' solutions is important (Jacobs et al., 2010; Şen ve Güler, 2017). The purpose of this study is to examine the decision-making skills of mathematics teachers and mathematics preservice teachers regarding how to provide feedback on students' solutions to problems related to proportional reasoning. This study aims to answer the following questions:

1. What suggestions do middle school mathematics teachers and preservice mathematics teachers offer to address the errors in students' incorrect solutions?

2. What suggestions do middle school mathematics teachers and preservice mathematics teachers provide to support the further development of students who offer correct solutions?

Method

Model

This study is part of a larger research project described by Jacobs et al. (2010), which encompasses all aspects of the skill of noticing, focusing specifically on the dimension of "deciding how to respond on the basis of children's understanding.' Participants were asked to provide suggestions both for correcting errors in students' incorrect solutions and for supporting the further development of students who provided correct solutions. The study employed a case study model, which is a research method that involves an in-depth examination of one or more cases, environments, social groups, etc. (McMillan, 2000; as cited in Büyüköztürk et al., 2018, p. 23). Since students from both one school and one university were selected, the research was conducted as a case study.

Participants

In this study, to obtain the suggestions of teachers and preservice teachers, data were first collected from the students taught by the participating teachers. For this, 5th, 6th, 7th, and 8th-grade students in a public school in Istanbul were asked to solve six problems related to proportional reasoning. These problems were designed to cover all proportional reasoning problems identified in the literature. The solutions obtained were analyzed based on proportional reasoning strategies, and incorrect strategies were identified. Examples of each strategy were selected and prepared for review by the teachers and preservice teachers.

Five middle school mathematics teachers participated in this study, coded as T1, T2, ..., and these codes were used when presenting the findings. The characteristics of these teachers are shown in Table 1. below.

Table 1

Characteristics of the Middle School Mathematics Teachers Participating in the Study

Teacher	Years of Experience	Classes Taught
T1	2 years	8th grade
T2	6 years	6th grade
T3	16 years	5th grade
T4	2 years	7th and 8th grades
T5	2 years	6th and 7th grades

The other participants in this study were nine senior preservice mathematics teachers from a public university. These preservice teachers had completed courses such as Approaches to Teaching and learning mathematics and special methods of teaching mathematics. They were selected based on their grade points average (GPA) rankings, with three students from the top, three from the middle, and three from the lower ranks. The preservice teachers are coded as P1, P2, ..., and these codes were used when presenting the findings. The GPA rankings of the preservice teachers are as follows: P1, P3, and P5 are in the top ranks; P2, P6, and P7 are in the middle ranks; and P4, P8, and P9 are in the lower ranks.

Data Collection Tool

In this study, a semi-structured interview technique was used. Semi-structured interviews allow for both the asking of pre-prepared questions and, if necessary, the asking of additional questions to obtain more detailed information about the research topic (Büyüköztürk et al., 2018).

During the interviews, participants were asked for their suggestions on how to address the errors in students' incorrect solutions through the question: "What would you do for students who solved the problem incorrectly? What kind of interventions would you make?" Additionally, the participants' suggestions for advancing the abilities of students who provided correct solutions were collected through the question: "What would you do for students who solved the problem correctly to help them advance? For example, how would you modify the problem?"

Data Collection and Analysis

Participants were asked to provide suggestions both for correcting errors in students' incorrect solutions and for supporting the further development of students who provided correct solutions. The data collected from the participants were analyzed using content analysis. Content analysis is a systematic and replicable method of data analysis in which specific rules are applied to code, categorize, and summarize certain words or themes within the text (Büyüköztürk et al., 2018, p. 259).

In analyzing the suggestions made by participants to correct errors in students' incorrect solutions, codes were first created based on the suggestions, and similar suggestions were grouped under a single code. These suggestions were then categorized as effective, low effective, or ineffective. Similarly, in analyzing the suggestions made by participants to

support the further development of students who provided correct solutions, codes were created based on the suggestions, and similar suggestions were grouped under a single code. These suggestions were also categorized as effective, low effective, or ineffective.

The criteria used to categorize the suggestions are provided in Table 2 below.

Table 2

Criteria for Suggestions

	Criteria for Effective Suggestions	**Criteria for Low-effective Suggestions**	**Criteria for Ineffective Suggestions**
Suggestions for the elimination of errors	Suggestions that will make the student realise the multiplicative or additive relationship in the question and make proportional reasoning	Suggestions to make you realise that you are only doing the question right or wrong More rote-based recommendations Retelling the same question without suggesting anything new, presenting visuals to help them understand the question, etc.	Suggestions that the student will have difficulty in understanding (equation, inverse proportion, etc.).
Suggestions for further improvement	Making changes that will take the problem one step further (adding new variables, having the student determine the variables, etc.), having the problem set up, trying to solve the problem with different strategies	Suggestions given to those who make mistakes	Suggestions for understanding the problem

Validity and Reliability

In qualitative research, the concepts of dependability and transferability are used in place of reliability, while credibility and confirmability replace the concept of validity (Creswell, 2013; Lincoln and Guba, 1985; Merriam, 2009; Patton, 2002). In this study, expert opinions were sought to ensure dependability. Initially, an expert was consulted during the coding of the participants' statements to determine which codes the statements corresponded to (for example, a teacher's statement being coded as "providing examples from daily life"). Subsequently, meetings were held with three experts to categorize the codes appropriately. Initially, two categories were established: effective and ineffective. During the meeting, it was decided that some codes fell between these two categories, leading to the creation of a category for low-effective suggestions. To ensure transferability, the research process was

detailed comprehensively. For credibility and confirmability, in-depth data analysis was conducted, and each code was illustrated with an excerpt in the findings section.

Ethical Committee Approval

The ethics committee permission for the article was obtained by the Yıldız Technical University Publication Ethics Committee with the decision numbered 2021/01 dated 21.03.2021.

Findings

In this part, the suggestions of mathematics teachers and prospective mathematics teachers for the correction of errors for incorrect student solutions and the suggestions for the progress of students who made correct solutions are given. These suggestions were analyzed one by one for each problem and presented in tables. These suggestions were grouped as effective suggestions, low effective suggestions, and ineffective suggestions.

In Table 3.1. below, the suggestions of the teachers and pre-service teachers for eliminating the errors for the incorrect solutions of the students in problem 1 and the suggestions for the further improvement of the students who made correct solutions are given. In addition to these suggestions, the participants who had these suggestions were also included.

Table 3

Suggestions Offered by Participants for Problem 1

		Effective Suggestions	Low Effective Suggestions	Ineffective Suggestions	No Suggestion
Problem 1: Additive Problem	Suggestions for the elimination of errors	Giving Examples from Daily Life (T1- T2- T3- T4- P1-P2-P6-P9) Making Realize The Additive-Multiplicative Relationship (T5- P7 P8) Visualization (P5)		Teaching formulating equations (T4-P3-P4-P6)	
	Suggestions for further improvement	Adding a New Variable-Asking Different Questions Regarding the Problem (T2-P4-P6)		Giving Examples from Daily Life (T1) Changing variables in the problem (T4-T3-T5-P1-P2-P3-P5-P6-P8-	P7

P9)

When examining Table 3, it is observed that for Problem 1, suggestions such as providing examples from daily life, highlighting additive-multiplicative relationships, using visualization, and teaching the strategy of equation formulation were made to address student errors. For example, T1, who suggested providing examples from daily life, explained as follows:

"In general, what the student is failing to analyze is the age difference. 'If there is a 3-year difference between you and me, it will still be a 3-year difference 10 years later.' Because the student cannot reason this out, I would provide a simple example. For instance, 'What is the age difference between you and your sibling? 5 years. What will it be in 20 years? It will still be 5 years.' If I can explain that the difference does not change, I can help the student solve this problem better."

T5, who suggested highlighting additive-multiplicative relationships, stated:

"In the first instance, we can explain to the student that the concept of multiples is related to multiplication, while the increase in age is related to addition."

P5, who suggested using visualization, explained:

"I could create a timeline with units, maybe on paper. Then, on the timeline, I would arrange each age with a difference and advance Ayşe's age by 18 years, and similarly, create a timeline for the father, advancing his age in the same way, so they can observe the difference."

T4, who suggested teaching the formulating equation, stated:

"I would explain that this problem can be solved with an equation. I would say Ayşe is x, and her father is 3x. Or if the class level is 6 or 5, I would use 'apple' and say 'three apples.'"

To advance the skills of students who provided correct solutions, suggestions such as introducing a new variable, asking different questions related to the problem, providing examples from daily life, and changing the variables in the problem were made.

T2, who suggested introducing a new variable and asking different questions related to the problem, explained:

"I would introduce 3 people instead. I would change the question and ask, 'How old will the father be?' I would make it a bit more challenging, for example, by asking how the sum of their ages changes. Then I would diversity the problem. As I said, I could add three people: the father, Ayşe, Ali, etc., and develop the questions further."

T1, who suggested providing examples from daily life, explained:

"I could ask the problem in a similar way. It could be more personal, like instead of Ayşe and her father, I could use you as an example. For instance, I could say 'you and your sibling,' to make it more concrete. By using examples from their own life, family members, I can create a more permanent understanding, by using examples from their own life."

As seen, T1's suggestion is focused on helping the student better understand and concretize the problem. However, since the student has already understood the problem and provided the correct solution, T1's suggestion was categorized as ineffective. P3, who suggested changing the variables in the problem, explained:

"Instead of just saying Ayşe's age is twice her father's current age minus 15, we could introduce other variables, like 2x-15, or add, subtract, halve, or quarter the amounts. We could add such things that require the four basic operations."

Based on P3's statements, it is seen that the problem is shifted from measuring proportional reasoning ability to equation solving. This suggestion was also categorized as ineffective.

Table 4 below presents the suggestions provided by participants for Problem 2.

Table 4

Suggestions Provided by Participants for Problem 2

		Effective Suggestions	Low Effective Suggestions	Ineffective Suggestions	No Suggestion
Problem 2: Missing Value and Part-Part-Whole Problem	Suggestions for the elimination of errors	Simplifying The Problem (T1-P1-P2-P7-P9) Making Realize The Additive-Multiplicative Relationship (P8) Using Unit Rates (T5-P3-P6) Concretization (P5)	Making the Problem Read Again- Retelling the Topic (T3- P8)	Making Distinguish Direct Proportion and Inverse Proportion (T2- P4)	T4
	Suggestions for further improvement	Changing variables in the problem (P3) Adding A New Variable (P4-P5) Directing to A Different Strategy (P8-P1)		Changing the numbers in the problem (T1-T4-T5-T2-P2-P6-P9) Asking Similar Problems (T3-P5)	P7

When examining Table 4, it is observed that suggestions such as simplifying the problem, using unit rate, providing examples from daily life, highlighting additive-multiplicative relationships, concrete representation, rereading the problem, reexplaining the topic, and distinguishing between direct and inverse proportion were made. T1, who suggested simplifying the problem, explained:

"I could show this in a more concrete way. How can I put it? I could use an example, or ask them to do something. For instance, as homework, 'You do this.' Or we could use an example with pizza. 'If I use this many ingredients for 1 pizza, how much would I need for 2 pizzas?' and so on to make it more concrete."

T5, who suggested using unit rate, explained:

"Before explaining proportion, I would first explain ratio, focusing on the value corresponding to one part, and then compare it with direct proportion. We would focus more on example solutions in this context. We compare and try to explain that these mean the same thing. This is one of the common problems we encounter in class. For instance, while teaching 6th graders last year, I explained that finding the value corresponding to one part and comparing it with the number of parts is logically the same as direct proportion. I would offer this as a solution."

P5, who suggested concretization, explained:

"Maybe we could make the problem more concrete so that the student can see the proportion. We could think of it as a drawing or prepare it from cardboard. For example, after mixing four onions with 8 cups of water, we could prepare eight solid plates, and the student can observe how much onion and water is allocated to each person."

P3's suggestion to change the variables in the problem explained:

"While preparing 20 meals, for example, how much oil is needed? How much should remain? During the meal, two, for instance, were dropped and ruined. So, how much is needed now? I think about playing with the

numbers here. Can the student identify the necessary relationships and carry out the operations? The ingredients could increase or decrease."

P8's suggestion to direct students to different strategies explained:

"Some students tried to calculate based on one person, finding the amount per person and then multiplying by the number of people. Instead, I would ask them to use proportion and solve it that way as well."

T1's suggestion to change the numbers in the problem explained:

"The student already understands this. I can change the numbers and give larger ones, increasing the complexity of the operations. Because they have already grasped the concept. I think we can change the problem's numbers and provide more numbers to develop their operational skills, as they have

As it can be seen, T1 made a suggestion that would enable the student to develop his/her calculation skills instead of developing his/her proportional reasoning.

The explanation of T3 who suggested asking similar problems is given below:

'If he/she does this, the child has already settled the subject. Then I continue with different examples related to this.'

In the statement of T3, again, there is no suggestion that will carry the student to an advanced stage.

Table 5 includes suggestions from teachers and prospective teachers regarding solutions to the third problem.

Tablo 5

Suggestions Provided by Participants for Problem 3

		Effective Suggestions	Low Effective Suggestions	Ineffective Suggestions	No suggestion
Problem 3: Quantitive Comparison and Well-Chunked Measures Problem	Suggestions for the elimination of errors	Simplifying The Problem (T3-P1-P9) Using Unit Rate (T4-T5-T1-T2- P2-P7-P9)	Concretization (P2-P5-P6) Explaining Division (T1-T2- P1-P4-P8)	Using Fraction Strategy (P2-P8)	P3
	Suggestions for further improvement	Adding A New Variable (T2-T5-P2) Directing to A Different Strategy (T3-P1-P9)		Changing The Numbers in The Problem (T1-T5-P6) Asking Similar Problems (T4-T5-P3-P4-P5-P7-P8)	

According to Table 5, the suggestions for this problem include simplifying the problem, using unit rate, concrete representation, explaining division, and using the equivalent fractions strategy. Below are the explanations of T3, who suggested simplifying the problem:

"We would just change the numbers, or maybe instead of a race, it could be something else like painting or reading books. These could be changed. But more simply, because when the numbers are more evenly divisible, without decimals, the child will understand better."

As seen in Appendix 1, in the third problem, it is difficult for the student to reason since the relationship between quantities is not an exact multiple. T3 noticed this and

suggested simplifying the problem so that the relationship is an exact multiple, and this suggestion was evaluated as effective.

Below are the explanations of T4, who suggested using unit rate:

"In these questions, I would first say that we need to find out how much one lap takes. Then, 'We can decide who is faster in this way,' I would say."

Below are the explanations of P2, who suggested concretization

"Maybe I could explain it with an animation because I don't think the student who gave the first answer understood it at all. With the help of a demonstration, I would perhaps bring two students to the board, create the scenario, and explain the question environment in that way."

As seen in P2's statements, the focus is more on helping the student understand the problem rather than promoting proportional thinking. While this suggestion might be effective for some students, it was considered likely ineffective for students who do not yet understand proportional reasoning.

Below are the explanations of P2, who suggested using the fractions strategy:

"I would have them think of it like equivalent fractions, either equalizing to 50 minutes or finding out how many laps they ran in 24 minutes."

P2's statements indicate that students who already have issues with proportional reasoning may not understand why they need to equalize to 50 minutes or 24 laps, so this suggestion was categorized as ineffective.

To help advance the skills of students who provided correct solutions, participants suggested introducing a new variable, directing them to different solution strategies, changing the numbers in the problem, and asking similar problems. Below are the explanations of T2, who suggested introducing a new variable:

"As I mentioned earlier, maybe I would increase the difficulty by adding a third person, like Tarık, Ozan, Ali, and then write something for Ali and ask, 'Who ran faster?' By increasing the number of people, I could raise the question to a higher level."

Below are the explanations of P9, who suggested directing students to different solution strategies:

"For example, in the second solution, the student reached the correct solution, but how did they use strategy? They added three laps and another three laps, which made one and a half. I would give numbers that would prevent this kind of thinking, so that they cannot reach a whole number or set up the ratio. I would make them set up a proportion calculation instead of guessing."

Finally, T4's explanation, who suggested asking similar problems, is as follows:

"I would solve different questions related to this topic."

Table 6 shows the suggestions made by the participants for solutions to the fourth problem.

Tablo 6

Suggestions Provided by Participants for Problem 4

Prof	Effective Suggestions	Low Effective	Ineffective	No suggestion

		Suggestions	Suggestions	
Suggestions for the elimination of errors	Concretization (T1- T3-T4-T5- P1-P2-P3-P4-P5-P6-P7) Giving Numeric Values (T2)	Making the Problem Read Again (P8) Giving Similar Examples (P9)	Explaining Inverse Proportion (T5)	
Suggestions for further improvement	Adding A New Variable (P3-P6)	Giving Numeric Values (T2-T5-P1-P2-P4-P9)	Asking Similar Problems (T1-T4-P5-P7-P8)	T3

According to Table 6 the participants suggested concrete representation, providing numerical values, rereading the problem, providing similar examples, and explaining inverse proportion. Below are the explanations of T1, who suggested concretization;

"I would go to the teachers' lounge, take two glasses of tea, and teach by doing. Which one is sweeter? I would put two sugars in the small glass and one in the large glass. It can be easily learned through this hands-on experience."

Below are the explanations of T2, who suggested providing numerical values:

"I would give an example from daily life or present it more numerically. For instance, 'Would the size of the glass be large?' I would guide them towards B in a more concrete way by establishing a ratio."

Below are the explanations of P8, who suggested rereading the problem:

"I would advise the student to read the question more carefully."

Below are the explanations of T5, who suggested explaining inverse proportion:

"For students who made mistakes, we could first explain the concept of inverse proportion here."

To help advance the skills of students who provided correct solutions, the participants suggested introducing a new variable, providing numerical values, and asking similar problems. Below are the explanations of P3, who suggested adding a new variable:

"I would add a new variable. In the second version of the tea, the bitterness came from the ratio of the tea's strength. If we brew tea with twice the strength, how many sugars would be needed to maintain the same sweetness ratio as before? I added a third variable like this."

Below are the explanations of T1, who suggested asking similar problems:

"I could diversify the question types. Similar question types, but I could give different examples. It might be a different object or a different example rather than tea."

As seen, while P3 suggested making the problem more difficult to help students move to a higher level, T1 suggested providing similar examples by changing the context of the problem.

Table 7 includes the suggestions made by the participants for solutions to the fifth problem.

Table 7

Suggestions Provided by Participants for Problem 5

Pr ob le	Effective Suggestions	Low Effective Suggestions	Ineffective Suggestions	Participants who did not make a

				suggestion
Suggestions for the elimination of errors	Using Unit Rate (T2-P8) Concretization (T5-T1-P7) Visualization (T3- T4-T1- P1-P3-P4-P5-P6-P7-P9) Simplifying The Problem (P1)	Explaining The Topic (P2-P3)	Using Fraction Strategy (P8)	
Suggestions for further improvement	Adding A New Variable (T1) Directing to A Different Strategy (T2-T3-T5-P1)		Asking Similar Problems (T4-T5-P3-P5-P6-P8-P9) Changing The Numbers in The Problem (P2)	P4-P7

According to Table 7, the participants suggested using unit rate, concretization, visualization, simplifying the problem, explaining the topic, and using the equivalent fractions strategy to address incorrect solutions. Below are the explanations of T2, who suggested using unit rate:

"I would guide them to unit rate. If 7 people ate 3 pizzas... I would direct them to 3/7 and 1/3 unit rates to find out which is more."

Below are the explanations of T5, who suggested concrete representation:

"For instance, we can select seven girls and three boys from the class and represent them as a whole pizza. Here, we could say there are three pizzas. To distribute them, what do we need to do? First, we need to explain division because some students performed subtraction here. The basic operation in proportion is multiplication. We need to explain that proportion can be done with multiples or multiplication. With the support of materials, we can explain this situation more easily."

Below are the explanations of T3, who suggested visualization:

"We could explain this, for example, by drawing a picture. We could equalize it. If this one eats this much, and that one eats this much, 'Who eats less? Who eats more?' I would try to explain it visually for those who couldn't do it. I think they would understand better that way."

Below are the explanations of P1, who suggested simplifying the problem:

"I could change the numbers. Because here, for instance, the 3/7 pizza ratio might be difficult for students. I would make them perform operations where the answers are whole numbers."

Below are the explanations of P3, who suggested explaining the topic:

"We have two components, right? One component will be all pizzas, and the other will be all people. I need to emphasize who is giving what to whom. They have errors in division, fundamentally. Some of them have incorrect division from elementary school. First, I would correct those basic deficiencies and then try to progress."

P3's statements indicate that while they identified the deficiencies in students' division skills, it is unlikely that this suggestion would completely resolve the problem they are experiencing. Below are the explanations of P8, who suggested using the equivalent fractions strategy:

"I would suggest finding the common multiples of 7 and 3, thinking of it as 21 people. Then, how many pizzas would 21 people get? How many pizzas would 21 people get? This is what I would suggest."

To help advance the skills of students who provided correct solutions, the participants suggested introducing a new variable, directing them to different solution strategies, asking

similar problems, and changing the numbers in the problem. Below are the explanations of T1, who suggested introducing a new variable:

"I could add a different factor. For example, not just pizza, but maybe pizza and a drink. I could say, 'There's this much drink. Who drinks how much?' and thus increase the complexity."

Below are the explanations of T2, who suggested directing students to different solution strategies:

"To help them advance, I would ask for different solution methods. Instead of changing the problem, I would say, 'How else would you do it? What other solution strategies would you use?' This way, I would have a different method."

Finally, below are the explanations of T4, who suggested asking similar problems:

"I would change the problem. Instead of pizza, I would use bread, or something else."

Below are the explanations of P2, who suggested changing the numbers in the problem:

"I could change the numbers. For example, I would say that 3 boys ordered 2 pizzas."

Table 8 includes the suggestions made by the participants for solutions to the sixth problem.

Table 8

Suggestions Provided by Participants for Problem 6

		Effective Suggestions	Low Effective Suggestions	Ineffective Suggestions	Participants who did not make a suggestion
Problem 6: Missing Value and Scaling Problem	Suggestions for the elimination of errors	Simplifying The Problem (T1-T3-P1) Using Geometry Related Software (T5- P2-P5-P7)	Explaining the Similarity (T2-T4-T3-P3-P4-P6-P7-P8-P9)		
	Suggestions for further improvement	Making Set Up The Problem (T2) Making Find Different Relationships in The Problem (T5- P3-P4-P7)		Changing the Shapes in the Problem (T4-P9) Multiplying the Shapes in the Problem (T1-P1-P2-P5-P6-P8)	T3

According to Table 8, the participants suggested simplifying the problem, using geometry software, and explaining similarity to address incorrect solutions. Below are the explanations of T1, who suggested simplifying the problem:

"*For this question, the student needs to see this. For example, we gave it as 12 by 18, but since it's not an exact multiple, it results in a fraction like 2/3. First, I think I should show it as an exact multiple. For instance, if this side is 2 cm, the other side should be 4 cm. It should be twice as long, so I would show that the long side is proportional to the long side and the short side is proportional to the short side. I would show that the ratio is fixed, for example, it could be 2 or 3 or 5 times as long... First, I would show that it's a fixed number, and then I would explain that it can also be given as a fraction, not just as an exact multiple. Then I would explain the solution.*"

Below are the explanations of T5, who suggested using geometry software:

"We can explain it visually. Generally, we could use dynamic software models for this. Using physical materials might be difficult because as 12 and 18 grow, they don't increase proportionally. We could use visual software support to show that as 12/18 grows, it increases at the same rate."

Below are the explanations of T2, who suggested explaining similarity:

"I would tell the student that there is a relationship because the short side is similar to the long side. 'What kind of relationship is there between the long sides?' The short sides must also have the same relationship because of the similarity. I could have them establish the same relationship. For example, if one side is 15 times longer, the other side must also be 15 times longer. Additionally, I could ask the student what might happen when the short side is proportionate to the long side to maintain the same proportion."

To help advance the skills of students who provided correct solutions, the participants suggested making students formulate problems, finding different relationships in the problem, changing the shapes in the problem, and increasing the number of shapes in the problem. Below are the explanations of T2, who suggested making students formulate problems:

"I could ask the student to create two similar rectangles. This way, I could make them both formulate a problem and solve the problem they created. I would say, 'Create a similar problem like this.'"

Below are the explanations of T5, who suggested finding different relationships in the problem:

"We could have them establish a proportion related to the areas. We could create awareness about how the areas change. For example, if they find the question mark using the relationship 'if it's 10 by 12, then what will it be at 18?' (T5 wrote it down). So, we created option A here. This option A made the student find the question mark. After finding the question mark, we could have the student calculate the areas and observe the change in the areas. After observing this change, for instance, we could help the student realize that while the ratio constant in similarity for lengths is a single factor, for areas, it becomes squared. This could help the student get ahead, especially in similar questions."

Below are the explanations of T4, who suggested changing the shapes in the problem:

"I would apply the same question to different quadrilaterals, pentagons, and polygons. I would give triangles, pentagons."

Finally, below are the explanations of T1, who suggested increasing the number of shapes in the problem:

"I could increase the number of shapes. Instead of two shapes, I could include three. This way, the student could build the logic before jumping into the calculation."

As seen, the suggestions of T1 and T3 are more aimed at helping students who couldn't solve the problem to better understand and reinforce the concept. Therefore, these suggestions were categorized as ineffective.

Discussion and Results

In this study, feedback given by teachers and preservice teachers based on 6 different problem solutions involving proportional reasoning were examined. In this section, the results obtained from the feedback for each problem were discussed.

In first problem, according to Table 3, the participants provided effective suggestions for addressing the errors in this problem, such as giving examples from daily life, highlighting additive-multiplicative relationships, and using visualization. By relating mathematics to daily

life, students can create connections between mathematics and their own lives (Stylianides and Stylianides, 2008). This, in turn, can increase students' motivation for the mathematics course and, consequently, enhance their success in mathematics (Singletary, 2012). Therefore, it can be said that providing examples from daily life can be effective in addressing students' errors. Participants who suggested highlighting additive-multiplicative relationships can be said to have made an effective suggestion because the inability to distinguish between additive and multiplicative relationships is likely to cause errors in this problem, and addressing this issue can help correct students' errors in this area (Langrall and Swafford, 2000). Teaching through concrete representation can also help students better understand the topic in mathematics and minimize their errors, making this suggestion effective as well (Temel et al., 2015). Additionally, some participants suggested teaching the strategy of equation formulation, but this suggestion is not effective for this problem. This is because none of the errors in this problem stem from a lack of understanding of equations. The effective suggestions made for advancing the students who provided correct solutions to Problem 1 include introducing a new variable and asking different questions related to the problem. Introducing a new variable contributes to students' mathematical progress by increasing the number of objects or people they need to consider. Asking additional questions involving different relationships can also contribute to students' mathematical progress by encouraging them to engage in different types of mathematical thinking. However, providing examples from daily life and changing the variables in the problem are not effective suggestions for advancing students' progress in mathematics. Providing examples from daily life is generally effective when used to address students' errors (Stylianides and Stylianides, 2008), so it is unlikely to contribute significantly to students' progress. Participants who suggested changing the variables in the problem believed that this would help develop students' arithmetic skills, but since the problem does not involve significant changes in numbers and operations, students may not progress in mathematics by performing similar operations. For this problem, most mathematics teachers and preservice mathematics teachers made effective suggestions for addressing students' errors. However, most mathematics teachers and preservice mathematics teachers did not make effective suggestions for advancing students who provided correct solutions.

According to Table 4, the effective suggestions made by participants to address students' errors in this problem include simplifying the problem, using unit rate, giving examples from daily life, highlighting additive-multiplicative relationships, and using concretization. Participants who suggested simplifying the problem aimed to adjust the

numbers in the problem so that they are exact multiples, thus guiding students toward proportional solutions. Indeed, they are likely to achieve their goal, as studies by Artut and Pelen (2015), Steinthorsdottir (2006), and Degrande et al. (2019) have found that middle school students are more likely to arrive at proportional solutions in problems where the numbers are set as exact multiples. Using unit rate is also effective in addressing students' errors, as unit rate is an effective method for teaching proportional situations (Cramer et al., 1989; Van de Walle et al., 2013, p. 458). Some participants aimed to address errors by having students reread the problem or re-explain the topic. These participants identified the cause of the errors as students not reading the problem carefully or not fully understanding the topic. Although this possibility is low, it still exists, so these suggestions were categorized as low-effective. However, they did not provide detailed information on how to re-explain the topic. Simply re-explaining the topic may not be sufficient for students to better understand it. Some participants suggested distinguishing between direct and inverse proportion, but none of the errors in this problem were caused by students' inability to distinguish between direct and inverse proportion. Therefore, this suggestion will not address students' errors in this problem. The effective suggestions made by participants to advance students who provided correct solutions in this problem include changing the variables in the problem, introducing a new variable, and directing students to different strategies. Participants who suggested changing the variables aimed to transform this proportional problem into a fixed relationship problem by adding a new variable, thus encouraging students to think about a different mathematical situation. Distinguishing between proportional and non-proportional situations can help students advance in proportional reasoning (Modestou and Gagatsis, 2010). Therefore, it can be said that this suggestion will be effective in advancing students' progress. In fixed relationship problems, as one variable in the problem increases or decreases, the other remains constant (Dooren et al., 2010). Participants who suggested introducing a new variable aimed to transform this proportional problem into a non-proportional one by adding a new variable, making it an effective suggestion for advancing students' progress in mathematics. Participants who suggested directing students to different strategies aimed to change the problem so that students who used the unit rate strategy would be directed toward the cross-multiplication strategy. This suggestion will also contribute to the advancement of students who provided correct solutions, as the cross-multiplication strategy is considered more advanced than the unit rate strategy (Langrall and Swafford, 2000). Most participants, however, made suggestions that were not effective in advancing students' progress in mathematics, such as changing the numbers in the problem and asking similar problems. The

numbers used in the problems in the study were not exact multiples of each other anyway, so, changing the numbers in the problem will not contribute to students' progress in mathematics. Asking similar problems will not change the mathematical structure of the problem, so students will not be encouraged to explore different mathematical relationships. Therefore, this suggestion will not contribute to students' progress in mathematics. For this problem, most mathematics teachers and preservice mathematics teachers made effective suggestions for addressing students' errors. However, most mathematics teachers and preservice mathematics teachers did not make effective suggestions for advancing students who provided correct solutions.

According to Table 5, the effective suggestions made by participants to address students' errors in this problem include simplifying the problem and using unit rate. The suggestions categorized as low effective include concretisation and explaining division. Explaining division was only suggested for students who made errors in division with remainders. Since participants indicated that division would be explained in a straightforward manner, this suggestion is likely to be ineffective in addressing students' errors in division. Although concrete representation has been mentioned in the first paragraph as an effective way to help students better understand mathematical concepts and minimize errors, the concrete representation suggested for this problem is less effective in addressing errors. This is because participants suggested simulating the problem, but the two individuals selected for the simulation may not maintain the same speeds as those in the problem, and even if they run at a constant speed, it is unlikely they will complete their laps within the specified time. Some participants suggested using the equivalent fractions strategy to address errors in this problem, but this suggestion is not effective in correcting students' errors. Although the numbers in the problem are not exact multiples of each other, the equivalent fractions strategy is one of the most advanced strategies in proportional reasoning, making it difficult for students who have made errors to understand the problem or the concept using this strategy (Noelting, 1980; Langrall and Swafford, 2000). The effective suggestions made by participants to advance students who provided correct solutions in this problem include introducing a new variable and directing students to different strategies. The ineffective suggestions include changing the numbers in the problem and asking similar problems. For this problem, most mathematics teachers and preservice mathematics teachers made effective suggestions for addressing students' errors. While most mathematics teachers made effective suggestions for advancing students who provided correct solutions, most preservice mathematics teachers did not.

According to Table 6, the effective suggestions made by participants to address errors in Problem 4 include concrete representation and providing numerical values. The suggestions categorized as low effective include rereading the problem and providing similar examples. Providing similar examples may not be effective in addressing errors in this problem, as students who do not understand the problem are likely to also not understand similar examples. Explaining inverse proportion was suggested by only one participant and is not effective in addressing errors in this problem, as none of the errors in this problem were caused by a lack of understanding of inverse proportion. The only effective suggestion made by participants to advance students who provided correct solutions in this problem was introducing a new variable. The suggestion categorized as low effective was providing numerical values, as this suggestion does not take the problem to a different level and may not contribute to students' progress. Asking similar problems will not contribute to the advancement of students who provided correct solutions, as it does not change the mathematical structure of the problem. In this problem, almost all mathematics teachers and preservice mathematics teachers made effective suggestions for addressing students' errors. However, except for two preservice mathematics teachers, the other participants did not make effective suggestions for advancing students who provided correct solutions.

According to Table 7, the effective suggestions made by participants to address students' errors in Problem 5 include using unit rate, concrete representation, visualization, and simplifying the problem. Like concrete representation, visualization, when used in teaching, helps students better understand a mathematical concept and minimize errors (Temel et al., 2015). The suggestion categorized as loe effective in addressing students' errors in this problem is explaining the topic. The suggestion to use the equivalent fractions strategy will not correct students' errors in this problem. The effective suggestions made by participants to advance students who provided correct solutions in this problem include introducing a new variable and directing students to different solution strategies. The ineffective suggestions include asking similar problems and changing the numbers in the problem. For this problem, most mathematics teachers and preservice mathematics teachers made effective suggestions for addressing students' errors. While almost all mathematics teachers made effective suggestions for advancing students who provided correct solutions, almost all preservice mathematics teachers did not.

According to Table 8, the effective suggestions made by participants to address students' errors in Problem 6 include simplifying the problem and using geometry software. Using geometry software is effective in addressing students' errors in this problem, as it

allows students to visualize similarity. The suggestion to explain similarity has a low impact on addressing students' errors in this problem. The effective suggestions made by participants to advance students who provided correct solutions in this problem include making students formulate problems and finding different relationships in the problem. Since problem formulation is a high-level skill, making students formulate problems can contribute to their mathematical progress. Participants who suggested finding different relationships in the problem aimed to have students discover the relationship between the similarity ratio of the sides and the ratio of the areas of the shapes, thus providing students who solved the problem correctly with new knowledge. Therefore, this suggestion is also effective in advancing the mathematical progress of students who provided correct solutions. The suggestions to change the shapes in the problem and to increase the number of shapes in the problem are ineffective in advancing students who provided correct solutions, as these actions would create a similar problem. Therefore, these suggestions will not contribute to the mathematical progress of students who provided correct solutions. Most mathematics teachers made effective suggestions for addressing students' errors in this problem. Nearly half of the preservice mathematics teachers made effective suggestions for addressing students' errors in this problem. However, most mathematics teachers and preservice mathematics teachers did not make effective suggestions for advancing students who provided correct solutions.

In general, it can be concluded that mathematics teachers are sufficiently capable of making suggestions to address students' errors in incorrect solutions. This finding is consistent with the results found by Jacobs et al. (2010). In their study, Jacobs et al. (2010) found that only mathematics teachers with more than four years of experience were able to make suggestions to address students' errors, while novice mathematics teachers, those with two years of experience, and preservice mathematics teachers struggled to make such suggestions. However, this result contradicts the findings of LaRochelle (2018) and Chick (2010). LaRochelle (2018) found that mathematics teachers struggled to make suggestions to address students' errors in their study on the noticing skills of mathematics teachers and preservice mathematics teachers. Chick (2010) found similar results in their study, concluding that mathematics teachers had difficulty making suggestions to address students' errors.

When it comes to preservice mathematics teachers, it can also be concluded that they are sufficiently capable of making suggestions to address students' errors in incorrect solutions. This result contradicts the findings of Bahar (2019), LaRochelle (2018), and Jacobs et al. (2010). In their study, Jacobs et al. (2010) found that preservice mathematics teachers, novice mathematics teachers, and those with two years of experience struggled to make

suggestions to address students' errors. Bahar (2019) also concluded that preservice mathematics teachers were insufficient in making suggestions to address students' errors in their study on the pedagogical content knowledge of preservice mathematics teachers regarding proportional reasoning. This result is consistent with the findings of Özel (2019), who found that preservice mathematics teachers were sufficiently capable of making suggestions to address students' errors in incorrect solutions in their study on the noticing skills of preservice mathematics teachers.

In general, it can be concluded that mathematics teachers and preservice mathematics teachers are insufficient in making suggestions to advance the mathematical progress of students who provided correct solutions. Taylan (2016) found that preservice mathematics teachers were insufficient in making suggestions to advance the mathematical progress of students who provided correct solutions. The reason for this result is that most of the suggestions they provided for students who provided correct solutions were in the form of exercises. This finding is consistent with the results found by Özel (2019), who concluded that most of the suggestions provided by preservice mathematics teachers for advancing the progress of students who provided correct solutions were in the form of exercises.

Recommendations

The recommendations related to this research are provided below:

Mathematics teachers struggle to make suggestions that contribute to the mathematical progress of students who provide correct solutions. In-service training can be provided to mathematics teachers on this topic.

Preservice mathematics teachers also struggle to make suggestions that contribute to the mathematical progress of students who provide correct solutions. A curriculum could be prepared on this topic within mathematics education courses such as Approaches to Teaching and Learning Mathematics and Special Methods of Teaching Mathematics for preservice mathematics teachers.

The suggestions made by preservice mathematics teachers who have not taken any mathematics education courses and those who have successfully completed most of the mathematics education courses can be examined to see how they address students' errors in incorrect solutions.

The suggestions made by preservice mathematics teachers who have not taken any mathematics education courses and those who have successfully completed most of the

mathematics education courses can be examined to see how they contribute to the mathematical progress of students who provide correct solutions.

A study could be conducted to observe how the teaching experience of mathematics teachers affects their ability to make suggestions that contribute to the mathematical progress of students who provide correct solutions.

A study could be conducted to observe how the general academic performance of preservice mathematics teachers affects their ability to make suggestions that contribute to the mathematical progress of students who provide correct solutions.

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The ethics committee permission for the article was obtained by the Yıldız Technical University Publication Ethics Committee with the decision numbered 2021/01 dated 21.03.2021.

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Appendix

Proportional Reasoning Problems

Class:

1-) Ayşe's father's current age is 3 times Ayşe's age. If Ayşe's current age is 18 years old, what is her father's current age? When Ayşe is 36, how old will her father be? Explain how you found it. (Adapted from Bethea(2003))

2-)

4 onions
8 glasses of water
2 tablespoons of oil
½ cup chopped celery

A soup recipe for 8 people is given in the table above. A housewife who wants to prepare this soup for 6 people with the same taste,
a-)How many onions does it need?
b-)How much water does it need?
c-)How much oil does it need?
d-)How much chopped celery does he need?
Explain how you found your answers. (Adapted from Hines and McMahon (2005)).

3-) Tarık and Ozan ran in the park, circling the perimeter of the park. Tarık ran 8 laps in 25 minutes and Ozan ran 3 laps in 10 minutes. Who ran faster? Explain how you found it. (Adapted from Heller et al. (1989))

4-) Tufan drank his breakfast tea in a larger glass than yesterday, with less sugar. The taste of this tea is compared to yesterday's tea;
a) it is with more sugar
b) it is with less sugar c) it is the same d) the information given is insufficient.
Write and explain which option is correct. (Taken from Duatepe and Akkuş (2006)).

5-) In a pizzeria, 7 girls are sitting at one of the tables and 3 boys are sitting at another table. The table where 7 girls are sitting has ordered 3 pizzas, and the table where 3 boys are sitting has ordered 1 pizza. Accordingly, which table has the highest amount of pizza per person? Explain how you found it. (Adapted from Lamon (1993))

6-)

10 cm

12 cm

? cm

18 cm
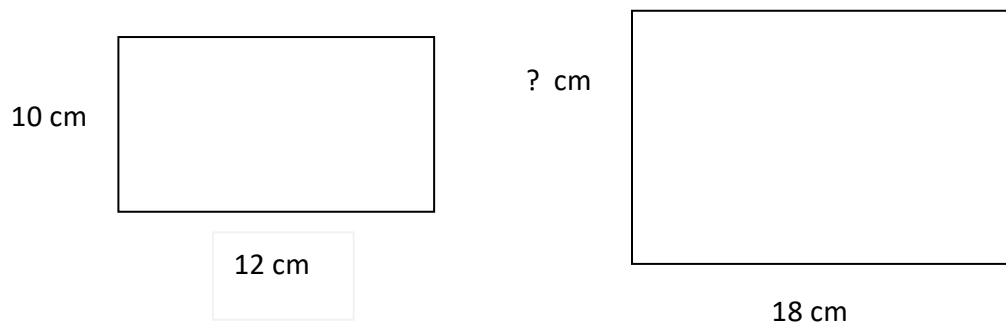
The two rectangles above are similar rectangles. Accordingly, what is the length of the short side of the larger rectangle, in cm? Explain how you found it (adapted from Bethea (2003)).