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CONTENTS		Pages
	Inside cover	I
	Generics Page	II
	Contents	VII
<b>Articles:</b>		
1.	Examining the Relationship Between Early Childhood Teacher Candidates' Empathic Tendencies and Social Problem-Solving Skills (Research Article)	1
2.	Exploring the Integration of Artful Thinking as an Innovative Approach to Foster Critical Thinking Skills (Research Article)	24
3.	From "Can AI think?" to "Can AI help thinking deeper?": Is use of Chat GPT in higher education a tool of transformation or fraud? (Research Article)	49
4.	Examining the Relationships Between Media Literacy, Technology Integration Skills, and STEM Applications Self-Efficacy Perception via A Structural Equation Model: A Study of Visual Arts Teacher Candidates (Research Article)	72
5.	Hey, GPT, Can We Have a Chat?: A Case Study on EFL Learners' AI Speaking Practice	91
6.	Probing into the impact of EFL teachers' instructional innovativeness on student engagement: A predictive moderated model	108

7.	Flipped Learning: An Innovative Model for Enhancing Education Through ChatGPT (Theoretical article)	124
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# Examining the Relationship Between Early Childhood Teacher Candidates' Empathic Tendencies and Social Problem-Solving Skills

Nur Banu YİĞİT<sup>1</sup> Özge PINARCIK SAKARYALI<sup>2</sup>

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## Abstract:

The purpose of this study was to examine the relationship between early childhood teacher candidates' empathic tendencies and social problem-solving skills. A total of 187 teacher candidates studying in the department of Early Childhood Education at Duzce University participated in this study. The relational research model, a quantitative research method, was used. The data of this study were collected through a personal information form, the Empathic Tendency Scale, and the Social Problem-Solving Inventory (SPÇE-SF). The researchers analyzed the data using Pearson Correlation and one-way ANOVA with the SPSS program. According to the findings of the study, the empathic tendency levels and social problem-solving skills of the early childhood teacher candidates participating in the research are at moderate levels. In addition, there was a moderate positive relationship between participants' empathic tendencies and social problem-solving skills. Finally, it is seen that the empathic tendencies of the participants do not differ according to personal data such as gender, educational level, mother's and father's educational level, family type, family attitude, number of siblings, and birth order. The participants' social problem-solving skills differed only by gender and number of siblings.

## Keywords:

Early childhood education, early childhood teacher candidates, empathic tendency, social problem-solving skills

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## INTRODUCTION

The fundamental human need for interpersonal connections and relationships is a pervasive aspect of an individual's social existence across various stages of life. Nevertheless, the process of communication with others throughout one's lifetime can be fraught with numerous challenges and complexities. Responses to these challenges can yield both positive and negative outcomes in an individual's communication endeavors. Bingham (2004) characterizes problem-solving as the process of surmounting challenges in achieving a particular objective, whereas social problem-solving pertains to the capacity to identify interpersonal conflicts and select effective and adaptive strategies to resolve these specific problematic situations (D'Zurilla & Nezu, 1990). It is important to note that there is no consistent and universally accepted definition of this concept in the literature, and various models have been proposed to delineate the constituent elements that underpin socially adept behavior (Crick & Dodge, 1994; Dodge, 1986). All of these models share a common thread, emphasizing that social problem-solving encompasses three core facets: (1) perceptual skills, involving the ability to discern salient information related to the interaction partner, such as their facial expressions conveying emotions; (2) cognitive components, which involve comprehending the perspective of the other party involved; and (3) performance-based processing steps (Tse & Bond, 2004). This process may involve the generation of potential alternative solutions to a given problem, the careful selection of the most appropriate alternative, ideally one that offers a practical resolution while also addressing social sensitivities (Channon & Crawford, 2010). Subsequently, it involves the execution of the chosen solution within the context of interpersonal interactions, and ultimately, the assessment of the undertaken action with regard to goal achievement and its implications for interpersonal relationships. This enumeration demonstrates that emotional and cognitive empathy components are fundamental prerequisites for the effective resolution of social problems. A review of the literature reveals a strong correlation between social problem-solving skills and empathy, as indicated by several studies (Lewis et al., 2001; Nacar & Tmkaya, 2011; Yılmaz, 2011). Davis (1983), a prominent figure in the field of empathy, has made significant contributions by conceptualizing empathy multifaceted. He defines empathy as an individual's response to another person's observed experiences. According to Davis (1983), empathy encompasses both affective and cognitive components. It involves the process of one person empathetically placing themselves in the shoes of another, comprehending and accurately sensing that person's emotions and thoughts, and then conveying this understanding to them (Dokmen, 2004). It involves the process by which a person empathically places himself/herself in the position of another person, understands and accurately senses that person's emotions and thoughts, and then communicates this understanding to that person (Dokmen, 2004). This definition underscores the vital role of empathy as an effective tool for resolving interpersonal issues that individuals encounter in their daily lives. Considering that communication and empathy are closely intertwined concepts, it becomes evident that the levels of social

problem-solving skills and empathy in individuals exert a substantial influence on their ability to communicate effectively.

In an educational setting, empathy also plays a crucial role in resolving social problems in the classroom, thus fostering constructive communication between educators and children (Köksal Akyol & Koçer Çiftçi, 2005). Understanding children from their perspective should be a primary awareness for an early childhood teacher. Only through this can they effectively guide the atmosphere in their classrooms with positive discipline, safety, and transparency (Mutlu et al., 2014). These empathic tendencies of early childhood teachers, which play a crucial role in children's cognitive, behavioral, and emotional development, are associated with effective practices and outcomes related to social problem solving (Meyers et al., 2019). For instance, studies have indicated that early childhood teachers who possess empathy toward a child's social context gain a more profound insight into the underlying causes of behavioral issues. This insight enables teachers to respond in a manner that is most conducive to helping the child acquire appropriate behaviors and adaptive strategies (Barr, 2011; Waajid et al., 2013). Buettner et al. (2016) investigated how empathy in teachers fosters a sense of belonging and emotional safety among students, which are crucial for effective learning environments. Waajid et al. (2013) also emphasized the role of empathy in mitigating the negative effects of stress and trauma on students' academic performances and well-being. Teachers who demonstrate empathy create a supportive environment where students feel understood and validated, thereby enhancing their resilience and ability to cope with challenges. Furthermore, studies by Cross and Hong (2010) have shown that empathetic teachers are better equipped to recognize and address the diverse social and emotional needs of students from varying backgrounds, ultimately promoting inclusivity and equity in education. In addition, McGrath and Van Bergen (2019) highlight how empathetic teaching practices contribute to the development of important socio-emotional skills in students, such as perspective-taking and conflict resolution. By modeling empathy, teachers not only support students' individual development but also cultivate a classroom culture characterized by kindness, respect, and cooperation. When early childhood teachers actively engage in empathy with children, they are better positioned to delve into the distinctive challenges or situations that individual children face. This approach enhances their effectiveness in meeting the specific needs of each child, ultimately fostering more positive teacher-children relationships (Buettner et al., 2016; Cross & Hong, 2010; McGrath & Van Bergen, 2019). These studies underscore the critical importance of empathy as a skill within the classroom, especially in the realms of solving social problems and nurturing positive relationships with children in the early childhood period. Moreover, it is an essential attribute for individuals aspiring to pursue careers in education (Köksal Akyol & Koçer Çiftçi, 2005). Considering these studies, it is crucial to examine the relationship between the empathy levels of early childhood teacher candidates who are deemed to possess the necessary qualifications to embark on their careers and their proficiency in social problem-solving.

When the Turkish literature on the field is examined, it is seen that there are many studies on empathy and problem-solving skills. For example, Pala (2008) conducted research to reveal the empathy levels of teacher candidates and determine whether empathy levels differ according to some variables, to determine the empathic skill levels of teacher candidates (Köksal Akyol & Koçer Çiftçi, 2005), to examine the problem-solving skill levels of teacher candidates according to various variables (Ocak & Eğmir, 2014), and to examine the social problem-solving skill levels of teacher candidates (Samancı & Uçan, 2015). Considering the existing literature, the intersection of empathic tendency and social problem-solving remains unexplored within the context of early childhood education teacher candidates. Consequently, the aim of this study was to examine the proficiency of early childhood education teacher candidates in both social problem-solving and empathic tendencies, aiming to discern and establish any potential connections between these two pivotal dimensions. In this regard, the following research questions were created and answers sought: questions were posed and answers sought:

Q1) What is the level of empathic tendencies of early childhood teacher candidates?

Q2) What is the level of social problem-solving skills of early childhood teacher candidates?

Q3) Is there a statistically significant relationship between the level of early childhood teacher candidates' empathic tendencies and social problem-solving skills?

Q4) Do the empathic tendencies of early childhood teacher candidates differ significantly according to personal data (age, gender, graduated school, educational status of the family, family type, dominant attitude in the family, number of siblings, etc.)?

Q5) Do the social problem-solving skills of pre-school teacher candidates differ significantly according to personal data (age, gender, graduated school, educational status of the family, family type, dominant attitude in the family, number of siblings, etc.)?

## METHOD

In this study, a relational (correlational) research model, one of the quantitative research methods, was used. According to Creswell (2005), the relational research model; It measures the degree of relationship between two or more variables and enables investigation of whether the variables are related to each other. In addition, in relational research, there is no cause-effect relationship between variables, and variables cannot be manipulated by researchers (Fraenkel & Wallen, 2006).

## Participants

The participants of this study are early childhood teacher candidates who are students at Duzce University, Basic Education Department, Early Childhood Education Program. A total of 187 teacher candidates participated in the study by answering the surveys shared online, and detailed information about the participants obtained through the personal information form is given in Table 1.

**Table 1**

*Personal Information about the Participants*

<b>Personal Information</b>	<b>Options</b>	<b>n</b>	<b>%</b>
<b>Age</b>	"18"	9	4.8
	"19"	25	13.4
	"20"	41	21.9
	"21"	34	18.2
	"22"	35	18.7
	"23"	18	9.6
	"24"	8	4.3
	"25 and over"	17	9.1
<b>Gender</b>	"Female"	149	79.7
	"Male"	38	20.3
<b>Graduated school</b>	"Science/Anatolian High School"	101	54.0
	"Foreign Language Intensive High School"	2	1.1
		45	24.1
	"Vocational High School"	7	3.7
	"General High School"	4	2.1
	"Associate Degree"	28	15.0
	"Other"		
<b>Educational status of the mother</b>	"Illiterate"	27	14.4
	"Literate"	14	7.5

	“Primary school graduate”	91	48.7
	“Secondary school graduate”	26	13.9
	“High school graduate”	19	10.2
	“Graduated from a university”	8	4.3
	“Other”	2	1.1
<b>Educational status of the father</b>	“Illiterate”	7	3.7
	“Literate”	7	3.7
	“Primary school graduate”	75	40.1
	“Secondary school graduate”	35	18.7
	“High school graduate”	38	20.3
	“Graduated from a university”	24	12.8
	“Other”	1	.5
<b>Family type</b>	“Extended Family”	41	21.9
	“Nuclear Family”	130	69.5
	“Broken Family”	16	8.6
<b>Family attitude</b>	“Democratic Family”	137	73.3
	“Authoritarian Family”	41	21.9
	“Liberal Family”	9	4.8
<b>Number of siblings</b>	“1”	6	3.2
	“2”	49	26.2
	“3”	55	29.4
	“4”	25	13.4
	“5 and over”	52	27.8
<b>Birth order</b>	“first”	70	37.4
	“median”	71	38.0
	“last”	46	24.6
<b>Total</b>		187	100%

### *Data Collection Tools*

Three data collection tools were used in this study. Data collection tools used were; "Personal Information Form", "Empathic Tendency Scale" (Dokmen, 1988), and "Social Problem Solving Inventory" (Heppner & Peterson, 1982).

The questions in the Personal Information Form were developed by the researchers by reviewing the literature, and the necessary arrangements were made by obtaining expert opinions from an expert working in the field of early childhood education at a state university. The personal information form includes questions about the participants' age, gender, graduated school, educational status of family, family type and attitudes, number of siblings, and birth order.

Dokmen (1988) developed the Empathic Tendency Scale in 1988 to measure an individual's empathy potential in daily life. It is a Likert-type scale and consists of 20 questions, and each question is given a score from 1 to 5. When collecting the scores, the 3rd, 6th, 7th, 8th, 11th, 12th, 13th, and 15th questions are summed in reverse. The lowest score to be obtained from the scale is 20, and the highest score is 100. The total score represents the participants' empathic tendency scores. A high score indicates a high empathic tendency, and a low score indicates a low empathic tendency. The reliability of the test was obtained by Dokmen (1988) by administering the scale to a group of 70 students using the test-retest method, three weeks apart. Because of the analysis, the reliability of the scale was found to be .82. The split-half reliability between the scores the participants received from the odd and even items of the scale was found to be .86. Dokmen also conducted a validity study of the test in 1988. The validity of similar scales obtained by applying the "Understanding Emotions" section of the Edwards Personal Preference Inventory and the Empathic Tendency Scale to a group of 24 participants was found to be .68.

The first adaptation study of the Social Problem Solving Inventory developed by Heppner and Peterson (1982) was conducted by Akkoyun and ztan (1988. cited in Taylan, 1990). The Problem Solving Inventory, which was later adapted into Turkish by Taylan (1990) and ahin et al. (1993), consists of 25 items and is a 5-point measurement tool. In the reliability studies of the scale,  $\alpha = .88$  and the split-half reliability coefficient was found to be  $r = .81$ . The lowest score to be obtained from the scale is 25 and the highest score is 125. Low scores indicate being effective in solving problems, whereas high scores indicate not being able to produce effective solutions to problems.

Examples of the questions in the Personal Information Form and the items in the Empathic Tendency Scale and Social Problem-Solving Inventory, which are the tools used to collect data, are presented in Table 2.

**Table 2***Sample Questions and Items in the Data Collection Tools*

<b>Data Collection Tools</b>	<b>Sample Questions and Items</b>
<b>Personal Information Form</b>	How old are you?  What is your family type?  What is the attitude of your family?
<b>Empathic Tendency Scale</b>	"I often feel lonely."  "Other people's problems concern me as much as my own."  "Telling my troubles to a relative relieves me."
<b>Social Problem-Solving Inventory</b>	"When I have an important problem to solve, I feel threatened and afraid."  "When deciding, I do not consider all options carefully enough."  "When I must make an important decision, I feel uneasy and unsure of myself."

*Data Collection Process and Analysis*

Before data collection, ethical approval for the study was obtained from the Ethics Committee of Duzce University. The scales used to collect data for the study were digitized and made available online. These digital scales were shared with the early childhood teacher candidates. The data collected from participants in the online environment were transferred to SPSS 26.0 statistical software for the necessary analyses.

Before analyzing the data collected from the participants, skewness and kurtosis values were checked to check the normality distribution of the data obtained through the scales. Because the skewness and kurtosis values were between +1.5 and -1.5, it was determined that the data were within a normal distribution (Tabachnick & Fidell, 2013). Because the data showed normal distribution, parametric tests were used in the analysis process.

Descriptive statistics were used to determine values such as mean, minimum score, maximum score, and standard deviation from the scores received by pre-school teacher candidates from the Empathic Tendency Scale and Social Problem Solving Inventory. "Pearson Product Moment Correlation Coefficient" was calculated to reveal whether there was a relationship between the participants' empathic tendencies and social problem-solving skills. Finally, "one-way ANOVA analysis" was used to determine whether the



participants' empathic tendencies and social problem-solving skills differed according to personal data such as age, family type, and family attitude.

### *Ethical considerations*

Ethical Review Board: Scientific Research and Publication Ethics Committee of Duzce University

Date of Ethics Review Decision: 25.02.2021

Ethics Assessment Document Issue Number: 2021/55

## RESULTS

Under this heading, the analysis results that provide answers to the research questions will be presented.

### *Empathic tendency levels of early childhood teacher candidates*

The findings regarding the first research question of the study are presented in Table 3.

**Table 3**

*Empathic Tendency Levels of the Participants*

Scale	N	Min.	Max.	X	SD	Level
<b>Empathic Tendency Scale</b>	187	52.00	81.00	65.69	6.324	Moderate

Table 3 shows that the average score obtained from early childhood teacher candidates from the Empathic Tendency Scale is 65.69. Considering the score range that can be obtained from the scale (20-100) and considering the lowest and highest scores received by the participants, the empathic tendency levels of the early childhood teacher candidates participating in the study are moderate.

### *Social problem-solving skills of early childhood teacher candidates*

The findings regarding the second research question of the study are presented in Table 4.

**Table 4***Social Problem-Solving Levels of Participants*

Scale	N	Min.	Max.	X	SD	Level
<b>Social Problem-Solving Inventory</b>	187	49.00	113.00	77.42	9.37	Moderate

Table 4 shows that the average score obtained from early childhood teacher candidates from the Social Problem Solving Scale is 77.42. Considering the score range that can be obtained from the scale (25-125) and considering the lowest and highest scores received by the participants, the social problem-solving levels of the early childhood teacher candidates participating in the study are moderate.

*Relationship between empathic tendencies and social problem-solving levels of early childhood teacher candidates*

The findings regarding the third research question of the study are presented in Table 5.

**Table 5***Relationship between Empathic Tendency and Social Problem-Solving Levels of Participants*

SPSI		
ETC	r	.436**
	P	.000
	N	187

\*\*Correlation is significant at the 0.01 level (2-tailed)

The data obtained from the Pearson Correlation analysis presented in Table 5 indicate a significant relationship between empathic tendencies and total social problem-solving scores of the early childhood teacher candidates. According to Cohen (1988), when the Pearson correlation coefficient (r) is between .50 and 1.0, the level of the relationship between two variables is considered high; when it is between .30 and .49, the relationship level is moderate; and when it is between .10 and .29, the relationship level is considered low. When examining the relationship between the total scores obtained from the Empathic Tendency Scale and the Social Problem Solving Inventory, it can be seen that there is a positively moderate relationship between these two variables ( $r = .4363$ ,  $p < .01$ ). Considering the findings, it can be stated that empathic tendency and social problem-solving variables

are interrelated. Based on the data presented in Table 5 and the explanations above, as the empathic tendency levels of early childhood teacher candidates increase, their social problem-solving levels also increase.

*Differences in the empathic tendencies of early childhood teacher candidates according to personal characteristics*

The findings regarding the fourth research question of the study are presented in Table 6.

**Table 6**

*Differences in the Empathic Tendencies of Participants According to Personal Characteristics*

		<b>Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>p</b>
<b>Age</b>	Between Groups	319.738	7	45.677	1.148	.335
	Within Groups	7119.887	179	39.776		
	Total	7439.626	186			
<b>Gender</b>	Between Groups	24.826	1	24.826	.619	.432
	Within Groups	7414.799	185	40.080		
	Total	7439.626	186			
<b>Graduated school</b>	Between Groups	197.511	5	39.502	.987	.427
	Within Groups	7242.115	181	40.012		
	Total	7439.626	186			
<b>Educational status of the mother</b>	Between Groups	198.446	6	33.074	.822	.554
	Within Groups	7241.180	180	40.229		
	Total	7439.626	186			
<b>Educational status of the father</b>	Between Groups	158.172	6	26.362	.652	.689
	Within Groups	7281.454	180	40.453		
	Total	7439.626	186			
<b>Family type</b>	Between Groups	33.774	2	16.887	.420	.658
	Within Groups	7405.852	184	40.249		
	Total	7439.626	186			

<b>Family attitude</b>	Between Groups	162.789	2	81.395	2.058	.131
	Within Groups	7276.836	184	39.548		
	Total	7439.626	186			
<b>Number of siblings</b>	Between Groups	300.615	4	75.154	1.916	.110
	Within Groups	7139.011	182	39.225		
	Total	7439.626	186			
<b>Birth order</b>	Between Groups	173.916	2	86.958	2.202	.113
	Within Groups	7265.710	184	39.488		
	Total	7439.626	186			

Table 6 presents the results of a "one-way ANOVA analysis" conducted to examine the differences in early childhood teacher candidates' empathic tendencies based on personal characteristics. According to this analysis, there was no significant difference among the participants in terms of their ages ( $F_{age} = 1.148, p = .335$ ). Similarly, there was no significant difference based on participants' gender ( $F_{gender} = .619, p = .432$ ), graduated school ( $F_{graduated\_school} = .987, p = .427$ ), educational status of the mother ( $F_{educational\_status\_of\_the\_mother} = .822, p = .554$ ), educational status of the father ( $F_{educational\_status\_of\_the\_father} = .652, p = .689$ ), family type ( $F_{family\_type} = .420, p = .658$ ), family attitude ( $F_{family\_attitude} = 2.058, p = .131$ ), number of siblings ( $F_{number\_of\_siblings} = 1.916, p = .110$ ), and birth order ( $F_{birth\_order} = 2.202, p = .113$ ).

#### *Differences in the social problem-solving skills of early childhood teacher candidates according to personal characteristics*

The findings regarding the fifth research question of the study are presented in Table 7.

**Table 7**

*Differences in the Social Problem-Solving Skills of Participants According to Personal Characteristics*

		Sum of Squares	df	Mean Square	F	p
<b>Age</b>	Between Groups	620.094	7	88.585	1.008	.427
	Within Groups	15733.681	179	87.898		
	Total	16353.775	186			

<b>Gender</b>	Between Groups	405.048	1	405.048	4.698	.031
	Within Groups	15948.727	185	86.209		
	Total	16353.775	186			
<b>Graduated school</b>	Between Groups	167.203	5	33.441	.374	.866
	Within Groups	16186.573	181	89.429		
	Total	16353.775	186			
<b>Educational status of the mother</b>	Between Groups	951.110	6	158.518	1.852	.091
	Within Groups	15402.665	180	85.570		
	Total	16353.775	186			
<b>Educational status of the father</b>	Between Groups	875.087	6	145.848	1.696	.124
	Within Groups	15478.689	180	85.993		
	Total	16353.775	186			
<b>Family type</b>	Between Groups	158.274	2	79.137	.899	.409
	Within Groups	16195.501	184	88.019		
	Total	16353.775	186			
<b>Family attitude</b>	Between Groups	508.579	2	254.290	2.953	.055
	Within Groups	15845.196	184	86.115		
	Total	16353.775	186			
<b>Number of siblings</b>	Between Groups	869.664	4	217.416	2.556	.040
	Within Groups	15484.112	182	85.078		
	Total	16353.775	186			
<b>Birth order</b>	Between Groups	17.828	2	8.914	.100	.905
	Within Groups	16335.948	184	88.782		
	Total	16353.775	186			

Table 7 provides the results of a "one-way ANOVA analysis" conducted to examine the differences in early childhood teacher candidates' social problem-solving skills based on their personal characteristics. According to this analysis, there was no significant difference among the participants in terms of age ( $F_{age} = 1.008$ ,  $p = .427$ ). However, a significant difference was found among the participants based on their gender ( $F_{gender} = 4.698$ ,  $p =$

.031). Similarly, there was no significant difference based on participants' graduated school ( $F_{\text{graduated\_school}} = .374, p = .866$ ), educational status of the mother ( $F_{\text{educational\_status\_of\_the\_mother}} = 1.852, p = .091$ ), educational status of the father ( $F_{\text{educational\_status\_of\_the\_father}} = 1.696, p = .124$ ), family type ( $F_{\text{family\_type}} = .899, p = .409$ ), family attitude ( $F_{\text{family\_attitude}} = 2.953, p = .055$ ), and birth order ( $F_{\text{birth\_order}} = .100, p = .905$ ). However, there was a significant difference among the participants based on the number of siblings ( $F_{\text{number\_of\_sibling}} = 2.556, p = .040$ ). The post hoc tests showed where differences among the groups occurred. Post hoc comparisons using the Tukey HSD test indicated that the mean score for Group 3 ( $M=74.98, SD=9.43$ ) was significantly different from that for Group 4 ( $M=81.52, SD=11.59$ ). That is, having three siblings and having four siblings differ significantly in terms of their social problem-solving skills.

## DISCUSSION

In this study, researchers examined the relationship between early childhood teacher candidates' empathic tendencies and social problem-solving skills. For this purpose, five research questions were prepared and the research questions were answered in the finding section.

According to the results of the research, the empathic tendency of the early childhood teacher candidates who participated in the study was found to be moderate. While the maximum score that can be obtained is 100 points, the average score of teacher candidates is 65.69. Considering this result, it is not sufficient for teachers who will transfer their empathic tendency skills to society and for teacher candidates who will be the teachers of the future (Yüksel & Adıgüzel, 2012). When early childhood teachers are able to empathize with children, they are able to enter their world, which results in a positive, safe, and transparent classroom atmosphere for children. Teachers who can understand children's needs with empathic thinking can understand children's needs more accurately and strive to meet them in a healthy way (Pala, 2008). In contrast, teachers with less empathic tendencies may create a more unsafe atmosphere in their classrooms, and children may tend to alienate themselves from the classroom (Yaşar & Erol, 2015). At the same time, it is thought that teachers' empathic understanding can contribute to the child's self-perception and that teachers' social problem-solving skills will be positively affected (Çelik & Çağdaş, 2010).

Another result of this research is related to the social problem-solving skills of the participants. The social problem-solving skills of the early childhood teacher candidates who participated in the study were found to be moderate. The average score of 77.42 out of 125 shows that the early childhood teacher candidates have a fair grasp of social problem-solving. In practical terms, this means that they are likely to know how to handle common social situations in the classroom, like resolving minor conflicts among children or communicating effectively with parents. However, they might not be as skilled in more complex or challenging scenarios like handling intense emotional outbursts or navigating

diverse classroom dynamics (Jones et al., 2015). These results highlight the need for targeted improvements in teacher training programs, particularly emphasizing practical, hands-on experiences and emotional intelligence development (Jennings & Greenberg, 2009). This approach is crucial in early childhood education, where teachers play a pivotal role in shaping children's social and emotional learning (Ashdown & Bernard, 2012). While the study points to a reasonable baseline skill set, it also underscores the importance of personalized training approaches, considering the individual variability among teacher candidates (Sabol & Pianta, 2012). The findings indicate that while candidates are generally prepared, there is significant room for enhancing their capabilities to navigate and solve social problems (Rimm-Kaufman & Hamre, 2010).

The finding that there is a moderate, positive relationship between empathic tendencies and social problem-solving skills in early childhood teacher candidates aligns with and is supported by various studies (Aktaş & Sezen-Balçikanlı, 2018; Findlay et al., 2006; İmece & Arslan-Cansever, 2019; McMahan et al., 2006; Yılmaz, 2011). This correlation demonstrates that individuals who possess higher levels of empathy are also more adept at navigating social problems effectively, a conclusion echoed by Segal et al. (2013), who emphasize the role of empathy in understanding different perspectives, which is crucial for conflict resolution and social interaction. This relationship is especially relevant in early childhood education, where, as Mashburn et al. (2006) pointed out, educators with heightened empathic skills can foster nurturing and emotionally intelligent classroom environments. In addition, Miklikowska et al. (2011) highlight that empathy is positively correlated with prosocial behavior, which is integral to social problem solving. The implications of these findings for teacher training are significant, as Jennings and Greenberg (2009) advocate for integrating empathy training into teacher education to bolster these capabilities. Furthermore, İmece and Arslan-Cansever (2019) stress that teachers proficient in empathy and social problem-solving contribute greatly to positive classroom dynamics and holistic student development. In summary, the moderate positive link between empathy and social problem-solving skills in teacher candidates reflects their intertwined role in effective teaching, particularly in shaping the social and emotional landscape of early childhood education.

According to the findings, the empathic tendency levels of the early childhood teacher candidates participating in the study do not differ with personal data such as gender, age, graduated school, educational status of the mother and father, family type, family attitude, number of siblings, and birth order. This reveals a universal aspect of empathic development in individuals pursuing early childhood education, regardless of their demographic or familial backgrounds. In the realm of educational psychology, empathy is often posited as a trait that can be developed and nurtured through specific experiences and educational practices, rather than being solely influenced by demographic factors. For instance, a study by Tettegah and Anderson (2007) indicates that empathy in teachers can be fostered through targeted training and reflective practices, regardless of their personal

backgrounds. This perspective is reinforced by findings from Cohen and Strayer (1996), who found that empathy is more closely linked to interpersonal experiences and emotional intelligence development than demographic variables like age or gender. Moreover, the lack of a significant difference in empathic tendencies based on family factors such as type, attitude, and birth order shows that while the familial environment contributes to overall emotional development, professional training in education may play a more dominant role in shaping empathic skills in teacher candidates. This agrees with research by Spinrad and Eisenberg (2009), which highlights the complex interplay of various factors, including education and professional training, in developing empathic abilities. Thus, these findings underscore the importance of educational settings and professional development in cultivating empathy among early childhood teacher candidates. They reveal that empathy as a professional skill can transcend personal and demographic differences, highlighting the potential for inclusive and universally applicable training programs in empathy development for educators.

Finally, according to the findings, the social problem-solving skills of the early childhood teacher candidates participating in the study do not differ with personal data such as age, graduated school, educational status of the mother and father, family type, family attitude, and birth order. On the other hand, the social problem-solving skills of the early childhood teacher candidates participating in the study differ with gender and number of siblings. This finding offers an interesting perspective on the development of these skills in educational contexts. The difference in social problem-solving skills based on gender aligns with some research indicating that social and emotional learning can manifest differently across genders. Zins et al. (2004) found that females and males might develop and apply social problem-solving strategies differently, often influenced by socialization patterns and societal expectations. To give a more specific example, the results of the Ocak & Eđmir (2014) study, which examined the social problem-solving skill levels of teacher candidates, also support the current study. The results of this study show that female teacher candidates have significantly higher social problem-solving skills than male teacher candidates. Moreover, the influence of the number of siblings on social problem-solving skills is a notable finding. Past research, such as that conducted by Downey (1995), has shown that children from larger families often develop unique social skills because of the necessity of navigating more complex family dynamics. Having more siblings might provide more opportunities for social interaction, conflict resolution, and understanding diverse perspectives from an early age, which can translate into more effective social problem-solving skills. In addition, siblings often serve as role models, teachers, and adversaries, providing a rich social environment that fosters the development of social understanding and empathy. Dunn (2007) notes that sibling interactions significantly contribute to social and emotional development. In summary, the finding that the number of siblings correlates with social problem-solving skills in teacher candidates can be



understood within the broader context of family dynamics and sibling interactions contributing to the development of these essential skills.

## LIMITATIONS AND RECOMMENDATIONS

For future studies planned, researchers are advised to increase the number of samples, ensure gender distribution among early childhood teacher candidates participating in the study, and use qualitative data collection tools such as interviews or observations in addition to scales to obtain more detailed information.

## CONCLUSION

The empathic tendency levels of the early childhood teacher candidates participating in the study were moderate.

The social problem-solving levels of the early childhood teacher candidates who participated in the study were moderate.

Empathic tendency and social problem-solving levels of the early childhood teacher candidates are interrelated, and based on the data presented in Table 5 and the explanations above, as the empathic tendency levels of the early childhood teacher candidates increase, their social problem-solving levels also increase.

There was no significant difference among the participants' empathic tendencies in terms of age, gender, graduated school, educational status of the mother, educational status of the father, family type, family attitude, number of siblings, and birth order.

There is no significant difference among the participants' social problem-solving skills in terms of their ages. However, a significant difference is found among the participants based on their gender. Similarly, there was no significant difference based on participants' graduated school, educational status of the mother, educational status of the father, family type, family attitude, and birth order. However, there was a significant difference among the participants based on the number of siblings; having three siblings and having four siblings differed significantly in terms of their social problem-solving skills.

As a result, when the obtained data are evaluated as a whole, early childhood teacher candidates exhibit moderate levels of both empathic tendencies and social problem-solving skills. While these candidates demonstrate a fair capacity for empathy and handling social challenges, there is still room for further development in these crucial areas. Significantly, the study also uncovers a moderate, positive correlation between empathic tendencies and social problem-solving skills. This relationship highlights the interdependency of these two competencies: a teacher's ability to empathize appears to enhance their capability to effectively solve social problems. This linkage underscores the importance of nurturing empathy as a key component in teacher training programs, not only as a moral or emotional quality but also as a practical skill that contributes to more effective problem resolution in social contexts. These findings are instrumental for informing educational strategies,

indicating that enhancing empathic skills in teacher candidates may concurrently bolster their proficiency in managing social situations, ultimately leading to more effective and responsive teaching practices in early childhood education settings.

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### Data Availability Declaration

The data can be shared upon request.

### Author Contributions

*Multiple Authors with Equal Contribution:*

*Author Contributions:*

All authors, [Nur Banu YİĞİT], [Özge PINARCIK SAKARYALI] contributed equally to this work. They collaboratively handled the conceptualization, methodology design, data acquisition, and analysis. Each author played a significant role in drafting and revising the manuscript, ensuring its intellectual depth and coherence. All authors have thoroughly reviewed, provided critical feedback, and approved the final version of the manuscript. They jointly take responsibility for the accuracy and integrity of the research.

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# Exploring the Integration of Artful Thinking as an Innovative Approach to Foster Critical Thinking Skills

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## Abstract:

Designed by the Harvard University Project Zero team, Artful Thinking is basically a program that aims to improve students' awareness of art and increase their critical thinking skills by interpreting works of art and discussing them. In this way, students will acquire twenty-first century skills such as critical thinking and aesthetic understanding. The primary objective of this research was to investigate the impact of the Artful Thinking program on the development of critical thinking skills and attitudes towards art in 6th grade students, by implementing it as action research. This study was conducted in a middle school in Gaziantep, Turkey. 23 students and a Turkish teacher participated in the study. A total of twenty-four works of art (paintings, graffiti and ancient mosaics) were shown to students over eight weeks. Students expressed their opinions about each picture for 10-15 minutes. In order to make the students think in higher-order about art, the teacher asked questions prepared by the researcher. Thus, students were enabled to develop critical and higher order thoughts about the paintings. The findings from the students, teacher, and researcher indicated that the Artful Thinking program had a favorable impact on the students' perceptions of art, and that the students' cognitive abilities and capacity for articulation were enhanced by this program.

## Keywords:

Artful Thinking, Critical Thinking, Creative Thinking, Thinking Skills

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## INTRODUCTION

The literature on critical thinking has roots in three main academic disciplines: philosophy, psychology and education. While the philosophical approach traditionally focuses on the formal application of the rules of logic (Lewis & Smith, 1993; Sternberg, 1986), the psychological approach involves the mental processes, strategies and representations that people use to solve problems, make decisions and learn new concepts. The educational approach is based on classroom experience and observations of student learning, which is different from both philosophical and psychological traditions (Sternberg, 1986). Art, as an expression of the individual's innate urge for self-expression, serves as a catalyst for fostering independent thinking in individuals (Ülger, 2015; Kırıçoğlu, 2002). Understanding, interpreting, and evaluating art is an expression of critical thinking, whereas creating art is an expression of creative thinking. A number of theories that understanding, making sense of art, reflecting on art, chatting, expressing opinions, and discussing art can help students develop critical thinking skills (Freire & Macedo, 1998; Knight, 2010). The effect of art education on students' higher order thinking skills is a topic worthy of research. Upon examining the literature, it was seen that the effects of art on creative thinking are frequently addressed, but the effects of art on critical thinking are not sufficiently emphasized. A work of art can be an opportunity for the development of critical thinking for art lovers as well as a product of the artist's creativity. Therefore, examining the effect of artful thinking on critical thinking is a noteworthy issue.

Upon examining the curriculums developed by the Ministry of National Education (MoNE) of the Republic of Turkey, it becomes evident that the objective is to nurture students who possess critical thinking skills and are capable of making meaningful contributions to society and culture. Furthermore, one of the curriculum's goals is to train individuals who have developed aesthetic sensitivity with verbal reasoning (MoNE, 2023). In this context, including original projects can enrich the education program in terms of improving students' critical thinking skills, gaining aesthetic sensitivity and contributing to culture. The Artful Thinking program can be considered as an effective approach to achieve these goals within the framework of critical thinking activities.

The Artful Thinking program, developed by Harvard Project Zero and Traverse City Area Public Schools, aims to both increase their awareness of art and improve their thinking skills by enabling K12 students to think deeply about a work of art (Tishman & Palmer, 2007). According to the Artful Thinking Final Report (2006), the purpose of the Artful Thinking approach is to strengthen the thinking and learning of students by regularly using visual art and musical works while applying the curriculum to teachers.

This program is designed as classroom teachers express their opinions about a work of art orally or in written for ten to fifteen minutes with their students in their classes. Two of the seven sub-dimensions of the constructivist approach environment are based on "finding discussions and interviews" and "sharing ideas with others", allowing students to

develop original thoughts about the work of art and express their thoughts freely under the leadership of the teacher. Thus, students not only develop their ability to think deeply about the work of art, but also learn to respect the opinions of other students and to create a synthesis from their own thoughts and those of others.

The Artful Thinking program can basically be evaluated in the context of two basic components of students' thinking dispositions and thinking routines. Both of these components are directly related to the program's goal of teaching thinking (Tishman & Palmer, 2007). Teaching thinking means that the teacher not only provides knowledge in the learning environment, but also encourages students to use their thinking skills and educates them as thinking individuals (Perkins & Ritchhart, 2004; Güzel Yüce, 2012). It is necessary to have intellectual skills and characteristics in order to think with high quality. Artful Thinking is one of the important factors for the intellectual development of the students. Thus, the students learn to experience art and to appreciate it at the same time.

The Artful Thinking program focuses on developing students' dispositions to reasoning, exploring viewpoints, finding complexity, comparing & connecting, questioning & investigating, observing & describing (Tishman & Palmer, 2007). These six dispositions can be explained briefly as follows:

Reasoning is one of the most important dimensions of critical thinking. The Turkish word for "reasoning" is "muhakeme" has the same root as "mahkeme" which means "court of justice". It means making an argument and making an impartial decision based on the available evidence. It is a high-level thinking action done by elaborating and making sense of an event, problem or situation around "Why" and "How" questions within the framework of logic (Erdem, 2011).

Exploring viewpoints, as one of the principles of the constructivist approach, which is an educational philosophy, briefly expresses being sensitive to the mental state of others. These mental states can include beliefs, desires, intentions and perceptions (Surtees et al., 2012). Johnson (1975) defines perspective as "the ability to understand how a certain situation appears to someone else and how that person reacts to the situation cognitively and emotionally" (Aslan, 2017). It helps students see and explore multiple perspectives. It helps them understand that different people can have different types of connections to the same thing and that these different connections affect what people see and think (Artful Thinking, 2023).

Finding complexity is a product of complex thinking. Complex thinking is a high-level type of thinking that relies on both rationality and creativity. The complex way of thinking, which allows revealing more than one dimension and layer in uncertain and ambiguous situations, has a multilogical and dialogic structure to produce multiple solutions (Pacheco, 2020).

Comparing & connecting is the evaluation of the similarity and contrast effect of more than one thing or idea. Including contradictions can be used in this dimension of Artful

Thinking to improve students' thinking skills. Thus, students can express their thoughts from a wider perspective by making connections about different works of art. It encourages metaphorical thinking, which is at the center of creative thinking. Metaphors spark our imaginations to make comparisons between different things, leading to a deeper and richer understanding (Artful Thinking, 2023).

Questioning & investigating is an approach that develops students' ability to ask questions and find the answers they seek. With this method, it is ensured that the student examines the issue in detail and strives to find a solution. Students actively participate in the process by asking questions, making research and observations, and taking responsibility (Davis, 2005). It helps students develop their own ideas and interpretations based on what they see, and arouses curiosity by encouraging them to wonder and ask questions (Artful Thinking, 2023).

Observing & describing is an approach that encourages students to look carefully at details. "What do you see?" and "What do you think of what you see?" helps students distinguish between observations and comments. It challenges them to develop detailed, nuanced and creative verbal explanations. It also encourages them to distinguish between observations and interpretations by asking them to keep their opinions - comments - about the work of art. This strengthens students' ability to reason carefully because it gives them practice in making long-term observations before making judgments (Artful Thinking, 2023).

Upon examining the educational methods employed since the time of Socrates to the present, it is evident that the promotion of critical thinking holds a significant position. Education has always placed a strong emphasis on teaching students how to think critically, rather than dictating what to think, throughout the course of history. The general response to the inquiry "How should one approach thinking?" can be identified as "critical thinking". This study focuses on the examination of "Artful Thinking" as a new method of critical thinking. Artful Thinking is more than teaching students thinking skills. Because Artful Thinking, which adopts a dispositional approach, allows students to transfer their thinking skills to various contexts. Thus, it is ensured that students acquire intellectual behaviors and acquire the ability to think deeply about works of art. After the Artful Thinking program, the student's thinking ability develops and the motivation to use this ability regularly occurs (Tishman & Palmer, 2007).

### **Importance of the Research**

There is a need for an enriched education program in schools on critical thinking, which is considered one of the basic skills of the twenty-first century (Bağceci & Şenel, 2019). An important aspect in developing critical thinking skills is the creation of a classroom environment that encourages critical thinking among students who experience the interaction between teachers and students (Borich, 2004). Adding engaging activities to the curriculum can help students achieve the desired results while also making critical thinking

instruction fun and dynamic. Conducting a special study on art is an effective opportunity to both develop critical thinking and broaden students' perspectives on art. The body of research supports the idea that critical thinking skills developed by art students are enhanced by the reflective thinking and aesthetic inquiry that occurs when they discuss artwork (Lampert, 2006). Critiquing and interpreting works of art in the classroom encourages students to thoughtfully consider multiple perspectives on art content (Geahigan, 1997). This study on artistic thinking is important in terms of developing students' views on art, providing them with the ability to interpret works of art, and enabling them to use critical thinking effectively.

### *Purpose of the Research*

The purpose of this study is to conduct action research using the Artful Thinking program to investigate how sixth grade students' perceptions of art and the development of critical thinking abilities are affected. It is expected that students will improve their critical thinking skills, which is one of the main objectives of the Ministry of National Education (MoNE). It is expected that the data to be obtained as a result of this study will contribute to the shaping of K12 education programs.

### *Sub-questions*

In accordance with the study's objectives, the investigation was designed to address four key inquiries, utilizing perspectives and insights gathered from participating students, the teacher, and the researcher. Thus emphasis is placed on the purpose of the study and the specific methodological approach employed to gather information, thereby sharpening the statement's focus:

1. What opinions exist among the students who took part in the program on Artful Thinking?
2. Does this program affect students' high-order and multidimensional thinking?
3. Does this program affect students' thinking development, elaboration and oral expression skills?
4. How does this program affect the teachers that are involved? formatting ensures the readability and professional appearance of your work, aiding in effective communication of your research findings.

## **METHOD**

This study was carried out with qualitative research methods. A key feature of qualitative research is to explore the depth of one or more conditions. In this study, Action Research, one of the patterns of qualitative research, was preferred as a model. Action research; it is also known as participatory research, collaborative inquiry, emancipatory research, action learning, contextual action research (O'Brien, 2001). This model refers to a

controlled research process conducted by the researcher and/or teacher with the aim of identifying and modifying future practices. This research is carried out within the scope of issues related to education (Ferrance, 2000). Carson, Connors, Smits, and Ripley's (1989) action research exhibits several key characteristics and methodological resemblances, as documented by Aydın (2005). Firstly, this approach is firmly grounded in the principle of cooperation, emphasizing the importance of collaborative efforts in conducting research. Secondly, it is characterized by a systematic learning process, underlining the structured and organized nature of the research endeavor. Thirdly, it demands an open-minded approach from researchers, encouraging receptivity to new ideas and perspectives. Furthermore, it serves as a method for the development and implementation of innovative practices. Lastly, it commonly involves small groups working together in a collaborative fashion, fostering synergy and collective problem-solving. These elements collectively define the fundamental traits of Carson, Connors, Smits, and Ripley's action research methodology. Action Research is a widely used model especially in the field of education in recent years. This model combines research and implementation. The researcher's being close to the data, knowing the process closely and being a data collection tool at the same time are the characteristics of this model. The frequently preferred data collection tools in action research are observation, interview and document analysis (Yıldırım & Şimşek, 2013).

In this study, the reasons for preferring action research are as follows: addressing the inadequacies observed in both students' critical thinking and art-related perceptions, facilitating the active participation of the researcher in the study and observing the implemented education on-site, providing an opportunity for collaboration with the practitioner teacher, being an iterative process based on improvement and development, the ability to directly observe the process due to it being a field research, easy adaptability to the educational program, and its effectiveness as a method for problem-solving.

### *Study Group*

This study was conducted in the 6th grade of a private middle school (middle schools are from 5th to 8th grades in Turkey) in Gaziantep, one of the country's largest cities in southeastern Turkey, during the 2022-2023 academic year. Of the 23 students in the class, 9 girls and 14 boys, 6 were immigrants. This study was formed by a homogeneous sample, which is one of the purposive sampling methods. Although it is a private school, the students generally come from middle class families. It can be said that the study group is homogeneous sampling because they are children from families that are similar in socio-cultural and socio-economic aspects. A small and homogeneous study group is preferred in the homogeneous sampling method, which is the opposite of maximum diversity sampling (Yıldırım & Şimşek, 2013). Due to ethical rules, the first letter of the students' names and surnames were used instead of student names in the article.

### *Implementation Process*

The study's implementation process followed a systematic sequence of steps. Initially, a comprehensive eight-week study plan was meticulously prepared. Subsequently, a careful selection was made, choosing 22 paintings out of a pool of 30 for integration into the Artful Thinking program. In order to effectively convey the program's essence to the participating teacher, an informative text was created. To further encourage critical thinking among the students during the program, provocative questions were created. To ensure the program's successful execution, a two-hour training session was conducted for the practicing teacher. Simultaneously, students were informed about the upcoming artistic exploration. Before the formal program launch, students were handed a semi-structured interview form with three questions aimed at gauging their initial perspectives on art. The core of the study comprised an intensive eight-week program, consisting of three lessons each week. In these sessions, students engaged in discussions about various paintings, spending ten to fifteen minutes contemplating each piece, which was presented on a smartboard. The teacher actively prompted students with inquiries to encourage profound thoughts and reflections. In the eighth week, a unique experiential component was introduced, involving a field trip to the Gaziantep Zeugma Mosaic Museum, renowned as the world's largest mosaic museum. Here, students had the opportunity to express their insights on mosaic artworks with a history spanning two millennia through written reflections. Throughout the implementation, the researcher diligently observed the proceedings. Following the program's conclusion in the ninth week, students were again presented with a semi-structured interview form, this time focusing on their post-implementation views on art. Additionally, face-to-face group interviews with students were conducted to gain a deeper understanding of their experiences and perspectives. Finally, the teacher was invited to share their opinions on the program through a semi-structured interview form, providing valuable insights into its effectiveness and impact. This systematic approach ensured a comprehensive and rigorous execution of the study.

### *Sample Questions*

Sample questions that will trigger students to think deeply in the process of examining works of art are given below. The basic critical thinking skills identified by the American Philosophical Association, including interpretation, analysis, evaluation, inference, and explanation, were used to identify the critical thinking skills of art students. Questions for students to develop responses such as understanding, inferring, identifying and distinguishing arguments, evaluating alternatives, thinking analytically, questioning evidence, and creating stories were developed with the participating teacher. Any of these questions can be posed to the class by the teacher, and also students also invited to ask these questions freely.

- What do you think about this painting? What are the things that make you think this way?

- How does this painting make you feel? What are the things that make you feel this way?
- What is happening in this painting? Why?
- In what different ways can you look at this work? How does it look from a different perspective?
- What can you say for sure about this painting? What are the things that make you think this way?
- Is there anything you can discover in this painting? What would you like to explore in this work?
- Is there a detail or a secret in this painting that you think no one has seen?
- What does this work look like? What are the things that make you think this way?
- What might this work be about? Why do you think that?
- Do you think there is a chaos in this painting? Is it a visible chaos, or is there a chaos you can't see but feel in the background of the painting? Why do you think that way?
- Why do you think the event you saw in this painting happened? What could be the antecedent events? What are the things that make you think that way?
- What could have happened after the event in this painting? What could be the successor events? What are the things that make you think that way?
- Can you develop interesting questions about this work? (Can you ask questions that none of your friends can think of? Who can ask the most questions?)
- If you wanted to give a name to this painting, what would you name it? Why would you choose such a name?
- What does this painting remind you of from real life? How does this thing you remember make you feel?
- What else does this painting remind you of? What are the similarities and differences between these two situations?
- If you were the owner of this painting, what would you do with it? Why is that?
- Is there anything in this painting which annoys you? Why is that?
- Is there anything in this painting which makes you feel happy? Why is that?
- How does color affect the mood or message of the artwork?
- Are there any unique or unusual techniques that stand out to you?
- How might different people interpret this artwork differently?
- Are there any symbols or metaphors in the artwork? What might they represent?
- Can you identify any artistic styles or movements that this artwork may be associated with?
- What do you think are the strengths and weaknesses of this artwork?
- What did the artist who made this painting think of while making this work?
- What if this painting had a sound? Why is that?
- What would this work of art be like if it had a taste? Why

### *Works of Art*

The researcher initially curated a collection of 30 paintings for inclusion in the Artful Thinking program. Subsequently, a collaborative evaluation took place, involving a visual arts teacher, resulting in the decision to utilize 22 of these artworks within the project's framework. Additionally, during a museum trip, students were granted the opportunity to select two mosaic images of their preference, bringing the total number of artworks used in the project to 24.

The selection of paintings was guided by a set of specific criteria. These criteria included considerations such as the composition of the artworks, the utilization of colors, the degree of emotional involvement they evoked, their originality, the diversity in settings (both in terms of time and place), and the representation of various artistic styles. These factors collectively informed the thoughtful selection of artworks that would best facilitate the objectives and experiences of the Artful Thinking program.

### *Data Collection Tools and Data Analysis*

In this study, data was collected using a quadratic data collection approach. In this way, the accuracy, reliability, comprehensiveness, depth, and generalizability of the study were ensured and attempts were made to reduce misleading factors. The data collection tools are:

- i. Pre-implementation and Post-implementation interview form for students (which is like pretest and posttest in quantitative research)
- ii. Face-to-face group interview with students
- iii. Interview form for the participant teacher
- iv. Researcher's observations

Explanations on data collection tools are given below:

**Pre-Implementation and Post-Implementation Interview Form for Students:** In order to determine the students' attitudes toward art, a pre-implementation form was given to the students prior to enrollment. These students participated in the Artful Thinking Program for eight weeks. At the end of the eight weeks, the post-implementation form was given to the students who participated in the Artful Thinking program to determine the extent to which their views on art had changed. Then, by comparing the pre-implementation data with the post-implementation data, an attempt was made to determine whether or not the students' views of art had improved. In preparing the questions on the interview forms, the Project Zero (PZ) community's interview questions were used and it was decided to make some minor changes to the application method and content. In this study instead of PZ's "I used to think..." task a Pre-implementation interview was used and instead of PZ's "Now, I think about art" task a Post-implementation interview form was used. These are the changes in terms of implementation. According to the changes made in the questions' content, the following three questions were asked to the students:



1. What do you think about art in general?
2. How does it make you feel when you see a work of art?
3. What does a good painting make you think?

Although the Artful Thinking program is a study on thinking dispositions, second question in the student interview form was included in order to evaluate the emotional state caused by a work of art.

Face-To-Face Group Interview With Students: In addition, face-to-face group interviews were held with the students after the program. In this interview, the students were asked, "What are your views on the development and enrichment of this program?"

Interview form for the Teacher: The interview form was given to the teacher at the end of the program, unlike the students in terms of application. The questions in the teacher interview form are given below:

1. Do you think Artful Thinking has caused a significant change in your students' views on art?
2. Has Artful Thinking caused a significant change in your views on art?
3. What are the advantages and disadvantages of the Artful Thinking project?
4. What are your views on the enrichment and dissemination of the Artful Thinking project?
5. Do you think the arts have a significant relationship with the curriculum? What are your views before and after the project?
6. Do you think that the Artful Thinking program has an impact on your students' high-order thinking skills?

Observation of the Researcher: A total of four observations were made by the researcher, once in the first and fifth weeks and twice in the eighth week. In order to carry out the observation process systematically, a critical thinking observation form was created by the researcher. In this form, students' affective state, self-expression, interpretation, analysis, evaluation, inference, explanation and self-regulation skills were addressed.

### *Ethical considerations*

Ethical Review Board: Scientific Research and Publication Ethics Committee of Gaziantep University

Date of Ethics Review Decision: 05.10.2023

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### *Validity and Reliability*

Before collecting data, a Turkish teacher and a visual arts teacher checked whether the questions were purposeful and understandable. A pilot study was also carried out with five

students from an alternative sixth grade class. No changes were made to the questions after the pilot study. With this study, the content and qualification validity of the semi-structured interview forms was ensured. It was decided to give 15 minutes to answer the student interview forms. Triangulation was done for the reliability of the data.

### *Data Analysis*

A computer program was used to analyze the student interview data. Students' responses to the interview forms were coded by the researcher using free coding. The codes were then reorganized by two researchers. In addition to the numerical tables, the statements of the students are also given as quotations. The data obtained from the face-to-face group interviews with the students are given as quotations. In addition, the teacher's views and the researcher's observations are also included.

## RESULTS

Before starting the program, 23 students who participated in the Artful Thinking program were given an interview form consisting of three questions as a Pre-implementation. Students were given 15 minutes to fill out the interview forms. During the implementation process a total of 24 paintings were examined by the students for eight weeks. At the end of eight weeks, the students were given a Post-implementation interview form with the same three questions. The answers given by the students were evaluated in two dimensions as "positive" and "negative" categories. Numerical data were obtained by coding the answers of the students under these categories.

### *Interview Forms for Students*

The first question of the interview form is "What do you think about art in general?" The answers given by the students to the question were analyzed. The categories and codes obtained are given in the Table 1 below.

**Table 1.**

Artful Thinking Student Interview Form Question 1

Categories	Codes	Pre-implementation	Post-implementation
Positive Attitudes towards Art	It's peaceful	4	3
	It's nice	4	6
	I find it interesting	0	1
	It's astonishing	1	0
	It's good	4	3
	It's eternal	1	1
	It's mysterious	1	0
	It makes you feel happy	1	2
	It's fun	2	2

	My mind is cleared	0	1
	I love art	0	2
	It develops different perspectives	0	4
	It develops imagination	0	3
	It's instructive	0	1
	It's meaningful	0	1
	We can express ourselves	2	0
	It's provoking	3	10
	It's required	0	1
Importance and Value of Art	It's useful	1	0
	It's very important	2	3
	It's proud	1	0
	It's like the jugular vein of man	1	0
	We should deal with art	1	0
	I respect art	1	0
	Art is everything	0	1
	It's indispensable	0	1
	It's valuable	1	0
	It is life	0	1
	It develops people	0	2
	Total	31	49
Mixed or Negative Attitudes towards Art	It's boring	1	0
	I don't understand art	1	0
	Not suitable for me	1	0
	It's nothing	2	0
	Difficult to understand	1	0
Neutral	I am not interested in art	1	0
	I don't mind it	1	0
	Total	8	0

In the analysis of the answers given to the first question, four categories emerged as "Positive Attitudes towards Art, Importance and Value of Art, Mixed or Negative Attitudes towards Art, Neutral". In the first two categories, students created a total of 31 positive codes in the Pre-implementation, and a total of 49 positive codes in the Post-implementation. According to this data, it can be said that there is a fifty percent increase in the positive opinions of the students about art in general after the implementation. Some of the positive opinions of the students in the Post-implementation are as follows:

"I used to just look at the paintings and pass by, but now I think about the invisible aspects of the painting, its smell and its sound." (HH)

"I became more interested in art than I used to be." (UD)

"Art is indispensable in our lives. Art develops people mentally and physically." (ED)

"After this project, I started to think that art is as infinite as the universe." (IBS)

"I can now look at works of art from different perspectives." (UAD)

"Every time I look at a painting, I feel my mind cleared." (MTY)

"Art is a very beautiful thing, it is peaceful, it gives people different perspectives." (EDH)

"Art is necessary in every corner of the human being. Thanks to this project, we got to know a lot of artworks and it was very useful." (ZY)

"I try to see what no one else sees in a work of art. The mosaics in the museum were very impressive." (FH)

"I think my imagination developed thanks to this project." (TO)

"In the past, works of art meant nothing to me, thanks to this project, when I look at a painting, I try to understand its story, I learnt how important art is." (MI)

"I think about art in much more detail now." (BU)

For the first question, eight negative codes were formed in the Pre-implementation, but it is seen that there were no negative opinions in the Post-implementation.

The second question of the interview form was asked to determine the affective situations of the students. The question is "How does it make you feel when you see a work of art?" The answers given by the students to the question were analyzed. The categories and codes obtained are given in the Table 2 below.

Table 2.  
Artful Thinking Student Interview Form Question 2

Categories	Codes	Pre-implementation	Post-implementation
Curiosity	It arouses curiosity	4	2
	It's different	1	0
	It's interesting	2	0
	Sense of discovery	0	1
Surprise	It's surprising	3	4
	It's staggering	1	0
Impressive	It's impressive	1	0
	It's exciting	4	3
	It feels perfect	1	0
	Artwork draws me in	1	2
Happiness	It makes me dreaming	0	1
	It gives happiness	10	15
	It feels good	3	5
	It's fun	2	0
Empathy	Butterflies fly inside me	0	1
	I try to feel artist's feelings	1	0

	I feel empathy	2	5
	I want to make it too	0	1
Emotional	It makes you feel love	1	0
	It makes you emotional	1	3
	I'm filled with perseverance	0	1
	It warms me up	0	1
Peacefulness	It is peaceful	2	7
	It's proud	1	4
Pride	A sense of effort and achievement	1	2
	I have to make it too	0	1
	I respect	0	1
Respect	It's worthy of appreciation	1	0
	Total	43	60
Negative	Nothing	1	1
	Total	1	1

In the analysis of the answers given to the second question, ten categories emerged, the first nine of them as “positive” categories and the last one is as “negative” category. The students created a total of 43 positive codes in the Pre-implementation, and a total of 60 positive codes in the Post-implementation. According to this data, it can be said that there is a thirty seven percent increase in the positive affective expressions of the students about art in general after the implementation. However, only one negative code was formed in the Pre-implementation and Post-implementation. Some of the positive affective expressions of the students in the Post-implementation are as follows:

“I feel restless, so I am very happy.” (BU)

“I feel happy and proud when I see a good work of art. I don't know why I'm proud, but it makes me feel proud.” (MI)

“Some of the pictures are so beautiful that I imagine I am in the picture.” (TO)

“It removes all my unhappiness and makes me happy.” (YNB)

“I feel all the emotions described in the work.” (FH)

“I am proud on behalf of the artist. I feel that I can make similar works, and I feel a sense of it.” (ZY)

“I feel at peace.” (EDH)

“I get happy and sometimes I get emotional.” (MTY)

“I contemplate.” (UAD)

“I used to be careless, but now I feel good and at peace.” (IBS)

“A work of art warms my heart, I feel things like surprise, curiosity and happiness.” (ED)

"I feel the mood in the piece." (UD)

"If the work is peaceful, butterflies fly inside me." (GA)

"It's such a comforting feeling that it's like my soul flies away and then comes back."  
(HH)

The third question of the interview form is "What does a good work of art make you think?" The answers given by the students to the question were analyzed. The category and codes obtained are given in the Table 3 below.

**Table 3.**

Artful Thinking Student Interview Form Question 3

Categories	Codes	Pre-implementation	Post-implementation
Curiosity and Wonder	I am curious about the artwork	8	7
	I wonder how the artist created the work	2	2
	I try to understand the artist's thoughts	2	6
	I try to understand the artist's feelings	4	3
	I question myself why I can't do it too	2	0
	I would like to do similar or better	6	1
	I imagine what I don't see in the work of art	0	1
	I look for the secret / mystery in the work	1	2
	I think about the confusion in the artwork	0	2
	I think about the story of the artwork	0	2
	I think when the work was done	0	2
	I think about the smell in the work	0	1
	I think about the voices in the work	0	1
Admiration and Respect for Art and Artists	I admire the artist	3	3
	I think art is important	1	0
	Art makes people happy	1	1
	Good art requires effort	1	4
	I consider the details	1	3
	Empathy to the artist	6	4
	Old artworks are better	0	1
	I feel astonished	1	1

Engagement with Artwork	Every art is beautiful	1	0
	I feel going into the work of art	1	0
	I try to understand the work of art	2	3
	Art is soothing	0	1
	Art provides different perspectives	0	1
	I think we need to be careful no matter what we do	1	0
Total		44	52

In the analysis of the answers given to the third question, three positive categories emerged which are "Curiosity and Wonder, Admiration and Respect for Art and Artists, Engagement with Artwork". Students created a total of 44 codes in the Pre-implementation, and a total of 52 codes in the Post-implementation. According to this data, it can be said that there is a thirteen percent increase in the positive views of the students about art in general after the implementation. No negative code was formed in the Pre-implementation and Post-implementation. Some of the positive views of the students in the Post-implementation are as follows:

"I wonder how the artist makes his work, what kind of brushes and paints he uses."  
(HH)

"I wonder who the artist is doing his work for." (GA)

"I think about what is tried to be meant in the work, under what conditions the artist made this work, this kind of things." (UD)

"Is there a secret hidden in the work, I think about it." (ED)

"I think works of art used to be much better quality, technology makes art artificial."  
(NA)

"I feel all the emotions in the work inside me." (HEK)

"I'm curious about the artist's feelings." (EDH)

"A good work of art requires a lot of effort and working." (ZY)

"I get the feeling that I can do it too and I try to do it." (FH)

"I wonder about the story of the painting, I wonder what happened before and what might happen after." (YN)

"When I see a good work of art, it should make me say 'Wow!', I need to understand the artist's work." (MI)

"I think about things that I didn't think about before, like the smell, the taste, the story." (BU)

Face-to-Face Group Interview with Students

Some of the opinions received from the students in the face-to-face group interview are given below:

“Through this project, we learnt to respect different views, I think it was very enjoyable.” (UD)

“It developed our imagination.” (LS)

“Such activities should be done not only in Turkish lessons but also in other lessons.” (BU)

“Each picture was like a puzzle, it was very exciting.” (TO)

“It would have been nicer to visit galleries and see the works there rather than seeing them from the smart board.” (IBS)

“A similar work can be done not only with painting, but also with music.” (NA)

“It would be more enjoyable if students asked questions about the work.” (ED)

“The paintings to be used in the project should not clearly express what they want to convey so that we can make different interpretations.” (UA)

“Some paintings should not be shown as a whole so we can imagine the rest of the painting and compare it with the whole work later.” (MTY)

### *Teacher Interview*

The opinions of the Turkish Language Teacher, who applied the Artful Thinking program in her class for eight weeks, are given below:

“By using critical thinking, we were able to create visual representations and improve intersensory communication. The program produced excellent results. During the studies carried out with critical thinking, the transfer of social, cultural and literary characteristics of civilizations into art boosted my interest and deepened my inquiry. The students were quite effective in producing rich content ideas in the subsequent weeks, despite their initial difficulties in the first two or three weeks. Because Artful Thinking relies on interpretation based on description, it was quite simple for the students to infer concepts from the images. Nonetheless, our students found it challenging to decipher the image's central idea and/or attempt to convey the feeling that was meant to be conveyed. We started working on helping our students with weak descriptive power, read books and increase their vocabulary. With this study, we clearly discovered that our students know a limited number of adjectives. After that, we provided the students with a list of the most often used adjectives in Turkish, both positive and negative, along with their definitions. Our homework for the pupils was to use every adjective in a sentence. We observed that when our pupils' vocabulary grew, so did their ability to understand images on a much wider level. In this sense, I can also state that the kids' proficiency in Turkish has increased. Thanks to the Artful Thinking project,



students developed not only critical but also creative and analytical thinking skills. I can easily say that their interest in art has increased.”

“I didn't believe there was a link between the curriculum and art until this program. Following our study on Artful Thinking, I came to the conclusion that art permeates every part of our existence and finds a way into our feelings and thoughts. I believe that a variety of fields can benefit from Artful Thinking. Activities involving Artful Thinking are simple to incorporate, particularly in spoken instruction. For example, I think that permanent learning can be achieved by using artworks related to the subjects learned in such as Social Studies, History and English courses. Thanks to this study, just as students' Turkish vocabulary and self-expression skills increased, students' foreign language skills in English lessons can also be increased if it is used in the lessons.”

“I believe that a study such to this one may be conducted to improve students' writing abilities. I schedule time in my classes for my pupils to journal on their emotions and ideas after viewing an artwork.”

“Consequently, I can say with certainty that following the initial weeks of the Artful Thinking program, students were able to develop very different ideas from what they had when we first started the program. In recent weeks, students have started speaking much more freely about their ideas. It is also a significant development that students come up with creative ideas. So much so that their interpretations of some of the masterpieces are so strange that I have to declare that I am impressed by their imagination.”

### *Researcher's Observation*

The researcher made two observations in the eighth week and one each in the first and fifth weeks. At the end of the study, the researcher made a general evaluation of the notes he took on the observation forms he prepared within the framework of the sub-dimensions of critical thinking. In each observation, the researcher also recorded the students' other thinking that was not included in the observation form. For instance, although it was not included in the form, the performance of the students in the dimensions of creative thinking was also considered noteworthy.

General evaluation of the observations made in the first week's implementation:

“It was noted that pupils were open to responding to inquiries regarding the paintings that were displayed to them. In order to get the pupils' attention, the teacher poses questions. She visits each workstation in an attempt to speak with as many students as she can. It might be argued that the students' ideas were lacking, despite their willingness to engage in the Artful Thinking implementation when it was something they had never done before. When reading and evaluating the artwork, it was noted that they took a highly realistic approach. It can be argued that female students contribute more successfully and that students don't generally come up with original ideas; instead, they tend to communicate identical views. They haven't grown to see things from numerous angles.

They talk on the paintings' visual aspects and are limited to their perceptions. When it comes to tasks like guessing and inferring, they don't work well enough. They expressed how much they had loved the activity in the conversation that followed its implementation. However, based on the first week experience, we can state that this practice can be tough for the teacher since students are too linked to the truth and are fearful of being ridiculed by expressing other things."

General evaluation of the observations made in the fifth week's implementation:

"It is clear from the fifth week's observation that the pupils have made significant progress since the first week. Students pay close attention to one another's opinions, comprehend conflicting viewpoints, and are encouraged to form more nuanced opinions by one another. Regarding their level of active participation in the activity, male and female students do not differ in any way. Male students are just as ready to voice their ideas as female students, despite what was noticed during the first week of classes. When compared to the fifth week of observation, the first week's observations revealed that the students are more capable of developing significantly different ideas, using their imagination more flexibly, and demonstrating their critical and creative thinking skills regarding the pictures. They also show that the students tend to think more logically and approach the paintings in a realistic manner when they analyze them. It's astonishing how many conclusions children draw regarding their ability to sense the invisible. By examining from an alternative viewpoint within the painting, and through the eyes of the painter, they offer various explanations for the paintings. In the interview with the students at the end of the course, it is seen that the students appreciate participating in Artful Thinking exercises."

General evaluation of the observations made in the fifth week's implementation and museum visit:

"Students' approaches to art have been found to significantly improve as a result of participating in Artful Thinking program. Pupils come up with a lot more concepts on the image. By expanding on one another's ideas or forming competing viewpoints, they are able to originate longer stories. They are passionate about creating the unseen stories behind the painting. For example, they can turn what is happening outside the window into a rich story, based on the sunlight reflected inside and the trees whose leaves are visible. They make logical inferences using the evidence. In my opinion, they have made significant progress in clarifying and analyzing the issues they deduced. They favor classical art over contemporary ones. They can use complex arguments regarding difficult-to-understand imagery to produce more vivid observations and assessments. They had a great day seeing the mosaic museum. They looked closely at the mosaic museum's approximately two millennia-old pieces. They worked by composing analyses and interpretations of the two pieces they selected. They said that even though they had visited the museum multiple times previously, this was the first time they had examined the mosaics in such depth."

“We can state that students' critical thinking abilities have generally increased as a consequence of our eight-week Artful Thinking curriculum implementation. Particularly in the areas of critical thinking and creating alternative, evidence-based perspectives, the kids performed exceptionally well. They have been noted to be highly effective in advancing one another's viewpoints and refuting one another's ideas. According to their evaluations, they required the teacher's support in constructing arguments in order to effectively communicate their opinions. In this particular setting, it can be argued that students tend to generate more innovative ideas than critical viewpoints. We can say that students also progress in creative domains such as fluency, flexibility, elaboration, narrative, looking from various angles, and abstract thinking when developing their views, even if this is not the primary focus of our study. Students expressed their happiness at having participated in the program at its conclusion.

## DISCUSSION

The results obtained from this research indicate that almost all students enjoyed the Artful Thinking program and expressed satisfaction with their participation in the program. Upon examining the student interview forms in general, it is observed that in the pre-implementation, students generated a total of 118 positive codes related to art, whereas in the post-implementation, they generated 161 codes. Allocating equal time for the completion of the interview forms in both applications eliminated potential manipulation due to time variability. It is believed that students generated a 36% higher number of positive codes in the post-implementation, suggesting that Artful Thinking is highly effective in further enhancing students' positive views on art. Alter, Unsworth, Paterson, Reid, and Rauch (2008) indicate that participating teachers tend to focus on developing students' artistic skills and knowledge rather than working towards improving their critical and creative thinking skills through Artful Thinking in art classes.

In the pre-implementation, students created a total of 9 negative codes, while the number of negative codes after the Artful Thinking program was found to be only 1. After the Artful Thinking activities, it is seen that the negative perceptions of the students about art disappeared to a great extent. Only one student stated that the Artful Thinking program did not change his views on art. Artful Thinking aims to foster an appreciation for the emotional and aesthetic aspects of art. By engaging with artworks, students may develop empathy, connect emotionally with different perspectives, and understand the power of visual expression (Tishman & Palmer, 2007).

The main purpose of this program is to determine whether students will acquire critical thinking skills through the Artful Thinking program and what their opinions about this program are. The observations made and the answers given by the students in the activities prove that the students have improved considerably in terms of higher order thinking. Ülger (2015) states in his study that art education improves students' critical thinking skills. İşler (2005) emphasizes that art criticism practices play an active role in the

development of critical and interpretive thinking skills. Çağış ve Eraslan-Taşpınar (2022) also found that the critical thinking skills of the students who were taught with the pedagogical art criticism method increased compared to the students who were taught with the traditional method. Daşdemir (2021) enabled students to make evaluations from different perspectives with visual art. This situation contributed to students' perspectives on the subject in artistic expressions, enriching their knowledge and gaining depth in their critical questioning. Dumitru (2019) analyzed 35 academic studies and reached the following conclusion: "The findings in the analyzed articles unexpectedly reveal not how critical thinking makes us better artists, but how the arts and humanities make us better critical thinkers." The findings of other researchers are in line with the findings of our research. Accordingly, we can state that Artful Thinking (or thinking with art) activities positively affect students' critical thinking skills.

The perspectives based on the observations of teachers and researchers suggest an increase in students' awareness of art. Pavlou (2013) emphasizes the role of discussing art in helping children begin to understand it. Art education is deemed crucial for the intellectual development of children (Jeffrey 2005; Cremin et al. 2006). Furthermore, through this project, students have had the opportunity to develop advanced thinking skills in an enjoyable manner. In terms of creative thinking, students have exhibited progress in dimensions such as fluency, flexibility, elaboration, imagination, storytelling, and abstract thinking. Art education is significant for the realization of creative learning (Jeffrey 2005; Cremin et al. 2006). Despite Pavlou's (2013) assertion that creativity does not develop through art viewing, our study has revealed that students indeed cultivate creative thoughts. However, it should be noted that this does not necessarily imply the ability of students to produce creative artworks.

It has been observed that students have shown improvement in the ways they express their thoughts, listen to each other's ideas, and even elaborate them. A doctoral thesis by Daşdemir (2021), which investigated the impact of visual arts education on critical thinking, also yielded similar results. According to Daşdemir, the activities have facilitated students in expressing themselves comfortably. Respect has been shown to students' comments, and constructive feedback has been provided to them. Consequently, students have demonstrated mutual respect for each other's viewpoints.

## LIMITATIONS AND RECOMONDATIONS

The results of our findings strongly support Artful Thinking as a powerful factor and highlight its role in fostering the holistic development of the new generation through art. In summary, this study has positively impacted students' perceptions of art. The promotion of student-centered education, particularly in expressing viewpoints and engaging in discussions, aspects of the constructivist learning environment, has been evident. Students learned to develop new and diverse perspectives through discussions, creating elaborated narratives inspired by each other's thoughts. They acquired skills in respecting different

opinions, receiving and delivering criticism. Through the activities conducted in Turkish language classes, students expanded their vocabulary and gained proficiency in expressing themselves. Moreover, they demonstrated advancements in critical skills such as interpretation, explanation, inference, and creative thinking by utilizing their imaginations. Within the scope of recommendations, it can be suggested to conduct a similar study examining the impact of Artful Thinking on creative thinking and/or high-order thinking. Additionally, implementing activities supported by both oral and written practices in English classes can be recommended to enhance students' language skills.

## CONCLUSION

Is the efficacy of art derived from other academic benefits such as mathematics or literacy, or should the focus be on the intrinsic value of art, independent of other intellectual performance domains? (Tishman and Palmer, 2007). This study does not aim to investigate the impact of the Artful Thinking approach on students' academic development or curriculum achievements. In accordance with the understanding that "art is for art's sake," the researcher decided to conduct this study to comprehend the influence of students' perceptions of art, thinking skills related to art, and higher-order thinking skills. The primary objective of this study is to delve into the impact of Artful Thinking on students' critical thinking skills in a more detailed manner and to establish a solid foundation in this regard. In the midst of a paradigm shift away from the constant pursuit of academic benchmarks, this research shed light on the subtle yet impactful influence of Artful Thinking on students' perceptions of art and opened a gateway to enhancing profound artistic thinking skills. The study was conducted from a perspective that focuses on multidimensional thinking skills, unveiling an intrinsic world of value within art itself. The findings advocate for the recognition of art education as a catalyst contributing to the development of cognitive abilities surpassing the confines of traditional academic achievements.

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## Data Availability Declaration

No Primary Data Utilized:

This study is conceptual in nature and does not rely upon primary data collection. As such, there are no datasets directly associated with the presented findings. The discussions and conclusions drawn are based on an extensive review of existing literature and analytical insights put forth by the authors.

## Author Contributions

The authors of this research, Mustafa Şenel and Bülent Döş, were responsible for the conceptualization, methodology formulation, data collection, analysis, and interpretation. Furthermore, Mustafa Şenel and Bülent Döş took charge of drafting the initial manuscript, revising it critically for vital intellectual content, and finalizing it for publication. Both authors have read and approved the final manuscript and take full accountability for the accuracy and integrity of the work presented.

### *Author(s)' statements on ethics and conflict of interest*

**Ethics statement:** We hereby declare that research/publication ethics and citing principles have been considered in all the stages of the study. We take full responsibility for the content of the paper in case of dispute.

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# From “Can AI think?” to “Can AI help thinking deeper?”: Is use of Chat GPT in higher education a tool of transformation or fraud?

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## Abstract:

This research was conducted to see if using ChatGPT prompts students to think more deeply through reflection reports. The case study method and qualitative research methodology were used to carry out this study. Five graduate students in the Curriculum and Instruction department at Aksaray University's Social Sciences Institute who were teachers in various subjects and employed at various state school levels participated in the study. It was found that the majority of participants accepted all of the information presented by ChatGPT based on a citation as true, did not feel the need to control data reliability, and could be manipulated by ChatGPT while doing self-evaluation. Additionally, despite the fact that they prepared reflective reports in which they compared their essays with ChatGPT and included questions that prompted them to think critically and reflectively, as well as the fact that they had taken a graduate-level course on the teaching of higher order thinking skills, it was acknowledged that they could not demonstrate the expected performance in using higher order thinking skills other than to a limited extent. The onus should be on educators to pioneer positive examples of how to utilize ChatGPT and provide direction on how to harness its potential, supported by critical thinking, rather than to avoid using it and identify it as a tool to be avoided.

## Keywords:

Artificial intelligence, critical thinking, ethical considerations, reflective thinking, graduate students

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## INTRODUCTION

Artificial intelligence (AI) is the replication of human intelligence in devices that have been designed to reason and acquire knowledge similarly to humans. AI aims to develop machines that are capable of carrying out operations that ordinarily require human intellect, such as comprehending natural language, spotting patterns, resolving issues, and making judgments (Lebovitz et al., 2021; Turing, 2009). In 1950, Turing proposed the Turing Test, a standard for judging a machine's capacity for intelligent activity. AI systems centered on symbolic AI in the 1950s, using knowledge manipulation and symbolic representation. Expert systems were rule-based systems created by researchers in the 1960s that could solve particular issues by imitating the judgment of human experts (Chung & Silver, 1992). AI is now incorporated into many facets of modern life, from virtual assistants and recommendation tools to self-driving cars and cutting-edge medical software. The development of AI is still being driven by ongoing research and interdisciplinary cooperation (Bisconti et al., 2023), which shapes its potential applications and societal effects. One of the disciplines that seeks to use ChatGPT more effectively is education.

Higher education has recently received a lot of interest about the use of artificial intelligence (AI). AI-powered chatbots, like OpenAI's GPT-3, 3.5, and 4, have become an important resource in this situation. ChatGPT's capacity to increase student involvement is one of its main benefits in higher education. Students can ask questions and get prompt answers thanks to chatbots that enable real-time interaction. This quick feedback encourages active learning and may boost student involvement (Cotton et al., 2023; Rawas, 2023). Students can receive individualized learning support from ChatGPT. Chatbots can provide specialized recommendations and resources by examining students' questions and learning trends. This personalized method accommodates various learning preferences and fosters a more welcoming learning atmosphere (Adiguzel et al., 2023; Fuchs, 2023).

ChatGPT, however, may unintentionally produce and disseminate false information. This could lead students' astray in learning environments. If users are not attentive in how they interpret the material produced, it could result in incorrect conclusions in their research (De Angelis et al., 2023). What is more, students' ability to use thinking skills, especially critical thinking, may suffer from an over-reliance on ChatGPT. Genuine learning and intellectual growth can be hampered by relying on AI for solutions without comprehending the underlying concepts (Fuchs, 2023; Iskender, 2023).

At this point, another question arises: what do thinking skills refer? Although there are many definitions of the components of thinking skills, they refer to the synthesis, analysis, and evaluation levels of Bloom's cognitive taxonomy (Swartz & McGuinness, 2004). These skills can be listed as searching for meaning (analytical thinking), creative thinking, critical thinking, decision-making, and problem solving (Swartz & Parks, 2004).

Swartz & McGuinness (2004) have added one more skill, meta-cognition. Reflective thinking is also accepted as a higher-order thinking skill (Schön, 1992). Meta-cognition is employed in each of the thinking skills. In fact, all these skills finally reach problem solving or decision-making (Costa, 1985).

In this context, this study aimed to determine whether the use of ChatGPT in higher education can mediate learners' use of higher-order thinking skills. For this purpose, the participants who took the Teaching Thinking Skills course at the graduate level and had a background in theoretical knowledge and practices in the use of higher-order thinking skills were asked to evaluate the texts created by ChatGPT from a reflective perspective. Details about the research procedure are given in the following part. Based on this reflective perspective, it was aimed at enabling students to think more deeply by using the skills of control data reliability, self-evaluation, and decision-making, another thinking skill within the scope of critical thinking, which are among the higher-order thinking skills, while evaluating the text created by ChatGPT.

## METHOD

### *Model*

This study, which aims to deeply examine the participants' use of higher-order thinking skills through the use of ChatGPT in higher education, was conducted through qualitative research methodology and the case study method. The case study approach is used to study the case of an individual, group, occasion, organization, or society and assists in giving a thorough understanding of the nature, procedure, or phenomenon of a particular example under examination by using a variety of data collection techniques, including interviews, observation, documents, and questionnaires (Kumar et al., 2022). Accordingly, detailed information about the participants of the study, the participant selection process, the creation of data collection tools, the research and data collection process, and the analysis of the data are presented in the following sections.

### *Participants*

The participants of the research included five master's students (see Table-1) studying at the Curriculum and Instruction program of the Social Sciences Institute at Aksaray University who were teachers from different fields and working at different levels of state schools. The selection of participants was based on two criteria. Firstly, they were required to take the Teaching Thinking Skills course offered in the given program in the 2022-2023 spring term. The course lasts fourteen weeks. The main topics covered are: What is thinking? Can thinking be taught? Why is teaching thinking necessary?; approaches to teaching thinking; higher-order thinking skills and different classifications; analytical thinking; critical thinking; creative thinking; reflective thinking; metacognitive thinking; decision-making; problem solving; relationships between types of thinking. This was the first

criterion since the research was shaped upon whether ChatGPT could be used to provide activation of higher-order thinking skills such as reflective and metacognitive thinking, and these skills were the main topics of the given course. There were eight graduate students receiving this course. The second criterion was voluntary participation, and five out of eight students declared they would take part in the research.

**Table-1**

Information about Participants

	Age	Gender	Field	Works at
P1	40	M	Classroom	Primary school
P2	36	F	Computer	Secondary school
P3	32	F	Classroom	Primary school
P4	34	F	Philosophy	Secondary school
P5	41	F	Counseling and Psychological Guidance	High School

As can be seen in Table-1, of the five participants who voluntarily participated in the study, one was male and the other four were female. The average age of the participants was 36.6 years. Two of the participants work in primary school, two in middle school, and one in high school.

### *Data Collection Tools*

There were three data collection tools used in the research. The main tool that shaped the research was participants' reflective papers, in which they compared their essays with ChatGPT's. The reflective papers included answers to four questions, two of which were directly about ChatGPT's performance in writing essays and were intended to require students to compare their essays with ChatGPT's. These questions were:

1. What do you think about ChatGPT's essays?
  - a) Do you agree with the ideas put forward in the essay you reviewed? Why?
  - b) Are there any ideas you disagree with in the essay you reviewed? Why?
  - c) When you compared this essay with your own, did you find it scientifically better or worse than yours? Why?
  - d) Are there any shortcomings in the essay you reviewed?
2. Is there any information and/or opinion in the essay you reviewed that you would like to add to your own essay?

The remaining two questions were intended to reveal participants' personal attitudes towards the use of ChatGPT for academic purposes, together with any ethical considerations they may have. These questions were:

3. The essay you reviewed had been prepared by the ChatGPT application, which used an artificial intelligence algorithm. Do you think it is ethically appropriate to use such practices in scientific studies? Why?
4. Would you use ChatGPT in your future scientific studies (preparing assignments and essays, writing a thesis, etc.)? Why?

The two other data sources were the two essays written by the participants and ChatGPT. The first topic was given as “Can you explain similarities and differences between reflective and metacognitive thinking?” which would be placed in the analysis level of Bloom’s cognitive taxonomy. At this level, students are expected to detect and compare relationships, and it is advised that the content be familiar to them (Bloom, 1956). As participants had already studied these two terms in the Teaching Thinking Skills course, familiarity with the content was provided. The second topic was assigned as “What kind of similarities and differences are there between the sub-skills put forward by Facione (2011) and Swarts and Parks (1994) regarding critical thinking? Which one do you think is more logical? Why?”. Different from the first essay topic, this topic had two parts, first of which (What kind of similarities and differences are there between the sub-skills put forward by Facione (2011) and Swarts and Parks (1994) regarding critical thinking?) would be placed at analysis level again, but second (Which one do you think is more logical? Why?) would go to the evaluation level of Bloom’s cognitive taxonomy. The evaluation level includes the act of passing judgment on an object's worth in relation to ideas, works, solutions, techniques, materials, etc. and entails applying standards and criteria to determine how precise, efficient, cost-effective, or satisfying certain details are (Bloom, 1956).

### *Data Collection Procedure*

Data were collected through three data collection tools. First, the essays prepared by ChatGPT were analyzed from the perspective of students and research. Then, the essays prepared by ChatGPT, and students were analyzed and compared with each other by the researchers. Finally, the reflective reports of the participants were analyzed by the researchers. The data was collected between 15/07/2023 and 15/08/2023 through e-mails. The participants were sent the essay topics and given three weeks to prepare them. When they sent their essays to researchers through e-mails, the essays prepared on the same topics by ChatGPT were sent to participants and they were asked to examine them and return their reflective papers in a week. All five participants complied with the time limits and delivered the requested data to the researchers.

### *Data Analysis*

The first part of the data analysis included assessing essays prepared by both students and ChatGPT through a rubric that included four main criteria and was prepared by the researchers. The first criterion was the accuracy of information, and essays were examined in terms of providing valid information. The second criterion was the coherence of the text, which pointed out unity in terms of meaning and appropriate ties among sentences and was evaluated on four issues (Johns, 1986), namely relations between paragraphs, use of linking words, focusing on one idea in each paragraph, and indicating a main sentence. The third criterion was the level of correct answers, an indication to what extent participants provided the required information. Finally, the last criterion was the use of correct references, which was examined through validating if the cited resources included the given information. In

other words, all citations were carefully examined in the original resources by researchers. The rubric was subjected to three expert opinions, two of whom holding a PhD in Curriculum and Instruction and one in Counseling and Psychological Guidance.

When the final form of the essay was formed after experts' suggestions, all essays were rated as good, fair, or unsatisfactory in terms of these criteria independently by researchers, and the consistency between ratings was examined through Cohen's kappa, which is commonly used for quantifying inter-rater agreement on a nominal scale (Warrens, 2015), like the one used in this research. So, a total of 12 essays -ten coming from 5 participants and 2 coming from ChatGPT- were rated independently, and Cohen's kappa was calculated for all of them. Cohen's kappa values ranged between .80 and .91 which could be interpreted as substantial and almost perfect agreement (McHugh, 2012).

The second part of the data analysis included a content analysis of the reflection papers prepared by participants. The content analysis was carried out as a collaborative data analysis procedure in which two or more researchers work together to focus on and communicate about a common set of data in order to arrive at a shared interpretation, as collaboration promotes systematicity, clarity, and transparency (Cornish et al., 2014) that are crucial in terms of inter-coder reliability in qualitative research like this. As a result, the content analysis went on until an agreement was reached by the researchers.

### *Research Procedure*

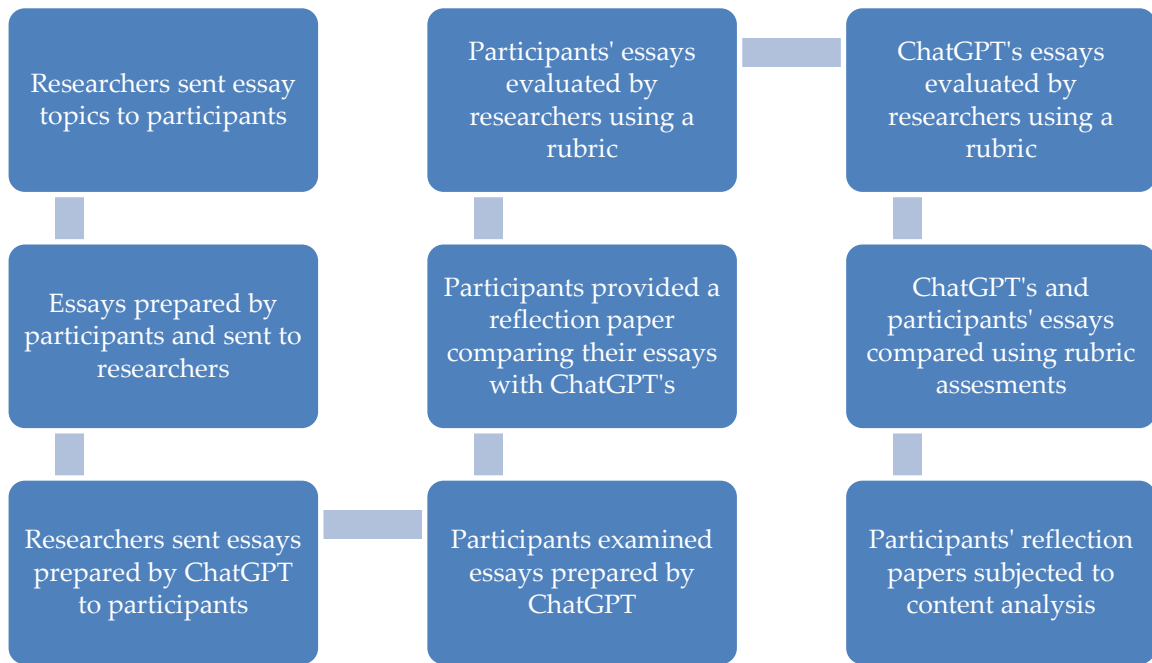
In the first place, researchers sent essay topics to participants, and then the participants prepared two essays with the given topics and sent them to the researchers. In the third step, researchers asked ChatGPT to prepare two essays with the same topics. It is to be noted that researchers first used ChatGPT's unlicensed version (3.5); however, its performance was low in terms of providing information and using in-text references. Then, a ChatGPT (version 4.0) license was bought, and the essays provided by this version were used in the research. The essay topics were prompted in ChatGPT as they were given to participants only with "adding required citations and references" at the end. The essays prepared in this way were sent to participants.

Then came the fourth and fifth steps of the research, in which participants examined essays prepared by ChatGPT through reflection questions that were provided by researchers and explained in the Data Collection Tools part. Participants were directed to compare their essays and performances with ChatGPT's with these reflection questions. The primary aim of generating such a reflection process was to activate higher-order thinking skills of participants. As a result, participants sent two reflection papers, one for each essay, to the researchers.

In the sixth and seventh steps, essays prepared by participants and ChatGPT were evaluated by researchers using the rubric that was explained in the Data Analysis part. Each essay was separately examined in terms of the criteria in the rubric. In the eighth step, participants' and ChatGPT's rubric evaluations were compared, which provided an

overview of and opportunity to compare human and artificial intelligence performances on given tasks. This step led researchers to be able to comment on the reflections of participants.

Finally, in the ninth step, participants' reflection papers were subjected to content analysis that aimed to investigate if students followed critical and metacognitive thinking skills they studied in the Teaching Thinking Skills course, and whether they were reflective.



**Figure-1** Research Procedure

In alignment with the overarching commitment to ethics, this study stringently adhered to all provisions delineated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive." It is imperative to note that there were zero instances of activities which might infringe upon the clauses stated under the "Actions Against Scientific Research and Publication Ethics."

Ethical Review Board: Aksaray University Ethical Review Board

Date of Ethics Review Decision: 20.06.2023

Ethics Assessment Document Issue Number: 2023/04-12

## RESULTS

**Research Question-1:** Is ChatGPT an effective source for academic research/studies? Is it a reliable information source? Does it represent the information coherently? Is the information provided by ChatGPT sufficient? Does ChatGPT use the correct references?

With the aim of replying to this question, essays prepared by ChatGPT (4.0) that included answers to the two questions given below were evaluated according to the rubric. The first essay provided by Chat GPT is given below:

Essay Question-1: Can you explain similarities and differences between reflective and metacognitive thinking adding required citations and references?

*Reflective thinking and metacognition both focus on the abilities to monitor and evaluate one's own thought processes. These two concepts have overlapped aspects and some distinctive features.*

*Similarities:*

*Both involve the individual being aware of his or her own thought processes and managing these processes (Flavell, 1979).*

*Reflective thinking and metacognition enable individuals to be more effective in problem solving, learning and decision-making (Zohar & Barzilai, 2013).*

*Differences:*

*Metacognition is generally a broader concept and encompasses an individual's ability to understand and control their own mental processes and strategies.*

*On the other hand, reflective thinking generally refers to the individual's process of evaluating a particular situation or experience (Schön, 1983).*

*While metacognition focuses more on learning and problem-solving strategies, reflective thinking focuses more on evaluating and understanding learning experiences and results (Kitchener, 1983).*

*While metacognition is often defined as "thinking about thinking," reflective thinking generally refers to reflecting on a situation or experience and is often performed to improve a particular action or situation (Schön, 1983).*

*References:*

*Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. American psychologist, 34(10), 906.*

*Zohar, A., & Barzilai, S. (2013). A review of research on metacognition in science education: Current and future directions. Studies in Science Education, 49(2), 121-169.*

*Schön, D. A. (1983). The reflective practitioner: How professionals think in action (Vol. 5126). Basic books.*

*Kitchener, K. S. (1983). Cognition, metacognition, and epistemic cognition. Human Development, 26(4), 222-232.*

The first essay topic was placed at the analysis level of Bloom's taxonomy. When the ChatGPT (CG) essay for this question was examined in terms of the accuracy of the given information, it was found that its performance was good as two main similarities and three differences explained in the literature were given. The second criterion in assessment was defined as the coherence of the text. The CG essay lacked relation between paragraphs as it provided most of the content in the form of a so-called "bullet point". The essay, as a result, was evaluated as unsatisfactory in this aspect. On the other hand, the essay was categorized as good in terms of use of linking words within paragraphs such as "both, on the other hand, etc.". When it comes to focusing on one idea in each paragraph, the essay was again assessed as good. The essay started with an introductory explanation, including the main idea, so it



was scored as good regarding this aspect. The level of giving correct answers was found to be good because the CG provided all required answers. The last criterion in the rubric was use of the correct references. The CG provided four references in the essay, as can be seen above. When the two references, Flavell (1979) and Zohar and Barzilai (2013), were analyzed, the given information was verified. Yet, the information cited from Schön (1983) by ChatGPT could be partly authenticated. When it comes to the fourth reference, Kitchener (1983), the cited information could be found partly again since the cited work did not include the topic “reflective thinking.” So, the overall performance in terms of using correct references was unsatisfactory. The second essay provided by Chat GPT is given below:

Essay Question-2: What are the similarities and differences between the sub-skills that Facione (2011) and Swartz and Parks (1994) put forward regarding critical thinking? Which one is more logical? Why? Can you explain these by adding required citations and references?

*Facione (2011) evaluates critical thinking through seven key skills or sub-skills:*

*Interpreting: Understanding and explaining communication.*

*Analysis: Determining the relationships of claims and arguments.*

*Evaluation: Determining the strength of an argument.*

*Inference: Identifying conclusions and constructing arguments.*

*Explanation: Expressing results and experiences clearly.*

*Self-correction: Identifying and correcting mistakes and biases.*

*Cognitive integrity / Cognitive ethics: Evaluating and appreciating your own thoughts and those of others.*

*On the other hand, Swartz and Parks (1994) conceptualize critical thinking as a set of different “thinking tools” and focus on teaching these tools across a variety of disciplines and contents. These tools usually include:*

*Comparison and classification.*

*Exemplification.*

*Analysis of contrasts and anomalies.*

*Analysis of sensitivity and assumptions.*

*Cause and effect relationships.*

*Evaluation and judgment.*

*Creating hypotheses.*

*Critical thinking, in both approaches, includes sub-skills such as analysis, evaluation, inference and explanation. However, while Swartz and Parks’ approach focuses more on thinking processes, Facione’s approach focuses more on thinking abilities.*

*Determining which approach “makes more sense” often depends on the instructional purpose, the learning context, and the specific needs of the student. Facione’s approach is perhaps more general and comprehensive, but*

*Swartz and Parks' approach is perhaps more concrete and useful for teaching and practice.*

*References:*

*Facione, P. A. (2011). Critical Thinking: What It Is and Why It Counts.*

*Insight Assessment.*

*Swartz, R. J., & Parks, S. (1994). Infusing the Teaching of Critical and Creative Thinking into Content Instruction. Pacific Grove, CA: Critical Thinking & Software.*

The second essay topic was placed at the analysis and evaluation levels of Bloom's taxonomy. The text provided by the CG for this essay was evaluated as unsatisfactory in terms of the accuracy of the given information. That is because the CG added one more dimension for critical thinking sub-skills, which was cognitive integrity/cognitive ethic, which was not verified from the cited reference (Facione, 2011) by the researchers. Similarly, the CG presented seven critical thinking sub-skills citing Swartz and Parks (1994), but five of them (Comparison and classification, Exemplification, Analysis of contrasts and anomalies, Analysis of sensitivity and assumptions, Evaluation and judgment) were given in the other types of thinking skills, such as analytical thinking, problem solving, and so on rather than critical thinking in the given reference. When it comes to the coherence of the text, it was seen that the text was mostly in the form of so-called bullet-point form, together with three short paragraphs. Besides, these paragraphs were not connected to each other. In this respect, the text was found to be unsatisfactory. On the other hand, sentences within the same paragraph were linked to each other through linking words that showed contrasts and cause-and-results relationships. Therefore, the text was rated as good in this respect. The text was rated good again in terms of focusing on one idea in each paragraph. For example, the following paragraph directly focused on comparing two approaches to critical thinking as required by the essay topic:

*Critical thinking, in both approaches, includes sub-skills such as analysis, evaluation, inference and explanation. However, while Swartz and Parks' approach focuses more on thinking processes, Facione's approach focuses more on thinking abilities.*

The text was evaluated to be good again in terms of indicating the main sentence as CG provided the main idea in the last paragraph of the text:

*Determining which approach "makes more sense" often depends on the instructional purpose, the learning context, and the specific needs of the student. Facione's approach is perhaps more general and comprehensive, but Swartz and Parks' approach is perhaps more concrete and useful for teaching and practice.*

The level of giving correct answers was unsatisfactory because the expected number of items concerning sub-skills of critical thinking proposed by the two approaches by Facione (2011) and Swartz and Parks (1994) was 12, while the CG provided 14 items, only seven of which were correct. This second essay was not evaluated in terms of the last

criterion in the rubric, which was the use of correct references, as the essay topic already limited the content to two references.

**Research Question-2:** How was the performance of participants compared to ChatGPT's?

Participant-1's (P1) essay was evaluated using the same rubric, and it was seen that the participant explained two main similarities and three main differences, so the performance was rated as good in terms of the accuracy of the given information. When it comes to the coherence of the text criterion, P1 essay was evaluated as good in terms of relation between paragraphs, use of linking words within paragraphs, and indicating a main sentence. However, it was rated as fair in terms of focusing on one idea in each paragraph since there was too much repetition in different paragraphs. For example, P1 started three paragraphs with these sentences below, all of which indicating a very similar idea:

Paragraph-1: *"Reflective and metacognitive thinking are interrelated thinking skills..."*

Paragraph-5: *"Reflective and metacognitive thinking are complementary skills..."*

Paragraph-6: *"Reflective and metacognitive thinking are not apart, they are together..."*

Since the essay started with an introductory explanation including the main idea, it was scored as good regarding this aspect. The level of giving correct answers was found to be good as P1 provided all required answers. Since there were not any citations within the text or references in the end, P1's performance in terms of using correct references was found to be unsatisfactory. As a result, P1 had a similar performance with CG in terms of the accuracy of the information and level of giving correct answers, while P1 had a better performance in terms of the coherence of the text and CG had a better performance in terms of using correct references.

Participant-2's (P2) essay was evaluated as fair in terms of the accuracy of the information since there was a misconception in terms of the two skills compared: *"The fine detail that separates reflective thinking and metacognition skills is; Metacognition is the cognitive process of the individual based on the pros and cons of the individual's learning; Reflective thinking is; We can say that it is the individual's ability to evaluate himself in general and realize what is suitable for him based on his pros and cons."* P2's performance in terms of the coherence of the text was good in all sub-dimensions because relations were provided between paragraphs, linking words were used within paragraphs, each paragraph focused on one main idea, and the essay started with a main sentence. The essay was evaluated as unsatisfactory in terms of the level of giving correct answers since there was a misconception of terms and inappropriate examples were given: *"...As a result of a student realizing that his desire to study decreases when he spends too much time on the internet; He makes study plans by limiting the time he spends on the internet (Reflective thinking)..."* This example is more suitable for self-evaluation sub-dimension of critical thinking. The use of correct references was unsatisfactory as there was only one in-text and there was not a references part at the end of the text. As a result, P2 had a better performance only in the coherence of the text criterion, while in all other three criteria CG showed a better performance.

Participant-3'S (P3) essay was assessed as good in terms of the accuracy of the information. When it comes to the coherence of the text, the essay was found fair in terms of focusing on one idea in each paragraph and relations between paragraphs because some paragraphs indicated both similarities and differences, and none of the paragraphs were linked to previous or coming paragraphs. For example, while second paragraph explained similarities between the two terms, third paragraph explained differences between them, and the fourth paragraph contained both similarities and differences. P2's performance was good in terms of using linking words within paragraphs and indicating a main sentence. The level of giving correct answers was good. On the other hand, there weren't any in-text citations or references at the end, so the performance in terms of using correct references was unsatisfactory. As a result, P3 performed better in terms of the coherence of the text while the performances of P3 and CG were the same in terms of the accuracy of the information and the level of giving correct answers. CG performed better than P3 in terms of using correct references.

Participant-4's (P4) essay was found to be good in terms of the accuracy of the information, as all the information provided by the participant was correct. The essay was evaluated as good in terms of the coherence of the text in all its sub-dimensions. The level of giving correct answers was evaluated as fair since one item was missing in both similarities and differences dimensions. When it comes to the last criterion, which is the use of correct references, it was assessed as unsatisfactory as there was only one in-text citation, which was not provided as a reference part at the end of the text. As a result, P4 performed the same as CG in terms of the accuracy of the information and was better than it when it comes to the coherence of the text. However, ChatGPT performed better than P4 in terms of the level of giving correct answers and using correct references.

Participant-5's (P5) essay was evaluated as good in terms of the accuracy of the information. As P5 provided similarities and differences in the form of bullet-points separately at first and then explained them in detail paragraph by paragraph, the assessment for the coherence of the text was good in all sub-dimensions. P5's performance in terms of the level of giving correct answers was good again. The use of correct references, on the other hand, was unsatisfactory since there weren't any in-text citations or a references part at the end of the text. As a result, P5 performed the same as ChatGPT in terms of the accuracy of the information and the level of giving correct answers. On the other hand, P5 performed better than ChatGPT in terms of the coherence of the text and worse than it in terms of using correct references.

P1's essay-two performance was evaluated, and it was found that P1's performance in terms of the accuracy of the given information was unsatisfactory because P1 explained Facione's classification of critical thinking sub-skills while Swartz and Parks' classification was not provided correctly. There was a limited relationship between paragraphs; various ideas were placed within one paragraph; there was a limited use of linking words within paragraphs, and there was not a clearly stated main idea; so, the coherence of the text was evaluated as unsatisfactory. Since half of the information provided by P1 was not accurate,

P1's performance in terms of the level of giving correct answers was unsatisfactory again. It is to be noted here that P1 had a personal judgment as required by the second part of the essay topic. As a result, ChatGPT outperformed P1 in terms of the coherence of the text, but they performed equally in terms of the accuracy of the given information and the level of giving correct answers.

P2's performance in terms of the accuracy of the given information was good as P2 provided and matched all sub-dimensions explained by two resources. The overall rating in terms of the coherence of the text was good since P2 set relations between paragraphs, used conjunctions within paragraphs, focused on one idea in each paragraph, and indicated a main sentence. Similarly, P2 was rated as good in terms of the level of giving correct answers. As a result, P2 performed better than ChatGPT in all aspects of the evaluation.

When P3's essay two was examined, it was seen that P3 explained nine sub-dimensions, while 12 was expected. So P3's performance in terms of the accuracy of the given information was good. The coherence of the text, similarly, was good since relations between paragraphs were provided, in-paragraph links were set, paragraphs included only one idea, and a main idea was indicated. As three sub-dimensions were missing in the essay, the rating of the level of giving correct answers was fair. To conclude, P3 performed better than ChatGPT in all three aspects.

P4's performance in terms of the accuracy of the given information was good because P4 provided all twelve sub-dimensions as stated in the two resources. The text's coherence was also strong since there were connections between paragraphs, interconnections within paragraphs, only one thought per paragraph, and indications of the core topic. The level of giving correct answers was also good, as all sub-dimensions were explained correctly. As a result, P4 had a better performance than CG for all criteria.

P5's performance in terms of the accuracy of the given information was fair since Facione (2011)'s three and Swartz and Parks (1994)'s two sub-dimensions were missing. On the other hand, the given sub-dimensions were matched. The assessment of the text's coherence was good in all sub-dimensions since P5 initially listed the similarities and contrasts in distinct bullet points before going into more depth about each one in a paragraph. Also, there were many linking words that increased the readability. When it comes to the level of giving correct answers, it was rated as fair since P5 added two sub-dimensions, namely curiosity and being systematical, which couldn't be verified in the given resources. To conclude, P5 performed better than CG in all aspects.

**Research Question-3:** Did the participants use critical thinking skills while writing reflection papers?

#### *Self-reflection Reports for Essay-1*

P1 indicated in the reflection report that he agreed with the content provided by CG, saying that "... The explanations stated in the essay helped us to understand better the similarities and differences between reflective and metacognitive thinking skills..." Besides, he took the information and citations provided by CG for granted as he clearly expressed: "...I agree with the whole content presented in this essay." On the other hand, P1 pointed out that his essay

was better than CG's because P1 did not only explained similarities and differences but also examined relations between the two types of thinking skills: *"These two skills are intertwined so it is impossible to explain these terms without mentioning their relationship. In my essay, I mentioned about this relationship, but ChatGPT did not..."* P1, according to the reflection paper, recognized his own scientific deficiencies while examining CG's essay by expressing: *"...Metacognition is a wider term than reflection and I would set my essay over this..."*

According to her reflection paper, P2 conceded most of the content provided by CG. The point that she disagreed was expressed as: *"I disagree the idea that metacognitive thinking is a wider term than reflective thinking which was claimed by ChatGPT."* P2 found her essay scientifically better than CG's and indicated it as follows: *"Mine is better because I made inferences by searching for information in a long while. I presented it in my essay by synthesizing them."* Similarly, P2 found CG's deficient as it lacked coherence in presenting the content and providing inferences: *"The content in the essay composed of different parts which are not related to each other, and it does not reach any results."* P2 clearly indicated that she did not want to take anything from CG's essay as she found many deficiencies in that work.

P3 agreed with the ideas provided in CG's essay indicating that *"I especially agree with the ideas claimed related to metacognition as one of the mostly discussed topics in philosophy is thinking about thinking... Since reflective thinking helps students deciding positive and negative sides of learning experiences, I agree with the ideas proposed in this essay."* P3 does not find CG's essay better than hers and explained it as: *"I prepared my essay by analyzing many resource books; however, there are only 3 references in ChatGPT's essay."* According P3 the main problem in CG's essay is the lack of explanation and presenting the content in the form of bullet points: *"The essay consisted of bullet points, and it lacks coherence."* P3 stated that she would add the following idea stated by CG to her essay: *"Reflective thinking and metacognition provides individuals with being more active in problem solving, learning and decision making."*

P4 admitted most of the ideas indicated by CG by indicating that she wrote similar things as provided in CG's essay. There was a point that she disagreed, and she explained it as follows: *"I don't agree that metacognitive thinking covers reflective thinking..."* P4 found CG's essay better than hers due to citations given by CG. When it comes to the deficiencies of the essay, P4 stated that there weren't any concrete examples while explaining the issue: *"There is no interpretation and examples in ChatGPT's work..."* Finally, P4 explained that there wasn't anything she wanted to transfer to her essay, and she explained it as follows: *"I read a lot of information and made interpretations while preparing my essay; however, there is not interpretation in CG's essay."*

P5 stated that she acknowledged all of the ideas indicated in CG's essay. On the other hand, she found her essay scientifically better than CG's claiming that: *"I research the topic in many various sources and gave examples and details in order to increase understandability; however, in ChatGPT's essay there were many short definitions only without any examples..."*

#### *Self-reflection Reports for Essay-2*

According to the reflection paper of P1 for essay two, P1 admitted all the claims by CG except that *"ChatGPT indicated that Facione's approach was overwhelming than Swartz and*

*Park's, but I think it depends on the teaching approach...". P1 stated that his and CG's essays were scientifically equal. On the other hand, P1 explained that CG didn't explain mutual and different points of the two approaches. P1 declared that he would like to add his essay two points from CG's: "...I would like to add cognitive integrity and ethic sub-dimensions to my essay..."*

P2 indicated that she agreed most of the content proposed by CG; however, she stated that she couldn't find cognitive integrity and ethic sub-dimensions in the proposed resources. She found her own performance in essay two better than CG because of the lack of coherence and understandability in its essay. Furthermore, CG's essay was criticized as being in the form of copy-paste taken from search engines. P2 surprisingly wanted to add her essay cognitive integrity and ethic sub-dimensions as they were indicated in CG.

P3 stated that she agreed with the ideas claimed in CG's essay as there were many mutual points between her and its essay. Yet, there were also ideas that P3 didn't agree on: *"...I am on behalf of Swartz and Park's classification but ChatGPT does not support one of them clearly..."* P3 indicated that CG's essay would be better than hers in terms of scientific aspect as CG would use documents in different languages other than Turkish: *"...ChatGPT's essay may be more scientific than mine because I have no opportunity to check academic papers in other languages than Turkish..."* Yet, P3 evaluated CG's essay as insufficient in terms of detailed explanation and exemplification. She added that she would like to transfer following sentence into her essay: *"...Since I couldn't recognize that detail, I would like to add the following comment into my essay: "Both approaches include sub-skills such as critical thinking, analysis, evaluation, implication and explanation. However, Swartz and Park's approach mostly focuses on thinking processes while Facione's focuses on thinking skills."*

P4 explained that she agreed on the ideas stated by CG except those about Swartz and Park's as CG proposed more sub-dimensions than hers. According to P4, her essay was better than ChatGPT's and the main deficiencies of CG's essay were lack of coherence and inferences: *"I don't want to transfer anything to my essay from ChatGPT's as it all included copy and paste information...In this essay we were supposed to give our interpretations and inferences..."*

P5 explained that she agreed on all claims by CG: *"I agree everything as similarities and differences have been clearly stated..."* She found her essay better than CG's since she provided more examples. She indicated that she would add a part of the similarities and differences proposed by CG as she hadn't included them in hers and found her essay more limited in terms of this aspect: *"...I wrote limited number of similarities and differences compared to ChatGPT..."*

**Research Question-4:** Do the participants find using CG for academic purposes ethically appropriate? Are they willing to use it in future research?

According P1 using CG in academic purposes may be ethical; however, data reliability and privacy, accuracy of the algorithm, authenticity and humanitarian responsibility may be problems. P1 explains it as follows: *"...As a result, by taking into ethical concerns ChatGPT can be used in the research..."* P1 expressed that he would be willing to use ChatGPT only for literature review to save time in the future research.

According to P2, using CG for academic purposes is not ethical because it is composed of a “copy and paste” algorithm. She indicated *“It is an algorithm based on copy and paste, so it is not ethical to use it...”* So, she rejects to use CG in the future research by saying that *“Learning is a cognitive development and reaching the information from pre-ready resources does not provide any benefits in terms of cognitive development. You learn only when you read and research yourself.”*

P3 finds using CG in academic research ethical by indicating: *“I googled these two terms and found many articles. ChatGPT does the same and presented us by refining them...”* Besides, P3 explained open willingness to use CG in future research as she explains: *“Using ChatGPT saves time, especially when you review the literature...”*

According to P4, there are not any ethical considerations in using CG in academic works; however, it may produce stereotype works unless the content provided by CG reproduced by human beings: *“Stereotype works are obstacles in front of the development of science and using ChatGPT without any interference may not help scientific development...”* She stated that she would use CG in future research for literature review but also filtering it through her mind.

P5 does not find using CG for academic purposes ethical: *“The information that is not learned does not belong to the individual... I don't think that an essay prepared by AI would belong to learners... AI uses limited resources...”*

## DISCUSSION

The first research question aimed to investigate ChatGPT's effectiveness in academic research. When ChatGPT's first essay on comparing reflective and metacognitive thinking was analyzed under the four criteria, it was seen that ChatGPT explained similarities and differences between the two terms correctly. As a result, ChatGPT's performance in providing information for a question at the analysis level of Bloom's cognitive taxonomy can be evaluated as successful. Besides, ChatGPT was good at presenting the content in the form of an essay in terms of using linking words within paragraphs, placing only one idea in each paragraph, and indicating a main sentence, while there was a lack of providing relations between the paragraphs. Although it was rated as fair in terms of coherence, it might be developed in this area. When it comes to the level of giving correct information, it was seen that ChatGPT performed mostly well. Yet, when the cited works were analyzed, some problems were found. Firstly, ChatGPT cited Flawell (1979) for the information it provided on reflective thinking; however, when this work was analyzed by the researchers, the term “reflective” was found only in one sentence, and that sentence does not include the information provided by ChatGPT. Secondly, the statement cited from Zohar and Barzalai (2013) could not be found in the given source, either. Thirdly, when the sources of Schön (1983) and Kitchener (1983) were examined, some of the statements presented by ChatGPT by referring to these sources could not be found. Through the reference to Schön (1983), definitions of the concepts of reflective and metacognition were made, but the terms metacognition and metacognitive were never used directly in the related book. Yet, the



definitions were accurate. In this case, it can be concluded that ChatGPT may have obtained the relevant definitions not directly from this source but from secondary sources referring to it. According to Dwivedi et al. (2023), even though ChatGPT is very sophisticated, it is still an AI model that relies on correlations and patterns it has learned from training data to function, which means that the text that is created could include errors, prejudices, and other types of false information that could undermine the validity of academic study. What is more, papers with minor originality and faults that go unnoticed are becoming more and more common, and ChatGPT will exacerbate this issue and provide articles that are frequently right but often compelling. This might, after all, skew scientific evidence, encourage plagiarism, and disseminate false information. Then, it would be advised to warn learners about these issues and develop a critical perspective with them in terms of using ChatGPT for academic purposes.

The second essay topic is a question at both the analysis and synthesis levels. The CG was found unsatisfactory in terms of the accuracy of information and the correct answer rate criteria in this question because five of the fourteen skills defined as sub-dimensions of critical thinking by referring to Facione (2011) and Swartz and Parks (1994) could not be found in the relevant sources. The CG states that he found four of these skills in Swartz and Parks (1994) and one of them in the other source. Swartz and Parks (1994) is the source where the CG makes the most mistakes in the essay. The relevant work is a book and is not open access on the internet, so it is possible that information might be taken from open access published secondary sources that cite this source, and this may have caused the problem. There are a number of research in the literature pointing out the incomplete or outdated knowledge as a limitation of the CG (Hariri, 2023; Ray, 2023). In terms of coherence, the CG's performance was found to be fair because, except for the inter-paragraph relationship criterion, CG was able to express the information appropriately and, more importantly, finally reach a synthesis-level conclusion by making a judgment. Mitrović et al. (2023) also indicate that CG has the capacity to produce grammatically perfect and convincingly human responses to numerous inquiry types from various fields. Thereupon, learners might be directed to examine CG's language use to improve and encouraged to ask CG's decisions in complicated situations (academic work and research) to have a starting point for themselves rather than copying it.

When the participants' reflective reports on CG were analyzed, it was seen that all participants except one accepted the information provided through in-text citations as correct. In this respect, it can be said that these participants did not use the sub-skill of controlling data reliability, which is a part of critical thinking skills, despite having taken a graduate course on this subject. The only participant who was skeptical about the accuracy of the information said that she could not check the accuracy of the information by expressing the possibility that CG could search in different languages. The literature holds a debate about whether using CG has the potential to decrease critical thinking and creativity (Plebani, 2023; Sallam et al., 2023). If this is the case, then the onus should be on

educators not to avoid the use of CG and label it as a tool to be avoided, but to pioneer good examples of how to use it and provide guidance on how to harness its potential, accompanied by critical thinking. In addition, it is seen that all participants stated that their essays were better in terms of creating the text from a holistic point of view, supporting the explanations by giving examples, and making connections within and between paragraphs. The reason why four of the five participants criticized CG for not giving concrete examples and not elaborating the narrative in terms of the coherence and comprehensibility of the narrative may be the habits they have acquired in their education so far. Because in the Turkish education system, the tradition of discussing the topic through examples is dominant, and participants wrote their essays by providing examples. However, CG did not place any examples in its two essays, which is not surprising as the prompts used did not include any demand to provide examples. In fact, the participants also expressed opinions about CG's essays such as whether they were clear, core, short or concise. Again, three out of five participants stated that they wanted to include the main idea sentences given by CG in their essays. In this respect, CG can be seen as adequate in making short and clear evaluations by presenting the main idea, which makes it an important source when learners lose their way.

A general evaluation of the participants' and CG's first essays in terms of the four criteria in the rubric reveals that CG was behind the participants only in terms of coherence, but in all other criteria, CG performed either equal to or better than the participants. In terms of the accuracy of the information, no participant outperformed CG. When the performances of the second essay were compared, it was observed that all participants, except one, outperformed CG in all criteria. The main reason for this difference between the performances of the participants and CG in the two essays may be that there were no resource limitations in the first essay and open access resources could be used. On the other hand, the sources that should be used for the second essay were specified in the question, and one of these sources (Swartz & Parks, 1994) is a book that is not open access, so it is likely that CG could not access it directly. As a result, CG created this essay based on limited and incomplete information and did not perform better than the participants. This indicates that using CG when resources that it could/should use are not open-access, its potential is limited and expectations should be kept low in terms of the performance. This can be an advantage when the aim is to limit learners' use of CG while it is a big disadvantage if learners need AI support due to a lack of time.

The participants performed similarly to CG in their first essay, but according to the self-assessment results in their reflective reports, they think that they performed better than CG because all participants except one stated that they did not have anything they wanted to take from CG's essay into their own essay. On the other hand, in the second essay, although all but one of the participants performed better than CG in all aspects, four of the participants stated that they wanted to take information, ideas, or insights from CG's essay. This may be because CG provided more information than the participants by giving

citations, even if incorrectly. According to the comparisons made by the students, they accepted the extra items presented by CG, which were incorrect, as correct. From this point of view, the participants did not feel the need to check the reliability of the data, even though they had previously learned it in the course and prepared an essay about it. Accordingly, CG could not mediate the use of higher-order thinking skills, even though participants were directed through questions in reflection papers. It seems that these four participants performed self-evaluation, a sub-dimension of critical thinking, incorrectly. Only one of the participants stated that she did not have the opportunity to check the data reliability by expressing the possibility that the cited information provided by CG might be taken from the sources written in different languages, and therefore she did not want to transfer any information to her own study.

Three out of five participants did not see any ethical problem in the use of CG in academic studies, and these participants stated in their reflective reports that there were sections that they could transfer from CG's essay to their own essays. From this point of view, it can be said that there is consistency in the opinions of the participants in their reflective reports. These participants also stated that they would filter the information they would receive from CG through their own filters, which they did not do according to reflective reports. Accordingly, it can be concluded that these participants think that CG can be an important source of information, but they do not trust it completely. On the other hand, the other two participants do not consider the use of CG in academic research ethically appropriate and do not think that there can be a transfer of knowledge from CG's essay to their own essays. It is to be noted here that the literature is full of ethical considerations in using CG in the academic context in many fields (Liebrenz et al., 2023; Stahl & Eke, 2024). Since it would be impossible and, more importantly, unnecessary when the advantages it provides are considered to prohibit using CG in carrying out academic tasks, learners can be supported to use it in a more lecturer-controlled way in which ethical issues are eliminated. The lecturer-controlled way expressed in the previous sentence does not intend to highlight censoring but providing limitations in which learners will not get lost, save time and energy, and actively use higher order thinking skills, as the researchers of this article tried to reach. This might lead to CG or AI being a tool for transformation of education rather than fraud.

### LIMITATIONS AND RECOMONDATIONS

The research is limited to the data obtained from the study group. In addition, since this is a qualitative study, it is difficult to reach generalizations. Another limitation is that critical, analytical, and reflective thinking, metacognition, and decision-making skills under higher-order thinking skills were examined; skills such as creative thinking and problem solving were not addressed. In addition, research can be conducted on the use of AI in the areas of creative and problem-solving thinking skills.

For future research, a similar study can be conducted with a larger sample group using a quantitative method and more generalizable results can be obtained. The participants in this study were graduate students; the results can be compared by applying the study to study groups consisting of students with different educational levels. Studies can be conducted to develop guidelines on how artificial intelligence applications can be used in academic studies by adhering to scientific and ethical principles.

## CONCLUSION

In conclusion, in this study, which was conducted to determine whether using CG prompts students to think more deeply through reflection reports, it was observed that most of the participants accepted all the information presented by CG based on a citation as true and did not feel the need to control data reliability, and they could be manipulated by CG while doing self-evaluation. In addition, although there were questions that encouraged them to think critically and reflectively while preparing their reflective reports, in which they compared their essays with CG and although they had taken a graduate level course on the teaching of higher-order thinking skills, it was understood that they could not show the expected performance in using higher order thinking skills except for one participant. It was observed that the reason why two participants did not transfer content from CG's essays to theirs was not due to ethical concerns rather than the data reliability.

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### Data Availability Declaration

Data Availability Upon Formal Request:

While the primary datasets utilized in this study are not publicly accessible due to certain constraints, they are available to researchers upon a formal request. The authors have

emphasized maintaining the integrity of the data and its analytical rigor. To access the datasets or seek further clarifications, kindly reach out to the corresponding author. Our aim is to foster collaborative academic efforts while upholding the highest standards of research integrity.

### Author Contributions

All authors, Yalçın Dilekli and Serkan Boyraz contributed equally to this work. They collaboratively handled the conceptualization, methodology design, data acquisition, and analysis. Each author played a significant role in drafting and revising the manuscript, ensuring its intellectual depth and coherence. All authors have thoroughly reviewed, provided critical feedback, and approved the final version of the manuscript. They jointly take responsibility for the accuracy and integrity of the research.

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# Examining the Relationships Between Media Literacy, Technology Integration Skills, and STEM Applications Self-Efficacy Perception via A Structural Equation Model: A Study of Visual Arts Teacher Candidates

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## Abstract:

The purpose of this study was to examine the relationship between Visual Arts teacher candidates' media literacy, technology integration skills, and STEM application self-efficacies. The research, designed using the relational scanning model, was conducted with the participation of 204 Visual Arts teacher candidates. To collect the data, "Media Literacy," "Teacher Technology Skills," and "Teacher STEM Self-Efficacy Perceptions" scales were used in the study. The analysis of the research data was carried out using STEM analysis in the AMOS program. According to the research findings, visual arts teacher candidates' media literacy was found to be high, but their technology integration skills and STEM application self-efficacy were found to be moderate. According to STEM analyses, media literacy and technology integration skills significantly predict STEM self-efficacy in Visual Arts teacher candidates, both separately and together.

## Keywords:

Visual arts, teacher candidates, media literacy, technology integration skills, self-efficacy of STEM applications

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## INTRODUCTION

The change and development in the visual arts with technological developments and the opportunities offered by computers have also affected the concepts of art education and what and how to teach in educational programs. Visual arts teacher candidates must have competencies in traditional and contemporary art concepts to be well-equipped art educators in all aspects (Tepecik & Tuna, 2001). Art educators argue that its education should adapt to the changing structure of today's art (Mayo, 2007; Özdemir, 2022).

While technological developments lead to significant changes in the creation and presentation of art works, some studies need to be carried out in their evaluation. It is thought that there is a need for courses in institutions that train visual arts teachers, in which both applied studies contribute to the understanding of contemporary art and courses encourage students to read, write, think, and discuss. It is thought that the variety of courses on contemporary art education technologies should be increased to gain the ability to understand and interpret new understandings of art (Demirtaş & Özçelik, 2021; Oliveira, Oxley & Petry, 2006; Patton & Buffington, 2016).

When issues related to the use of technology in art and the review and arrangement of curricula are discussed, it should be noted that the use of technology is not new. What is meant by technology is not only the use of technology such as computers but also the use of modern tools and adequate equipment in the educational environment. Technology has supported artistic and creative expression in terms of tools, materials, and development for centuries (Robyler & Doering, 2010; Taylor & Carpenter, 2007). Especially in recent times, media literacy, art education-technology integration, STEM applications, online education, etc. have begun to come to the fore in art education, similar to other fields.

The concept of media literacy has been defined in different ways, each emphasizing a different aspect. According to the general definition of Aufderheide (1993), media literacy is expressed as "a citizen's ability to access, analyze, and produce information for certain results". Chu and Lee (2014) considered media literacy a life skill, especially for young people, to critically understand, analyze, and influence the media. Bulger and Davison (2018) evaluated media literacy as skills that support critical participation with the information presented by the media and provide ways to deal with fake news.

Media literacy, which emerges as an educational approach of the 21st century, is seen as an important factor in developing the knowledge and skills necessary for lifelong learning in a constantly changing world (Alexander & Galina, 2020; Moto et al., 18; Thoman & Jols, 2008). Media literacy requires both individuals' knowledge, media literacy skills, and critical understanding, analysis, interpretation, judgment, and active participation abilities (Buckingham, 2003; Domine, 2011; Sachdeva & Tripathi, 2019).

Although media use has benefits in constructing knowledge, research (Steeves, 2014; Wineburg et al., 2016) shows that young people have difficulty evaluating media content.

Students report that they are taught basic digital literacy competencies in school, such as searching online and verifying information, but research has shown that students have limited knowledge about the business aspects of online sites and platforms (Abrosimova, 2020; Eshet, 2004; Steeves, 2014). Similarly, students cannot effectively reason about information found on the internet (McGrew, Ortega, Breakstone & Wineburg, 2016) and have difficulty analyzing various media messages (Wineburg et al., 2016).

After emphasizing that media literacy education is a basic need, UNESCO published the Grunwald Declaration on Media Education in 1982. The declaration emphasizes that the conscious use of communication tools and products and media education are important at every stage of human life (UNESCO, 1982).

Stating that media literacy should be expanded to include digital media in the Grunwald Declaration, UNESCO has prepared guidelines focusing on digital media literacy. The resource titled "Media and Information Literacy: Policy & Strategy Guidelines", published in 2013, provides information about the knowledge and skills needed by societies in the use of new communication tools, including the Internet, and in the production of content. More than 70 countries are addressing the seriousness of this issue by enacting various activities related to media and information literacy. This study conducted by UNESCO is important because it is the first to combine the concepts of information literacy and media literacy, considering the right to access knowledge and information and to exercise freedom of expression through new communication technologies (UNESCO, 2013). The idea of current media literacy refers to a structure (Kapucu et al., 2021; Koltay, 2011) that includes integrated media environments of print, audio-visual, computer, mobile phone, and other smart technologies. Media literacy is generally defined as a skill set that encourages critical interaction via media messages (Livingstone, 2004; Hobbs and Jensen, 2009; Lähdesmäki & Maunula, 2022).

Efforts to integrate information and digital technologies into education have revealed the need to improve teachers' proficiency in technology use (Gülcü et al., 2013; Keser and Çetinkaya, 2013). Within the scope of the National Educational Technology Standards-NETS (National Educational Technology Standard), teachers should be able to focus on how technology facilitates learning and creativity in students and contribute to the development of technology-enriched learning environments. It also emphasizes that they should have basic competencies such as being able to work in harmony with the digital age and conduct research (NETS-T, 2008).

Technology integration in education means that students benefit from new technologies at a maximum level in line with the goals specified in the curriculum and use these technologies extensively in their learning process. Technology integration is part of every lesson, unit, or activity. It is defined as using or combining technology with teaching and learning strategies to meet the standards and learning outcomes of the program (Davies & West, 2014; Ramorola, 2013; Susanto et al., 2020). In Turkey, there are no criteria for media

literacy competencies among the general competencies of the teaching profession (ÖYGM, 2020). However, few studies have addressed teacher candidates' technology readiness and technology integration self-efficacies, technology integration self-efficacy perceptions, and digital competence levels. In this respect, this study is expected to contribute to the literature regarding the variables discussed in the research. It is thought that the ability to integrate technology into education is directly related to media literacy and the effective use of digital materials in learning-teaching processes. However, the lack of sufficient data on teachers' use of digital materials in their courses may negatively affect policies regarding technology integration. In this context, determining whether visual arts teacher candidates use digital materials in their courses and the contributions of the digital materials used in STEM education will undoubtedly produce important results in art education.

STEM approach is an education that brings together many disciplines, aiming to transform theoretical knowledge into practice and product, and educates students who think, question, research, and invent together with the requirements of the age and developing technology (Tytler, 2020; White, 2014). The most important task for the emergence of these students falls on the teachers. It is thought that teachers with high STEM proficiency will use different methods and practices in their professional lives and will have student-centered courses integrated with technology. The teachers' use of student-centered methods and their ability to bring together different disciplines, as in STEM activities, make them the best guide in teaching course objectives. Their inadequacy in designing STEM activities also reflects their teaching of subjects in different disciplines (Knowles, 2017; Lo, 2021; Shernoff et al., 2017).

In their research, aimed at determining the self-efficacy and concerns of Hong Kong teachers about STEM education, Gene, Jong, and Chai (2019) found that only 5.53% of the participants saw themselves as well prepared for STEM education. Participants had intense knowledge, management, and outcome concerns regarding the implementation of STEM education in their schools. Therefore, researchers state that there is an urgent need for clearly expressed professional development and pedagogical and technological skills for teachers to increase their self-efficacy in implementing STEM education (Bicer et al., 2020; Shahidullah, & Hossain, 2022; Woolfolk, Winne, Perry, & Shapka, 2009).

When studies on STEM education are examined, it is seen that importance should be given to the training of teachers and teacher candidates before the application of STEM education to students. It is stated that teachers and teacher candidates have the necessary knowledge about STEM education, but they do not have the competencies to implement it. Thus, in this study, teacher candidates' STEM education self-efficacies was examined according to relational research methods. As one of these studies, Dadacan's (2021) study examined teacher candidates' self-efficacy, awareness, and tendency to use STEM applications in terms of gender, department, and university variables. In their research, they used Yaman et al. (2018) STEM applications teacher self-efficacy scale and found that teacher candidates' self-efficacy for STEM education was at a medium level and did not differ

regarding any of the variables mentioned. Although teacher candidates' self-efficacy levels for STEM education are of critical importance in determining their decisions on integrating STEM activities in learning environments (Kurup et al., 2019; Thibaut et al., 2018), media literacy and technology integration skills are thought to be important as strong predictors of future STEM performances (Thompson & Kanasa, 2016). Therefore, studies are needed to be conducted on the impact of technology-related variables on both determining the self-efficacy levels of teacher candidates for STEM education and transforming them into performance.

The people who are primarily responsible for the implementation of STEM education in teaching-learning processes are teachers and teacher candidates (Wang, 2012; Wang, Moore, Roehring, & Park, 2011). In contrast, the professional and technological knowledge of teacher candidates affects the quality of education and student success (Jackson, Rockoff, & Staiger, 2014). In this context, it is thought that integrating technology into teaching and media literacy is important in STEM competencies of teacher candidates. It is seen in the literature that studies have been carried out mostly in the science and mathematics field regarding the integration of STEM competence, technology integration skills, and media literacy (Çayak, 2019; Lin, Chai, Di, Wang, 2022; Yılmaz, 2019). However, in recent years, there has been limited information on how competent visual arts teacher candidates are in using the technologies needed in classes effectively and efficiently and in STEM and media literacy. In addition, understanding the relationships among media literacy, technology integration skills, and STEM application self-efficacy perception can play an important role in the education of visual arts teacher candidates. Training programs to improve pre-service teachers' media literacy and technology integration skills can help them use STEM applications more effectively in their classrooms. Research on this subject may help to better understand the relationships between visual art teacher candidates' media literacy, technology integration skills, and STEM application self-efficacies perception. This study examines the relationship between visual art teacher candidates' media literacy and technology integration skills and their self-efficacy in STEM applications. In relation to this purpose, this study sought answers to the following research question and tested two hypotheses.

### *Sub Problems:*

What is the level of visual art teacher candidates' self-efficacies in media literacy, technology integration skills, and STEM applications?

### *Hypotheses:*

**H1:** Media literacy positively affects self-efficacy in STEM applications.

**H2:** Technology integration skills positively affect self-efficacy in STEM applications.

## METHOD

### *Research Model*

The relational survey model, a quantitative research method, was used in the research.

### *Participants*

The research population consists of students studying in Visual Arts Teaching departments at universities in Turkey. Due to the limitations of reaching the entire population regarding time, cost, and accessibility limitations, the sample consisted of students studying in four universities in the departments of Visual Arts Teaching. In this context, the convenience sampling method, a nonrandom sampling method, will be used. Queirós, Faria, and Almeida (2017) defined convenience sampling as a method that prevents loss of time, money, and labor. The convenience sampling method is frequently used in educational research and offers cost and accessibility advantages (Mujis, 2004). The convenient sampling method is an approach that reduces time, money, and labor losses. The researcher works on the most accessible and economical units to reach the required sample size (Acharya et al., 2013). The reason for choosing the convenience sampling method in this research is to select an easily accessible and applicable sample due to limitations such as time, money, and labor. However, this method has some limitations in fully representing the universe. This can be stated as a limitation of the study. In this context, forming the study group of the research using the appropriate sampling method reduced the practical difficulties in the research process and ensured the efficient use of limited resources. For this purpose, the research was conducted with 204 visual art teacher candidates. One hundred and thirty four of the teacher candidates were women and 70 were men. Again, 53 of the participating visual arts teacher candidates were in the first grade, 51 in the second grade, 52 in the third grade, and 48 were senior students.

### *Data Collection Tools*

The Media Literacy Scale, Technology Integration Skills Scale, and Teacher STEM Applications Self-Efficacy Scale were used as data collection tools in the study.

### *Media Literacy Scale*

The Media Literacy Level Determination Scale developed by zel (2018) was used in this study. There are 16 items in the scale that determine the level of media literacy. The reliability coefficient calculated by the developers was 0.82. Confirmatory factor analysis and the reliability coefficient of the scale were calculated for this study. The scale was scored as 1=never, 2=rarely, 3=sometimes, 4=often, 5=always. Confirmatory factor analysis was used to verify the construct validity of the Media Literacy Scale. The findings of the analysis indicated that the model fit values [ $\chi^2=250.58$ ,  $\chi^2/df=3.06$ ,  $p<.001$ , CFI=0.95, RMSEA=0.10, IFI=0.95, TLI=0.95, SRMR=0.07] were acceptable (Yurt, 2023). The lowest standardized factor loading value of the items in the scale was 0.65, whereas the highest was 0.79. The

Cronbach's alpha reliability coefficient was calculated to be 0.94 for the Media Literacy Scale.

### *Technology Integration Skills Scale*

In this study, a five-point Likert-type scale developed by Wang, Ertmer, and Newby (2004) was used to measure visual arts teacher candidates' technology integration competencies. The scale consists of 19 items and two subscales. All items in the scale form consist of positive items. Teacher candidates to whom the scale was applied responded to a 5-category rating expressed as "never", "rarely", "sometimes", "often" and "always". The data collection tool was designed to be filled in using the paper-pencil method, and all findings were obtained in this context. Comparison and relational analyses can be made with the total scores obtained from the scale or the total scores related to the sub-dimensions can be made with the demographic or dependent variables to be used in the research. Within the scope of this research, hierarchical confirmatory factor analysis was performed to test the construct validity of the scale. The analysis results indicated that the model fit [ $\chi^2=499.76$ ,  $\chi^2/df=4.10$ ,  $p<.001$ , CFI=0.94, RMSEA=0.10, IFI=0.94, TLI =0.92, SRMR=0.05] values were acceptable (Yurt, 2023). The standardized factor loading values of the items in the scale were 0.70 at the lowest and 0.93 at the highest. The Cronbach's alpha reliability coefficient was calculated as 0.95 for the Technology Integration Skills Scale.

### *Teacher STEM Applications Self-Efficacy Scale*

Özdemir et al. (2018) developed the STEM Applications Teacher Self-Efficacy Scale to measure the self-efficacy levels of teacher candidates. The scale consists of 18 items of 5-point Likert type. These were rated "Never (1), Rarely (2), Sometimes (3), Often (4) and Always (5)." Confirmatory factor analysis was used to verify the construct validity of the Teacher Self-Efficacy Scale for STEM Practices. The findings of the analysis indicated that the model fit values [ $\chi^2=301.25$ ,  $\chi^2/df=2.74$ ,  $p<.001$ , CFI=0.96, RMSEA=0.09, IFI=0.96, TLI =0.94, SRMR=0.04] were acceptable (Yurt, 2023). The lowest standardized factor loading value of the items in the scale was 0.72, whereas the highest was 0.90. The Cronbach's alpha reliability coefficient was calculated to be 0.92 for the Teacher Self-Efficacy Scale for STEM Practices.

### *Data Analysis*

Structural Equation Modeling was applied to test the relationship between visual art teacher candidates' media literacy and technology integration skills and their self-efficacy in STEM applications. The data obtained were evaluated using SPSS 27.00 and AMOS 24 package programs. Arithmetic mean, standard deviation, correlation, and SEM analyses were performed to evaluate the data.

In structural equation model analysis, to verify the model fit  $\chi^2/df$  ( $< 5$ ), the Root Mean Square Error of Approximation (RMSEA) ( $< 0.10$ ), the Standardized Root Mean Square Residual (SRMR) ( $< 0.08$ ), the Comparative Fit Index (CFI) ( $> 0.90$ ), and the Tucker-Lewis Index (TLI) ( $> 0.90$ ) indices were used, (Yurt, 2023).

### *Ethical considerations*

In this study, all rules stated to be followed within the scope of "Higher Education Institutions Scientific Research and Publication Ethics Directive" were followed. None of the actions stated under the title "Actions Against Scientific Research and Publication Ethics", which is the second part of the directive, were not taken.

Ethical review board name: Kütahya Dumlupınar University Chairmanship of the Social and Humanities.

Scientific Research Ethics Committee Date of ethics review decision: 02.02.2024.

Ethics assessment document issue number: 34.

## RESULTS

First, the study included descriptive statistical findings regarding media literacy, technology integration skills, and stem self-efficacy of visual art teacher candidates (See Table 1). The correlation analysis results between these variables were given (See Table 2). In the final stage of the study, structural equation model analyses between variables were given (See Figure 1 and Table 3).

### *Descriptive Statistics Results*

**Table 1.**

*Descriptive Statistics on Media Literacy, Technology Integration Skills, and STEM Self-Efficacy of Visual Arts Teacher Candidates*

	N	Minimum	Maximum	Range	Mean	Std. Deviation
Media Literacy	204	1,19	5,00	3,81	3,43	0,84
Technology Integration Subscale 1	204	1,00	5,00	4,00	3,24	0,96
Technology Integration Subscale 2	204	1,00	5,00	4,00	3,16	0,91
Technology Integration Scale Total	204	1,00	5,00	4,00	3,20	0,91
STEM Self-Efficacy	204	1,06	5,00	3,94	3,22	0,89

Table 1 shows the arithmetic mean and standard deviation values calculated for the media literacy, technology integration skills, and stem self-efficacy scores of the visual art teacher candidates. According to the average values, the media literacy of the visual art teacher candidates was found to be at a high level. However, their technology integration skills and STEM application self-efficacy were at a medium level.

### Correlation Analysis Results

Table 2 shows that the average scores of the participants in media literacy, teacher STEM application self-efficacy, and technology integration are calculated as 3.43 (SD = 0.84), 3.22 (SD = 0.89), and 3.16 (SD = 0.91). The results obtained indicate that the participants' media literacy perceptions were at a high level, while their self-efficacy for STEM applications and technology integration skills were at medium.

**Table 2.**

#### *Descriptive Values and Pearson Correlation Coefficients*

Variables	M	SD	1	2	3	4
1. Media Literacy	3,43	0,84	1			
2. Teacher Self-Efficacy Scale for STEM Practices	3,22	0,89	0,58**	1		
3. Using computer Technologies (TI)	3,24	0,96	0,60**	0,73**	1	
4. using a computer (TI)	3,16	0,91	0,59**	0,78**	0,87**	1
5. Technology Integration Skills Scale Total	3,16	0,91	0,62**	0,77**	0,89**	0,88**

\*\*p<0.01, N=204, TI= Technology Integration

there are medium- and high-level positive relationships between self-efficacy scores for STEM applications and media literacy ( $r=0.58$ ,  $p<0.01$ ) and technology integration skills ( $r=0.77$ ,  $p<0.01$ ) (Table 1). There is a moderate positive relationship between media literacy scores and technology integration skills ( $r=0.62$ ,  $p<0.01$ ).

### Structural Equation Model Analysis Results

To test the hypotheses of this research, the structural equation model shown in Figure 1 was developed and tested. In the model, media literacy and technology integration skills are included as independent variables, and self-efficacy for STEM applications is included as a dependent variable. The fit values obtained by testing the model [ $\chi^2=2801.69$ ,  $\chi^2/df=2.25$ ,  $p<.001$ , CFI=0.92, RMSEA=0.08, TLI =0.93, SRMR=0.07] indicate that the model is compatible with the data (Yurt, 2023). The path coefficients, significance levels, and confidence intervals included in the model are summarized in Table 2.



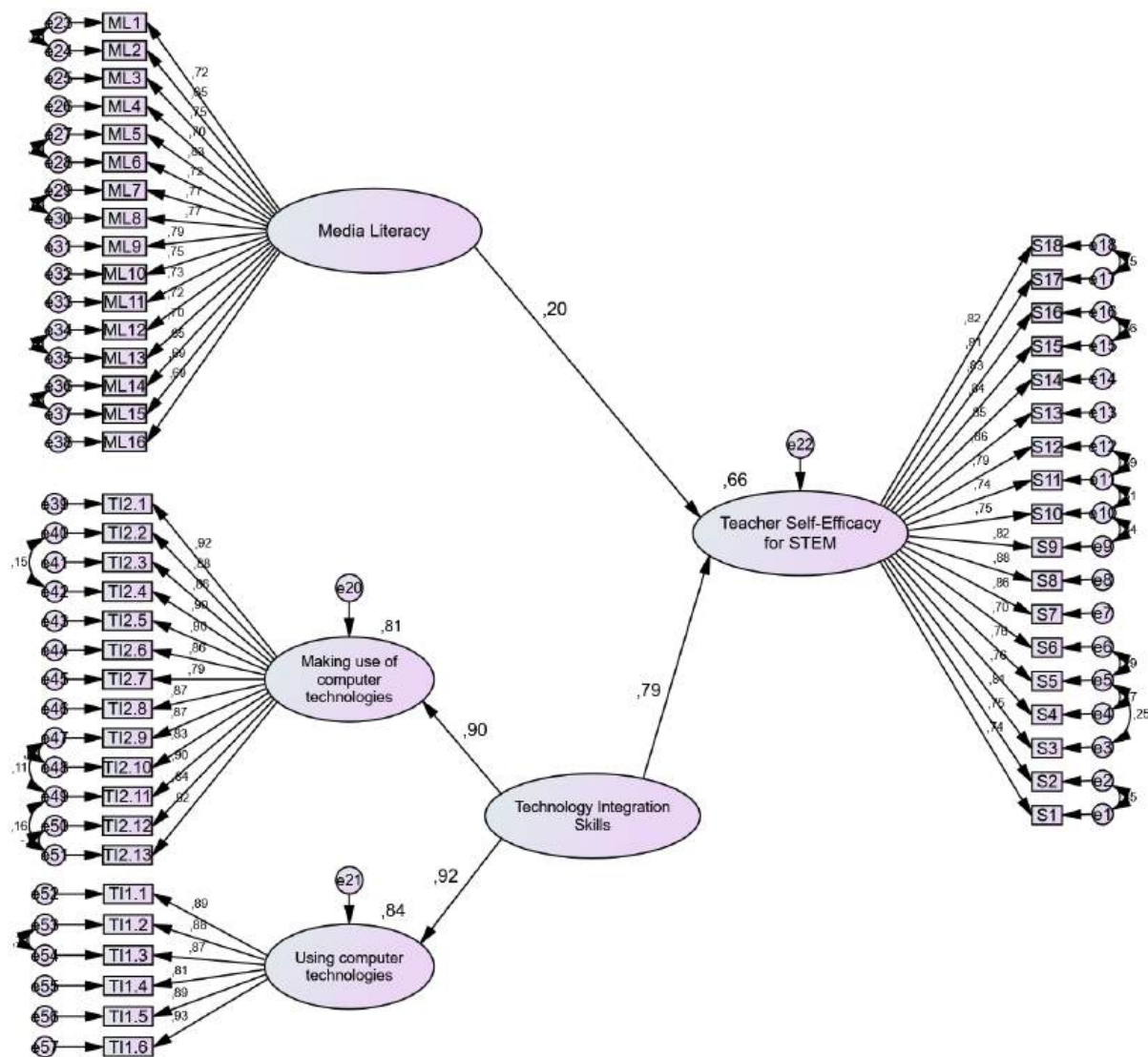


Figure 1. Structural equation model

Table 3 shows that the predictive power of media literacy for self-efficacy for STEM applications is 0.20 [95% CI (0.04; 0.39)]. According to this result, H1 was accepted. As media literacy increases self-efficacy for STEM applications, it also increases in visual art teacher candidates. The predictive power of technology integration skills for self-efficacy in STEM applications is 0.79 [95% CI (0.65; 0.89)]. According to this result, the H2 hypothesis was accepted. As technology integration skills increase in visual art teacher candidates, self-efficacy for STEM applications also increases. Media literacy and technology integration skills together explained 66% of the change in self-efficacy for STEM applications. Considering the standardized beta coefficients, it was observed that technology integration skills were more effective on self-efficacy for STEM applications than media literacy.

**Table 3.***Regression Weights*

			B	B	S.E.	C.R.	p	%95-CI	
								Lower	Upper
Media literacy	--->	Self-Efficacy Scale for STEM	0,20	0,21	0,05	3,81	***	0,04	0,39
Technology Integration Skills	--->	Self-Efficacy Scale for STEM	0,79	0,66	0,07	9,94	***	0,65	0,89

\*\*\*p<0.001, S.E.= Standart error, C.R. =Critical rate,  $\beta$ =Standardized beta, B = unstandardized beta

## DISCUSSION

In this study, visual art teacher candidates' media literacy, technology integration skills, and STEM application self-efficacy were examined on a relational basis. According to the research findings, the media literacy, high technology integration skills, and STEM application self-efficacy of the participating visual arts teacher candidates were found to be at a medium level. Thus, Dođru (2020) conducted a study on visual arts teachers and teacher candidates and found that the technology literacy of the participants was high and their technology integration skills were at a medium level. Similarly, similar findings to the present study were obtained in the literature on media literacy and technology competence (Dođru, 2020; Koh and Chai, 2013; Kara, 2021; Koyuncuođlu, 2021; Vosough Matin, 2023). These findings show that visual art teacher candidates generally perceive themselves as competent in technology literacy, skills, and use. However, in the study, visual art teacher candidates' STEM application self-efficacies was found to be at medium or below average levels. In fact, in the research of Geng et al. (2019), in which they aimed to determine the self-efficacy and concerns of Hong Kong teachers about STEM education, they concluded that very few of the participants saw themselves as well prepared and sufficient for STEM education. olakođlu and Gnay Gkben (2017) mentioned studies on STEM training given to teacher candidates in education faculties in Turkey, foreign examples of STEM education, and suggestions about the necessary program to train teachers who can carry STEM education to schools. Because of the research, it was observed that faculty members in education faculties were aware of STEM education but believed that their application competence was low.

Another finding of the research is the relationship between visual art teacher candidates' media literacy, technology integration skills, and STEM application self-efficacy. According to the analyses carried out in the AMOS program, media literacy and technology integration skills, separately and together, significantly affect STEM application self-

efficacy. As visual art teachers' technology integration skills and media literacy increases, their self-efficacy in STEM applications also increases. Thus, studies of Demirbağ and Bahçivan (2021), Greene et al. (2018), Le et al. (2022), Murphy & Kelp (2023), and Voda et al. (2022) had similar findings. To be digitally literate, it is necessary to be able to use technology at a social level as well as examine and integrate digital information (Margaryan et al., 2011). According to Greene et al. (2018) and Tang and Chaw (2016), realizing media literacy and technology integration skills, such as digital access, content creation, and resource sharing, positively affects the effectiveness of students and teachers in new and contemporary teaching practices like STEM. According to Margaryan et al. (2011), being familiar with technology alone is not enough for success in learning; having the right competencies and attitudes is equally important. Technological and digital competence gaps in teacher education have made it important for them to be able to integrate contemporary practices related to technology and teaching practices (Instefjord & Munthe, 2017). The study of Seferoğlu and Akbyk (2005) reveals the importance of pre-service and in-service training of teachers and teacher candidates on this subject.

In the literature, new approaches and effective integration of developing technologies have come to the fore in bringing developing technologies into the classroom (Goos and Bennison, 2008; Liao, 2007). These studies show that the use of technology in education requires teacher candidates and teachers to have competencies in the integration of technology into education. However, the implementation of technology integration skills on the basis of new teaching approaches is a dynamic, complex, and partly slow process (Harris and Hofer, 2009).

## CONCLUSIONS AND RECOMMENDATIONS

It is important for Visual Arts teacher candidates to feel competent in understanding their media literacy and technology integration skills and in integrating technology into STEM applications in their classrooms. According to the research findings, the media literacy of the participating Visual Arts teacher candidates was high, but their technology integration skills and STEM application competencies were moderate. The important result of the study is that media literacy and technology integration skills in Visual Arts teacher candidates are an important factor in their proficiency in STEM applications. In this regard, it is important to design Visual Arts teacher training programs such that students can use technology at an adequate level during the learning process. Visual Arts students who feel sufficient in their technology adaptation process skills will be equipped with the skills to use the teaching approaches and digital processes required by the age in the learning-teaching process when they begin teaching. This research was conducted using the quantitative research method. In a future study, a more detailed study can be conducted using a combination of mixed methods such as observation and interview. Convenience sampling method and conducting the research on a certain number of participants are the two important limitations of this study. The small number of teacher candidates studying

in visual arts teaching departments in Turkey affected the number of participants in the sample. In this context, it is recommended that future studies should be conducted on a larger sample.

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### Data Availability Declaration

The data can be shared upon request.

### Author Contributions

The sole author of this research, Zeliha Canan Özkan, was responsible for the conceptualization, methodology formulation, data collection, analysis, and interpretation. Furthermore, Zeliha Canan Özkan took charge of drafting the initial manuscript, revising it critically for vital intellectual content, and finalizing it for publication. The author has read and approved the final manuscript and takes full accountability for the accuracy and integrity of the work presented.

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## Hey, GPT, Can We Have a Chat?: A Case Study on EFL Learners' AI Speaking Practice

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*In an era of major advances in the digital world, artificial intelligence has been a part of programs, tools, applications, and platforms. It has also been integrated into fields of education including language teaching and learning. To this end, ChatGPT, one of the most recent AI-driven systems, has been proposed to support language learners' personalized studies. Thus, this paper presents a qualitative study aiming to explore how Turkish EFL learners in higher education use ChatGPT for speaking. For a deeper understanding, the study was designed as a case study which used multiple sources to collect qualitative data. In this sense, semi-structured interviews were held with the participants, and through open-ended questions, they were asked about their study habits and any background knowledge about ChatGPT. In a following session, they were introduced the chatbot and instructed on possible ways to use it for speaking practice. Screen recordings of the usage by the participants were another source to observe and later describe the process for the researcher. A final session of the interviews planned as a stimulated recall was held to explore the participants' ChatGPT use experience through their reflection. The thematic analysis of the data revealed codes and themes leading to language teaching implications about learner characteristics and use of AI for language studies.*


**Keywords:** Artificial intelligence, ChatGPT, L2 learning, speaking

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## INTRODUCTION

Artificial intelligence (AI) is becoming widespread by facilitating tasks completed by machines and humans in turn. On the other hand, it is raising concerns by performing tasks humanlike and having an unpredictable developmental potential in the future. One of those AI-driven tools with affordances offered and concerns raised is ChatGPT, which is a chatbot designed by OpenAI. With its free basic and more sophisticated versions, it is used in many areas and could achieve tasks that are associated with humans by nature. Thus, it is at the center of debates due to its possible illegal uses. However, when used properly, it helps users find information they are searching for rapidly to a certain extent. Therefore, the assumption is that it could also be used for language learning, and emerging literature on it implies a positive effect on language learners' knowledge and skill development (Jeon et al., 2023; Kohnke et al., 2023)

Speaking skill both in the first and second languages involves by nature multiple variables, which makes it complex and demanding for second or foreign language learners (Egan, 1999; Kara et al., 2017). One of the challenges is caused by lack of opportunities to have a real conversation which is bound to a context and knowledge of pragmatics to fulfil interactive tasks. Not having practiced speaking adequately enough to cope with the challenging nature of speaking and to develop competence in language, foreign language learners may get inhibited and anxious to start and/or keep speaking. Therefore, it is necessary for them to find ways to practice language through speaking tasks.

With technological developments reflecting in language learning and teaching, Computer-Assisted Language Learning (CALL) has launched to provide insights into how language learners could benefit from digital tools and applications to increase their language knowledge and improve skills. The latest developments have also made AI integration into language learning possible, and AI-powered tools, one of which is ChatGPT, have been prompted in language learning. On the one hand, the chatbot is new with emerging research findings, on the other hand there is not as much focus on speaking as on vocabulary since the basic free model of the ChatGPT principally "chats" rather than initiating voiced conversations. Notwithstanding, it is of great wonder if it could be beneficial for L2 learners to improve their speaking skill by using this chatbot, which is the focus of this research. With this focus, there is one research question with its sub-questions as suggested by Creswell (2014) related to qualitative studies.

**RQ1.** How is ChatGPT used by pre-intermediate EFL learners for the speaking skill?

**RQ1a.** What kind of speaking practices do they make?

**RQ1b.** Can they manage to have human-like conversations?

**RQ1c.** Do they meet any problems while using it?

**RQ1d.** How do they consider its use for speaking?

## Artificial Intelligence in Language Learning

Fast evolving technology has enabled people to take advantage of digital machines, tools, and applications to engage in second and/or foreign language learning, and thus, it proves benefits to teachers and students even in the pre-school (Prince, 2017). According to Blake (2013), if used appropriately, technology can assist language learners to engage in a target language, which is particularly crucial if learners have no opportunities to be exposed to the target language in its natural setting. There exist quite a lot of digital resources making language learning process fun and easier. Computer-Assisted Language Learning (CALL) and Technology-Enhanced Language Learning (TELL) are shaped around the use of digital, computerized systems that principally support language learners' out-of-class studies (Bećirovic et al., 2021; Chang & Hung, 2019). According to Bećirovic et al. (2021), engaging in the content provided by technological digital tools and the internet, language learners could access audio-visual materials and equipment, get help for their assignments, and increase their language knowledge and vocabulary, and through effective guidance on the use of technology, these learners could be self-regulated, autonomous language learners.

Self-regulated learning is defined as "a process by which learners direct and coordinate their efforts, thoughts, and feelings in order to achieve their learning goals" (Zimmerman, 2000, p. 15). In language learning, it is generally associated with learners with high level of proficiency as they have been reported to be more autonomous (e.g., Zimmerman, 2000). Furthermore, with its affordances such as access to natural language use through authentic content at any place and time, digital learning encourages self-regulated learning by allowing language learners to plan learning compatible with their own pace and learning needs (Carrier, 2017). Similarly, in the literature review conducted by Perry (2021), it was supported by evidence that digital, self-access resources had a strongly positive effect on second language learners' efficacy. Yet, the point is that digital literacy is essential to achieve learning goals, thus connecting self-regulated learning, digital literacy, and use of digital resources to learn a second and/or foreign language (Hamouma & Menezla, 2019; Perry, 2021; Yang et al., 2022)

In addition to digital resources, artificial intelligence (AI), referring to computerized systems that "think and act like humans" (Zhang & Chen, 2021, p. 6), has launched to be utilized in many fields and integrated into CALL or TELL for two decades. Since then, AI-driven tools have ubiquitously been used for language learning purposes as they promote learner-centeredness (Celik, 2023) and provide authentic input through interactive, individualized contexts (Lin & Chang, 2020). Concerning their benefits, chatbots defined as "virtual agents that can interact with users by processing input using natural language" (Jeon et al., 2023, p. 2) are one of the most popular AI-driven tools in language learning. In a general sense, it is stated that they have a positive impact on increasing L2 motivation and autonomy and decreasing speaking anxiety (Jeon, 2022; Tai & Chen, 2020). In the literature, there is also evidence on their positive effects specific to language skills; listening and

reading (e.g., Haristian, 2019), listening (e.g., Sharadgah & Sa'di, 2022), writing (e.g., Zhang et al., 2023) and speaking (e.g., Rahimi & Fathi, 2022). For instance, Zhang et al. (2023) searched for the effect of chatbot training on improving EFL learners' writing self-efficacy and proficiency in argumentative writing. The study conducted with fifteen participants through pre- and post- questionnaires, semi-structured interviews and evaluation of their writing performance has been reported to find out that while the training was likely to increase writing proficiency, it tended to decrease writing self-efficacy. On the significance of chatbots in the speaking skill, Rahimi and Fathi (2022) put an emphasis on the use of these tools in countries where there are few opportunities to practice English with limited exposure to natural language use only at school or language program. Similarly, Bibauw et al. (2022) highlighted the positive impact of the chatbots on increasing learners' accuracy and proficiency in language use. Ayedoun et al. (2019) stated that of all language skills, AI tools (chatbots) could be used the most effectively for listening and speaking skills. On the contrary, Sharadgah and Sa'di (2022) suggested that there were paralinguistic elements peculiar to listening and speaking such as gestures, emotions, and body language that the machines could not achieve.

Regarding the chatbots in language learning, a revolutionary era has started with the introduction of ChatGPT, a chatbot developed by OpenAI. The reason for its being considered as ground-breaking is in its high potential in operating human-like conversations and texts and presenting information that the user is searching for in seconds, which makes it ubiquitous in various areas. Moreover, it provides responses in the user's language. Also, topics and language could be changed during a chat. Even if AI use in language learning in general has been claimed to be still underrepresented (Huang et al., 2023), the existing research on the use of ChatGPT provides evidence on the significance of it in language learning (Huang et al., 2022; Jeon, 2021; Jeon, 2022; Lee & Jeon, 2022). Considering its affordances, it is even regarded as a "guardian angel" (Tlili et al., 2023, p. 1) for language learners. In this sense, the assumption could be that language learners' views about its use are quite positive, which has been supported by research findings. For instance, in a study relating ChatGPT usage and informal digital learning of English based on technology acceptance model, Liu and Ma (2023) found out that the participants viewed its usage positively, supporting evidence on its high potential to be a powerful CALL tool. Concerning its high potential, in their review, Kohnke et al. (2023) presented several suggestions to language learners and teachers on how to use it effectively. Specific to speaking skill, they suggested that it could be utilized to conduct dialogs, and ChatGPT could benefit to all proficiency levels as it could adjust complexity of dialogs in accordance with the user's language proficiency level.

Limitations are inevitably expected in relation to any digital tools. As for the ChatGPT's limitations in language learning, concerns center around its potential to evoke plagiarism. ChatGPT can generate texts and complete tasks that learners are supposed to do. Thus, it raises a concern about ethicality and plagiarism. Moreover, the chatbot could

provide inaccurate responses. Reliance on what is provided by ChatGPT has potential to lead further concerns and problems. Highlighting necessity of digital literacy, Kohnke et al. (2023) stated that training students on how to use ChatGPT effectively, raising awareness about the concerns and limitations could be a way to dispel concerns, which has supports in the literature (eg., Hamouma & Menezla, 2019; Perry, 2021; Yang et al., 2022)

Overall, considering the affordances, benefits of ChatGPT that are generally associated with self-regulated learning and, thus, high level of language proficiency and the nature of speaking skill with paralinguistic, pragmatic features, this study focuses on how it is used by EFL learners for speaking practice purposes.

## METHOD

### *Research Design*

Addressing the research question(s), the current research was designed as a qualitative study. As stated by Creswell (2014), in order to “collect detailed information using a variety of data collection procedures over a sustained period of time” (p. 101), the study was determined as a case study. Therefore, the participants’ ChatGPT use for speaking was examined over an eight-week period through screen-recordings and individual online interviews each week. While screen-recordings included the participants’ recording of their screen while or after they have used ChatGPT, the online interviews were stimulated-recalls in which they were encouraged to reflect on their experience. In an introductory online meeting, the participants were explained the research and procedures involved in it. In this meeting, background information about their language learning experience, their attitudes towards using digital and AI tools in language learning, their possible experience in using ChatGPT in language learning was gathered. Furthermore, they were introduced ChatGPT and provided with suggestions and prompts on how to use it for speaking purposes. The prompts included contextual dialogs in which various speech acts were performed such as asking for permission and requesting. Later, the participants used the chatbot for eight weeks. An online stimulated-recall interview was held at the end of each week, and they reflected on their practice. Finally, a semi-structured interview was held about their overall reflection on the use of ChatGPT. The interviews were held in the participants’ mother tongue; Turkish and translated into English.

### *The Researcher’s Role*

Indicating the researcher’s role in data collection and analysis is fundamental in qualitative research design (Creswell, 2014) as there could be biases negatively influencing the process in which the researchers interpret the results. Therefore, it is necessary to explain researchers’ background in relation to the research purpose and design to avoid any misconception. The biases that could be involved in this research are related to the research interests of the researcher in which the speaking skill and especially how to improve it particularly by integrating technology are among the primary ones. Thus, ChatGPT in

language learning as an AI tool has been an insight for the researcher. Yet, she avoided sounding as if she favored its use, and no interruption was made to the participants during data collection. Objectivity was the principle underlying all phases in the research.

### *Research Ethics*

In this study, ethical issues were meticulously handled. To this end, the ethical approval to conduct the study was gained from Zonguldak Bülent Ecevit University on the date of 28.03.2023. Furthermore, before pooling the participants, they were informed about the ethical issues and procedures concerning the research on a written form. Only voluntary students who agreed on participating in the research were involved in the study. During the interviews, the participants were informed about data recording and sharing principles. No personal data were shared with third parties.

### *Participants*

The participants were four language learners (3 female and 1 male at the age of 18-25) studying English at the School of Foreign Languages of a state university in Türkiye in the 2022-2023 academic year. Purposeful sampling was the main method in determining the target group. Concerning research purposes, pre-intermediate level group at the program was selected as the possible sample. Before recruiting the participants, the students in this group were informed about the research, and four of them were voluntary to participate in it. A pseudonym was picked for each participant, and they are to be addressed with the pseudonym in the rest of the paper.

**Table 1**

#### *Demographic and Background Information about the Participants*

Duygu	Female, no experience in ChatGPT use before
Neşe	Female, no experience in ChatGPT use before
Sevinç	Female, no experience in ChatGPT use before
Umut	Male, uses ChatGPT for his studies

### *Data Analysis*

Qualitative data analysis was performed on the data collected from the interviews and screen-recordings about the participants' ChatGPT use. Hand coding was conducted for the content analysis, and the data were categorized in accordance with common themes and codes that were then sustained through *member checking* (Creswell, 2014). Finally, participants' responses were used as explanations for them.



## RESULTS

This research aimed to focus on how ChatGPT is used by pre-intermediate EFL learners to practice speaking as part of out-of-class studies. For in-depth analysis, several sub-questions were addressed. First of all, what kind of practices they made was explored. As the importance of training has been emphasized in the existing literature, they were guided on possible ways to practice speaking on ChatGPT. The guidelines were based on contextual conversational patterns and speech acts such as asking for permission. The analyses of screen-recordings of the participants' ChatGPT usage revealed that the participants who got acquainted with ChatGPT only through guiding in this study practiced conversational patterns like the ones in the guiding session (Duygu, Neşe and Sevinç). They did not try any other uses. However, Umut, who had already had experience in using ChatGPT for various language study purposes, practiced speaking differently from the way that was suggested in the guiding session. He practiced it without any focus on a specific pattern or pragmatic action. Examples as evidence on this finding are as follows:

### Examples from Duygu's ChatGPT practice

İngilizce B1 Seviyesinde 'Opinions' cümlelerine örnek verir misin ?

Tabii ki! İşte B1 seviyesinde "opinions" (fikirler) konusunda örnek cümleler:

1. In my opinion, traveling is the best way to broaden one's horizons.  
(İnançımaya göre, seyahat etmek, bir kişinin ufuklarını genişletmenin en iyi yoludur.)
2. I think technology has made our lives easier in many ways.  
(Sanırım teknoloji, hayatımızı birçok açıdan kolaylaştırdı.)
3. From my point of view, exercise is essential for maintaining good health.  
(Benim bakış açımaya göre, egzersiz iyi bir sağlık için önemlidir.)

Teşekkürler, Birde ' Agreeing Opinions ' cümlelerine İngilizce B1 seviyesinde örnek verebilir misin ?

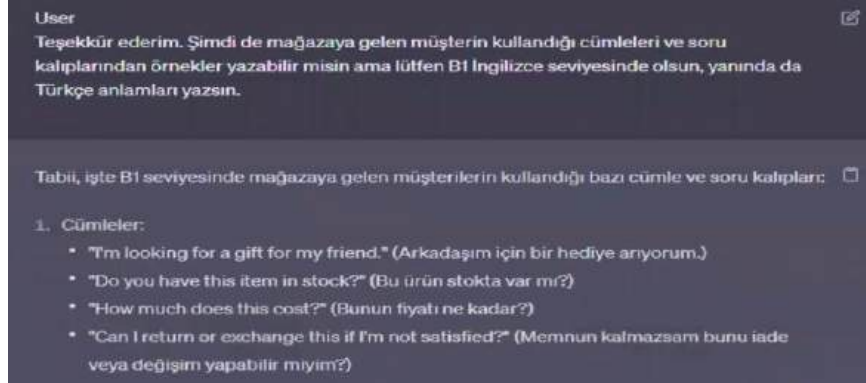
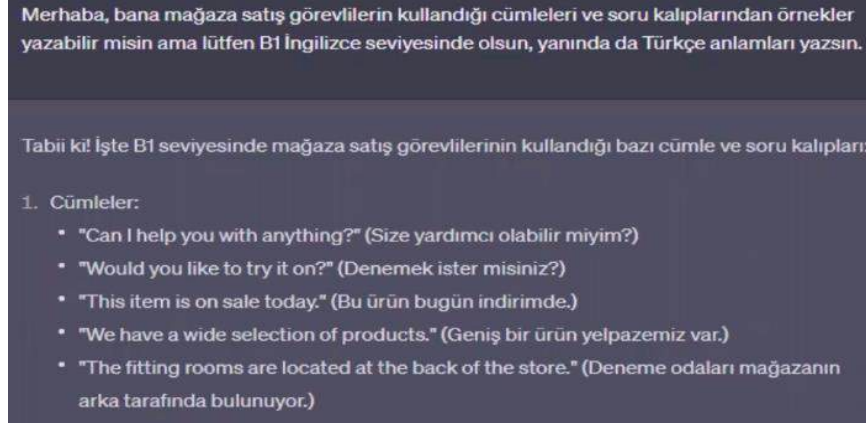
Elbette! İşte B1 seviyesinde "agreeing opinions" (fikirlere katılım) konusunda örnek cümleler:

1. I agree with you completely. The new policy will definitely improve the situation.  
(Seninle tamamen aynı fikirdeyim. Yeni politika kesinlikle durumu iyileştirecektir.)
2. I couldn't agree with you more. Learning a second language is an invaluable skill.  
(Seni daha fazla destekleyemem. İkinci bir dil öğrenmek paha biçilmez bir yetenektir.)
3. You're absolutely right. The company should invest more in employee training.  
(Kesinlikle haklısın. Şirket, çalışan eğitimine daha fazla yatırım yapmalı.)

As seen in the extracts, Duygu preferred practicing in her mother tongue, Turkish, even though they were suggested about the use of English and Turkish in the session. The translation of her messages in the first extract is "Can you give me examples about how to

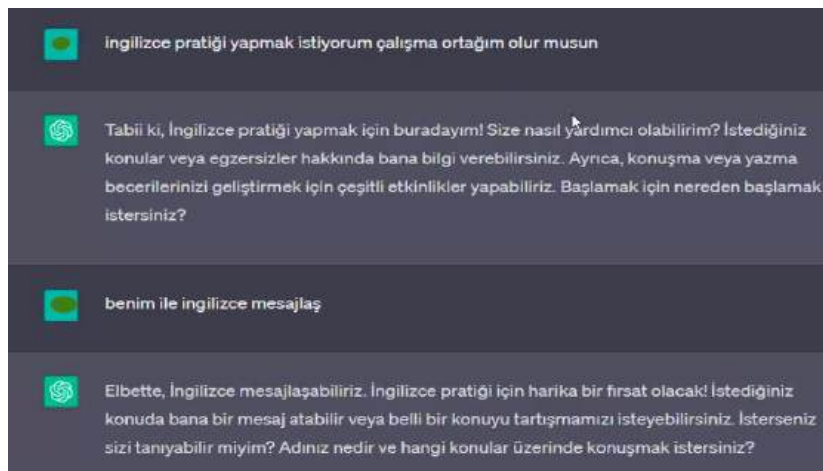
express opinions in English in B1 level? Accordingly, the chatbot gives examples about expressing opinions and agreeing on them in Turkish and English on sentence level.

### Examples from Neşe's ChatGPT practice



As in Duygu's examples, Neşe's prompt was in Turkish, and she practiced shopping in English. For this purpose, she asked ChatGPT to provide shopping phrases in English and Turkish translation of them. She also stated her language level as B1. In the first screenshot, she asked about what a shop assistant could say, and she asked about what a customer can say in the second one. ChatGPT appropriately responded to her requests. Sevinç also wrote her prompts in Turkish and had practice in the same way as Duygu and Neşe, but Umut's prompts were different from theirs.

### Examples from Umut's ChatGPT practice





Umut also used ChatGPT in Turkish to practice speaking in English. His prompt was “I want to practice English. Could you be my partner?”. ChatGPT responded positively to his request with the message “Of course, I am here to help you to practice English. You can inform me about what topics and exercises you want to practice on. Also, we could make various practices to improve your speaking and writing. Where do you want to start?”. Umut’s response was “write messages to me in English”. ChatGPT asked him to specify the topic on which they were going to have a chat, and they agreed on daily routines. As the chat was still in Turkish, ChatGPT asked about Umut’s daily routine in Turkish. Umut responded in English, so the chat continued in English. As seen in ChatGPT’s message, the chat was not about Umut’s daily routine, but about the future. When he wrote about his final exam, ChatGPT offered to help him about exam preparation. In the examples, it is seen that ChatGPT adjusts complexity in the language use (B1 level) and responses (daily routine-future) in line with the user’s prompts.

While the second sub-question addressed if the participants had human-like conversations with ChatGPT, the third one focused on whether they had any problems when using it. To this end, these two research questions seem connected. As for the findings of these questions, the examples concerning the participants’ ChatGPT use provide evidence for human-like conversations with the chatbot. On the other hand, the conversations were not always without problems. The examination of screen-recordings put forward that the participants occasionally had problems when ChatGPT misunderstood the prompts, provided long responses, or the participants could not express what they really asked for in their prompts. An example could be found in Sevinç’s experience.

### An example from Sevinç's ChatGPT practice

S: Bu ifadeleri Türkçe ve İngilizcesiyle birlikte diyalog halinde örnekleyebilir misin?

C: Tabii, işte Türkçe ve İngilizce olarak örnek bir diyalog:

Türkçe

Müşteri: Merhaba, kolsuz bir yaz elbisesi arıyorum. Çiçek desenli olanlardan var mı?

Satıcı: Merhaba, evet tabii ki. İşte size çeşitli çiçek desenli yaz elbiseleri

İngilizce:

Customer: Hello, I am looking for a sleeveless summer dress. Do you have any with floral prints?

In this chat, Sevinç practiced making a dialog about shopping. First, she asked about what phrases to use. When ChatGPT provided some phrases, she asked if the chatbot could use the phrases in dialogs in Turkish and English. Thereupon, ChatGPT first provided a dialog in Turkish and the translated version of the dialog in English. The analysis of recordings revealed that Duygu used a strategy to deal with this problem by making ChatGPT wait for her responses.

### An example from Duygu's ChatGPT practice

Tamam ben şimdi cevaplarımı tek tek yazıcam . Benim cevaplarımı bitirmemi bekle.

Tabii, sizi dinliyor olacağım. Cevaplarınızı yazdığınızda bana bildirin, bekliyorum olacağım.

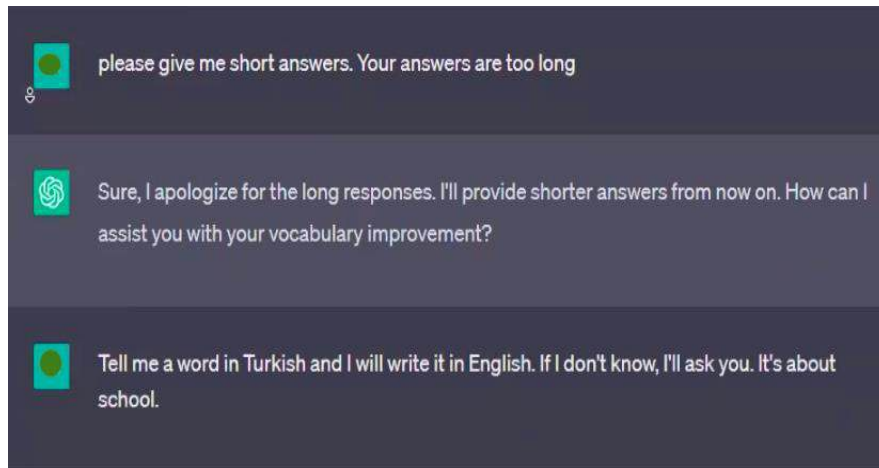
1. A: I agree with you

B: That's great to hear. It's always nice to find common ground on opinions.

2. B: I couldn't agree with you more !

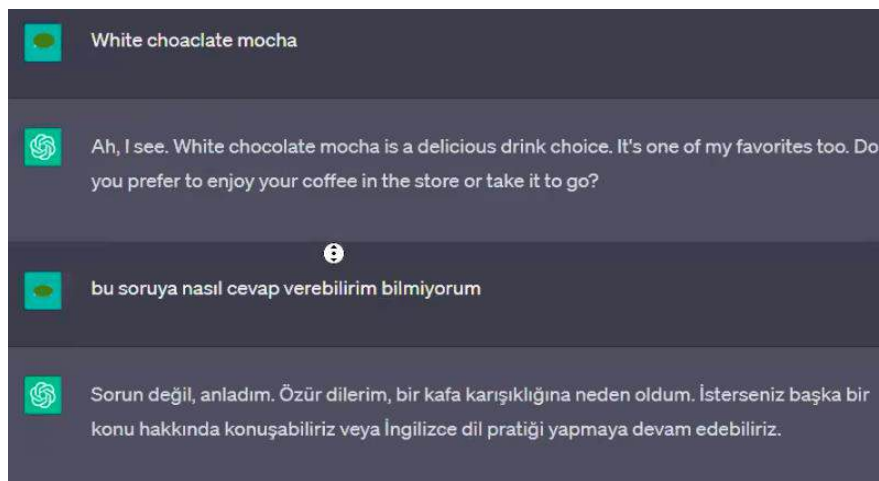
In this example, Duygu wrote "OK, I will write my responses one by one. Wait until I finish writing." ChatGPT agreed on that, and there were no problems in their understanding each other. Moreover, ChatGPT's long responses and not being able to respond were problems had by Umut.

### An example from Umut's ChatGPT use



As seen in the example, Umut explained that ChatGPT's responses were too long, which is in fact a strategy to deal with this problem. He also expressed when he did not know how to respond what ChatGPT had asked.

### An example from Umut's ChatGPT use



As seen in the example, they started conversation in English, and Umut switched into Turkish when he expressed that he did not know how to respond. Conforming his response, ChatGPT went on in Turkish, and apologized for the confusion.

The last sub-question focused on the participants' views about their experience in using ChatGPT for the speaking skill. Content analysis of the interviews suggested themes and codes which are as follows.

**Table 2.** Content analysis of the interviews about the participants' views

<b>Benefits</b>	<b>Drawbacks</b>
Providing opportunity to practice speaking in English	Incorrect responses
Scaffolding with detailed explanations and constructive feedback	Long responses
<b>The importance of prompts</b>	<b>The importance of prompts</b>
Flow in speaking	Misunderstanding leading to disruption in the chat

In keeping with the examples of the participants' ChatGPT use, the interviews confirmed that the participants had some problems when using the chatbot. Nevertheless, their overall reflection was that it could be effective to use it for speaking, and they had positive views about using it. In that regard, two of the responses are as follows:

Duygu "It was a good experience for me. Before that, I had not known ChatGPT. I practiced dialogs a lot, and it was helpful as we do not have many opportunities to practice speaking outside of the classroom."

Neşe "While using ChatGPT for speaking, I felt as if there had been a human that I was chatting except that I could not see his or her gestures. Yet, they were obvious enough in the conversations. I think this tool is effective when used properly."

In sum, the findings suggested the participants who had practiced speaking through ChatGPT found it useful, but they had several problems while using it such as break down in conversation which was caused by ChatGPT's misunderstanding.

## DISCUSSION

AI use in language learning is such a new research field that any contribution to better understand connections among related concepts could be considered as significant. Thus, this study revealed rich empirical evidence on this emerging research. The current research that was designed as a qualitative study provided long-term data on how EFL learners with pre-intermediate level used ChatGPT for speaking. In addition to its purpose of providing evidence in a general sense, the study particularly focused on language proficiency since high proficiency is often associated with higher level of learner autonomy and self-regulated learning. Therefore, language learners with lower level of proficiency were included in the study with an inquiry that questions if they had similar learner characteristics with the ones

having high level of proficiency. In this sense, it emerged that the participants in the study used ChatGPT effectively regardless of their proficiency. This finding is opposed to what has been suggested about self-regulated learning and proficiency (e.g., Zimmerman, 2000).

Additionally, digital literacy has been stated to be crucial for effective use of any digital tools (Bećirovic et al. 2021; Hamouma & Menezla, 2019; Kohnke et al. 2023; Perry, 2021; Yang et al., 2022). In the study, participants were guided on how they could use ChatGPT for the speaking skill, and the results demonstrated that they used the chatbot in the same way as they were guided. Considering that they found using ChatGPT for speaking through a guided practice, it could be concluded that this finding supports the existing research on the necessity of digital literacy and guidance on developing it.

This study also provided empirical evidence on ChatGPT's usage in language learning by suggesting its affordances and limitations. Benefits mentioned by the participants were providing opportunities to practice language and scaffolding by adjusting language and content in line with users' proficiency and providing constructive feedback while drawbacks were about problems caused by ChatGPT's misunderstanding. These findings are significant because existing literature mainly provides findings about learners' views and perceptions (e.g., Liu & Ma, 2023). Furthermore, the findings about benefits and drawbacks could be used to comment on what Sharadgah and Sa'di (2022) indicated about the nature of speaking and lack of potential of chatbots to improve speaking as it comprises paralinguistic elements such as emotions, gestures and body language that the machines could not manage.

To sum up, this research offers results that could increase understanding about how a new AI tool, ChatGPT, is used by language learners, which has been supported with evidence collected over a long period of time.

### LIMITATIONS AND RECOMMENDATIONS

While this study endeavored to provide deep insights into how EFL learners with pre-intermediate level used ChatGPT for the speaking skill, there were inevitable constraints, ranging from methodological restrictions to unforeseen external factors. For instance, limitations in this research might include limited sample size even though it was due to the nature of case studies. This limitation could impact the generalizability or applicability of the results.

To counter these limitations and enhance the robustness of future studies, the following recommendations are proposed:

1. Expand the sample size across different demographics.
2. Incorporate mixed methods to capture both quantitative and qualitative dimensions.

## CONCLUSION

This study aimed to investigate how EFL learners used ChatGPT for the speaking skill. Around this main aim, it was designed as a case study the data of which were collected over a relatively long period of time. The data analysis revealed findings that could contribute to existing research by providing insight to better understand “the guardian angel” (Tlili et al., 2023, p. 1) of the rapidly changing and developing digital and AI world.

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## Data Availability Declaration

### Data Availability Upon Formal Request:

While the primary datasets utilized in this study are not publicly accessible due to certain constraints, they are available to researchers upon a formal request. The author has emphasized maintaining the integrity of the data and its analytical rigor. To access the datasets or seek further clarifications, kindly reach out to the corresponding author. Our aim is to foster collaborative academic efforts while upholding the highest standards of research integrity.

## Author Contributions

### *Author Contributions:*

The sole author of this research, Ümran Üstünbaş, was responsible for the conceptualization, methodology formulation, data collection, analysis, and interpretation. Furthermore, Ümran Üstünbaş took charge of drafting the initial manuscript, revising it critically for vital intellectual content, and finalizing it for publication. The author has read and approved the final manuscript and takes full accountability for the accuracy and integrity of the work presented.

### *Author(s)' statements on ethics and conflict of interest*

**Ethics statement:** I hereby declare that research/publication ethics and citing principles have been considered in all the stages of the study. I take full responsibility for the content of the paper in case of dispute.

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## Probing into the impact of EFL teachers' instructional innovativeness on student engagement: A predictive moderated model

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### Abstract:


The main purpose of this study is to investigate the impact of English as a Foreign Language (EFL) teachers' instructional innovativeness on student engagement, with specific reference to behavioral and emotional aspects of engagement as perceived by the teachers. Given the ever-changing demands of contemporary education, this study underscores the importance of innovativeness and its influence on student engagement in L2 learning and teaching. The study adopted a cross-sectional design, utilizing a predictive moderated model, also assessing whether various teacher background variables such as educational status, gender, and field of graduation moderate the relationship between instructional innovativeness and student engagement. Data from 144 EFL teachers across Turkiye underwent analysis through partial least squares structural equation modeling (PLS-SEM). It was shown that instructional innovativeness significantly predicts both behavioral and emotional student engagement. However, only educational status, particularly differences between BA and PhD degrees, was found to moderate the impact on behavioral engagement, with no significant moderating effects identified for emotional engagement. In conclusion, this study highlights the merit of cultivating and fostering a culture of innovation among ELT practitioners to benefit students.

**Keywords:** EFL, innovation, engagement, technology, PLS-SEM

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## INTRODUCTION

Student engagement has long been recognized as a critical component in educational settings, influencing learning outcomes and overall student success. Defined as the extent to which students are involved in and committed to their learning, student engagement encompasses behavioral, emotional, and cognitive aspects of participation in educational activities (Fredricks et al., 2004). Within the context of learning and teaching English as a Foreign Language (EFL), student engagement is particularly paramount due to the need for active involvement in the learning process. Concurrent with the emphasis on student engagement is the significance of instructional innovativeness among EFL teachers. As the global landscape transforms, instructional strategies and instruments are also evolving to better engage and empower students. Teachers' adoption of instructional innovations, influencing and influenced by organizational dynamics, school climate, and classroom environment, revolutionizes teaching practices and the overall educational landscape through the incorporation of emerging methodologies and technologies. In this respect, teachers' openness to embracing innovative teaching practices is a fundamental factor in enhancing educational outcomes (Ghaith & Yaghi, 1997). Teachers display innovative approaches through different aspects such as goal-setting, updating curricula, adopting new teaching methods, improving interactions, and integrating advanced technologies (Salessi & Etchevers, 2020). Instructional innovation also transcends the boundaries of the physical classroom, extending to the virtual and blended learning environments (Kurucova et al., 2018). Through online learning platforms and virtual classrooms, EFL practitioners have unprecedented access to innovative pedagogical tools and resources that surpass spatial constraints and temporal limitations. As a result, recognizing that engagement is not a passive state but an active process, EFL teachers are increasingly turning to innovative methods to invigorate their classrooms. Whether through project-based learning, flipped classrooms, gamification, Web 2.0, or other innovative modalities, teachers consistently exert effort to create vibrant learning environments conducive to L2 development.

In the sphere of education, the dynamics between teachers' innovative practices and student outcomes are highly compelling. More specifically, the link between EFL teachers' adoption of instructional innovations and L2 learners' engagement, typically represented through educational technologies rather than the notion of 'innovation', is a topic of increasing interest and relevance in L2 research. Recent studies underscore the importance of adaptive and creative instructional methodologies in EFL settings, highlighting how they significantly influence student engagement. Insights have been derived from both within and outside the L2 domain. For instance, a meta-analysis by Means et al. (2013) stresses the efficacy of blended learning approaches, which integrate face-to-face instruction with online educational activities, in promoting student engagement and academic success. Likewise, research by Afzal and Rafiq (2022) demonstrated that effective instructional techniques are associated with increased student involvement in class, reinforcing that innovative teaching

strategies tailored to the needs of EFL students can bridge gaps in engagement that traditional methods fail to address. Abdelhalim (2017) focused on reading engagement in EFL contexts and proposed specific instructional strategies aimed at improving students' reading comprehension, showing that the overall training and strategies applied promoted students' active engagement. Moreover, Teng and Wang (2021) examined the influences of two types of educational technology on student engagement in Chinese EFL courses, that is, social networking systems and learning management systems. Their findings suggested that both have significant effects on tridimensionality of student engagement. Alsowat (2016) examined the flipped classroom teaching model in EFL contexts and found that flipped learning leads to gains in students' L2 higher-order thinking skills, engagement, and satisfaction.

The necessity for innovation among teachers is driven by rapid technological and social advances in society. Despite this need, there has been limited research into the notion of innovativeness of teachers, including the factors that influence it and the potential outcomes it can yield (Thurlings et al., 2015). This study sets out to explore the impact of EFL teachers' instructional innovativeness on student engagement, particularly focusing on behavioral and emotional engagement as perceived by teachers. Since cognitive engagement depends on age and capabilities (van Uden et al., 2013), this study centered specifically on the behavioral and emotional aspects of student engagement (Mih et al, 2015; Shih, 2008; Thomas & Baral, 2023). This study also examines the moderating effect of various background variables, including educational status, gender, and field of graduation, on the relationship between instructional innovativeness and student engagement. By examining these relationships, the study uncovers whether EFL teachers' innovativeness influences perceived student participation and interest in learning, and how this relationship may vary across different teacher demographics. With these considerations in mind, this study proposed the following hypotheses.

**H1:** EFL teachers' instructional innovativeness predicts students' behavioral engagement.

**H2:** EFL teachers' instructional innovativeness predicts students' emotional engagement.

**H3:** EFL teachers' background variables, i.e., educational status, gender, and field of graduation, exert a moderating effect on the relationship between their instructional innovativeness and students' behavioral engagement.

**H4:** EFL teachers' background variables, i.e., educational status, gender, and field of graduation, exert a moderating effect on the relationship between their instructional innovativeness and students' emotional engagement.

## Behavioral and Emotional Engagement

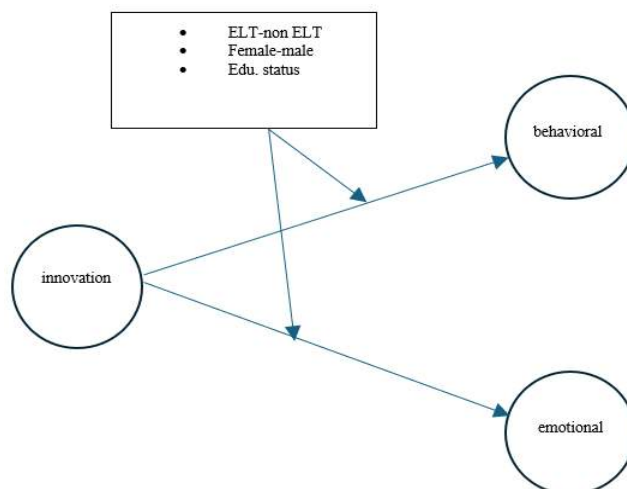
Fredricks et al. (2004) proposed a multifaceted model of student engagement that consists of three interconnected dimensions: behavioral, emotional, and cognitive. Behavioral engagement is characterized by appropriate behavior in school settings, active participation in academic tasks, and involvement in school-related activities. Emotional engagement encompasses the range of feelings students experience at school toward peers, teachers, and learning in general, such as happiness, sadness, boredom, anxiety, and curiosity (Jimerson et al., 2003). Cognitive engagement, on the other hand, focuses on students' cognitive investment in learning, that is, the mental operations they employ when tackling academic tasks, along with the variety and effectiveness of the strategies they utilize (Walker et al., 2006). Beyond behavioral, emotional, and cognitive aspects, engagement also involves an agentic dimension, which entails "students' constructive contribution into the flow of the instruction they receive" (Reeve & Tseng, 2011, p. 258).

Though no consensus exists on which components of engagement are more essential, studies often incorporate the behavioral and emotional elements of engagement (Lee, 2012). In line with the focus of the present study, Finn (1989) introduced a model of student engagement that is composed of two main elements: participation and identification. Participation, the behavioral aspect of the model, involves students sticking to school rules, following teacher instructions, and completing their assigned tasks. Identification, that is, the emotional facet, refers to students' feelings of connectedness to the educational institution and their attitudes toward learning. Along similar lines, Skinner et al. (2009) introduced a conceptual framework for understanding student engagement in educational settings, aligning it with traditional motivational definitions. Their framework separates engagement from disaffection, and differentiates between behavioral and emotional aspects of engagement while they do not function independently (van Uden et al., 2013).

## METHOD

### *Research Model*

Adopting a cross-sectional study design, this study utilizes a predictive moderated model to investigate the relationship between EFL teachers' instructional innovativeness and the two dimensions of student engagement, and potential moderating influences of a number of teacher background factors in this relationship. The research model is provided in Figure 1.



**Figure 1**  
Research Model

### *Participants*

The sample consisted of 144 English as a Foreign Language (EFL) teachers from different geographical locations across Türkiye. The majority of the sample were female teachers ( $n=112$ ), with 31 males, and one teacher who chose not to reveal their gender. The average age and professional experience of the teachers were 36.9 and 13 years, respectively. The educational makeup of the sample featured 38 teachers with Bachelor's degrees, 89 teachers with Master's degrees (ongoing or completed), and 17 with doctoral degrees (ongoing or completed). Most of the participants held degrees in English Language Teaching ( $n=112$ ), while others were graduates of non-ELT programs such as literature and translation ( $n=32$ ).

### *Data Collection Tools*

#### *Instructional Innovativeness Measurement*

The participants' instructional innovativeness scores were obtained from the Instructional Innovation scale comprising four items, a part of the revised version of the School Level Environment Questionnaire (revised SLEQ) developed by Johnson et al. (2007). The authors conducted both exploratory and confirmatory factor analyses, identifying and confirming five hypothesized factors. Teachers responded to the items in the Instructional Innovation scale (e.g., "we are willing to try new teaching approaches in my school.") on a five-point scale ranging from one (strongly disagree) to five (strongly agree). Teachers' responses to instructional innovativeness yielded a mean score above the average ( $\bar{X}=3.27$ ).

#### *Engagement Scale*

Student engagement as reported by teachers was measured through "Engagement Versus Disaffection with Learning: Teacher Report" scale which includes four statistically distinguishable sub-scales (Skinner et al., 2009). Given the specific purpose of the current



study, conceptually discerning engagement from disaffection, thereby excluding the disaffection sub-scales, the two sub-scales that measure students' behavioral and emotional engagement were utilized. Both of the sub-scales include five items, with minor modifications applied for the present study, such as "when working on classwork in my class, students appear involved." (behavioral), and "in my class, students are enthusiastic." (emotional). The items were rated on a four-point scale ranging from one (not at all true) to four (very true). Teachers' assessments of their students' behavioral and emotional engagement resulted in mean ratings of  $\bar{X}=2.36$  and  $\bar{X}=2.96$ , respectively, which shows the participating teachers perceived their students to be more emotionally engaged than behaviorally engaged.

### *Data Collection and Analysis*

The data collection instruments were administered online for practicality and accessibility. Participation in the study was voluntary, with all participants providing informed consent. Analysis of the data, conducted through SmartPLS 4 software (Ringle et al., 2022) with a 5,000 bootstrap sample, included a three-step procedure. The first step was oriented to the measurement model to examine the reliability and validity of the constructs. In the second step, using partial least squares structural equation modeling (PLS-SEM), the structural model was assessed to reveal the associations between the exogenous and endogenous variables (Hair et al., 2017). In contrast to the commonly used covariance-based SEM (CB-SEM), PLS-SEM uses a variance-based approach, and focuses on maximizing the explained variance in dependent variables (Hair et al., 2021; Jöreskog & Wold, 1982). Moreover, as a composite-based structural model, PLS-SEM is an effective method for theory development and exploratory analysis, without being affected by data distribution issues (Hair et al., 2021; Sarstedt et al., 2011). Thirdly, a multigroup analysis (MGA) was performed to reveal the interaction effects of variables. It is recommended to use PLS-based MGA instead of the traditional t-test approach when analyzing differences between path coefficients (Afthanorhan et al., 2015).

### *Ethical considerations*

Ethical Review Board: Selcuk University, Faculty of Education, Ethical Review Board

Date of Ethics Review Decision: 27.06.2023

Ethics Assessment Document Issue Number: E.780010

## **RESULTS**

### *Analysis of the Measurement Model*

Following the guidelines of Hair et al. (2017), reliability and validity of the reflective constructs were assessed. First, regarding the factor loadings, in the Instructional Innovation scale, one item had a negative loading and was consequently removed. The remaining factor

loadings were at an acceptable range, spanning from 0.84 to 0.93. Composite reliability (CR) and Cronbach's alpha values of the constructs exceeded the threshold of 0.70 (Cohen, 1988). The constructs also had average variance extracted (AVE) values above 0.50 (Fornell & Larcker, 1981). The values, suggesting convergent validity and internal consistency, are presented in Table 1.

**Table 1**

Validity and Reliability of the Constructs

Latent constructs	AVE	CR	Cronbach's Alpha
Behavioral engagement	0.791	0.876	0.868
Emotional engagement	0.808	0.934	0.921
Instructional innovativeness	0.753	0.835	0.836

Also, cross-loadings, heterotrait-monotrait ratio of correlations (HTMT) ratio, and Fornell-Larcker criterion were utilized to assess discriminant validity. First, cross-loadings of the indicators pertaining to the latent constructs were checked. If an indicator loads higher on a different construct than the one it is supposed to measure, it may be a sign that the indicator is not a good measure of the intended construct. Therefore, as a rule of thumb, each indicator should load higher on its own construct than on any other construct in the model (Hair et al., 2017). This process resulted in the deletion of three items, two items from the Behavioral, and one item from the Emotional Engagement scale. As shown in Table 2, all the remaining items had higher loadings on their intended constructs than on others, with differences in cross-loadings exceeding the 0.10 threshold (Gefen & Straub, 2005).

**Table 2**

Cross Loadings among the Items of the Latent Constructs

Items	behavioral	emotional	instructional innovativeness
behavioral-1	<b>0,872</b>	0,703	0,414
behavioral-2	<b>0,906</b>	0,640	0,502
behavioral-3	<b>0,890</b>	0,677	0,478
emotional-1	0,662	<b>0,876</b>	0,453
emotional-2	0,642	<b>0,884</b>	0,346
emotional-3	0,681	<b>0,926</b>	0,428
emotional-4	0,716	<b>0,909</b>	0,503
instructional-1	0,445	0,427	<b>0,863</b>
instructional-2	0,459	0,397	<b>0,899</b>
instructional-3	0,462	0,446	<b>0,840</b>

HTMT ratio of correlations were also evaluated based on the parsimonious threshold of  $<.85$  (Henseler et al., 2015), revealing satisfactory figures (emotional  $\leftrightarrow$  behavioral =  $0.842$ ; instructional innovativeness  $\leftrightarrow$  behavioral =  $0.613$ ; instructional innovativeness  $\leftrightarrow$  emotional =  $0.547$ ). Finally, Fornell-Larcker criterion, another measure of discriminant validity, was evaluated. The highlighted values in Table 3, that is, the square-roots of AVE, were greater than the estimated correlation values, thereby showing the discriminant validity of the constructs in the model.

**Table 3**

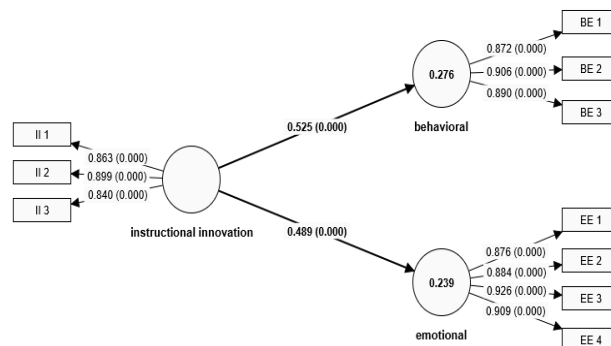
Fornell-Larcker Criterion

Latent constructs	1	2	3
Behavioral engagement	<b>0.889</b>		
Emotional engagement	0.754	<b>0.899</b>	
Instructional innovativeness	0.525	0.489	<b>0.868</b>

### *Analysis of the Structural Model*

The structural model was tested using a bootstrap sample of 5000, 5% level of significance, and percentile bootstrap confidence interval method. Before reporting the path coefficients and interaction effects, estimation of the fit of the model is provided. To this end, the standardized root-mean-square residual (SRMR) was evaluated as a goodness-of-fit measure. SRMR was found  $.059$ , demonstrating a good model fit as it is less than the suggested  $0.08$  (Henseler et al., 2014).

The structural model was evaluated in terms of its explanatory power of the endogenous constructs using  $R^2$ . The  $R$ -squared value is typically regarded as the primary method for assessing the explanatory power of a model (Henseler et al., 2016). Path coefficients were also assessed to reveal the strength of the relationships between the constructs in the model. Findings of the structural model are presented in Figure 2.



**Figure 2**

Path Coefficients

The suggested model accounts for 27.6% of the variance in students' behavioral engagement, and 23.9% in their emotional engagement. It was also determined that teachers' instructional innovativeness positively and significantly influences their perceptions of students' behavioral ( $\beta = 0.525$ ;  $t$ -value = 8.154;  $p = .000$ ) and emotional engagement ( $\beta = 0.489$ ;  $t$ -value = 7.665;  $p = .000$ ). Overall, also shown in Figure 2, the results provide evidence confirming Hypotheses 1 and 2. In other words, teachers' instructional innovativeness has a positive effect on students' both behavioral and emotional engagement.

#### *Multigroup Analysis (MGA)*

To demonstrate the estimation of the moderation effects, moderator variables were then included in pairs. A permutation MGA, a commonly used method (Matthews, 2017), was run to investigate the moderating effects of educational status (BA-MA, BA-PhD, MA-PhD), field of graduation (ELT-nonELT), and gender (female-male) on the association between teachers' instructional innovativeness and students' behavioral as well as emotional engagement. As illustrated in Table 4, MGA analyses showed that there were no significant differences between the groups on any of the paths, with the exclusion of BA-PhD comparison in the link between teachers' instructional innovativeness and students' behavioral engagement. These results reveal that neither the field of graduation nor gender serve as moderating factors in the relationship between teachers' instructional innovativeness and students' behavioral and emotional engagement. However, educational status acts as a moderator in the association between teachers' instructional innovativeness and students' behavioral engagement, but not their emotional engagement. The significant moderating effect of educational status was evident only in the comparison of teachers with BA and PhD degrees, with the influence being stronger for teachers with BA than with PhD. As a result, Hypothesis 3 was partly supported whereas Hypotheses 4 was rejected.

**Table 4**

#### Multigroup Analysis Results

Path	Path coefficient			CI	p value (2.5%; 97.5%)	Supported
	Male	Female	Difference			
Inno → BE	0.602	0.484	0,118	(-0.301; 0.291)	0.455	NO
Inno → EE	0.483	0.496	-0,013	(-0.298; 0.296)	0.921	NO
	<b>Non-ELT</b>	<b>ELT</b>				
Inno → BE	0,566	0,530	0,036	(-0.309; 0.306)	0,825	NO
Inno → EE	0,616	0,441	0,175	(-0.283; 0.309)	0,263	NO
	<b>BA</b>	<b>MA</b>				
Inno → BE	0,687	0,524	0,163	(-0.307; 0.282)	0,277	NO
Inno → EE	0,404	0,489	-0,086	(-0.290; 0.273)	0,552	NO
	<b>PhD</b>	<b>BA</b>				
Inno → BE	0,281	0,687	-0,406	(-0.317; 0.333)	<b>0,014</b>	<b>YES</b>
Inno → EE	0,701	0,404	0,298	(-0.439; 0.417)	0,156	NO

	MA	PhD				
Inno → BE	0,524	0,281	0,243	(-0.431; 0.318)	0,300	NO
Inno → EE	0,489	0,701	-0,212	(-0.382; 0.236)	0,280	NO

\*Inno=instructional innovativeness, BE=behavioral engagement, EE=emotional engagement, CI=confidence intervals, MA=Master's, BA=Bachelor's, PhD=Doctoral education.

\*Permutation MGA for MA-PhD was performed using a permutation number lower than the default (1000), probably due to the presence of a smaller number of observations in either group.

## DISCUSSION

This study examined the predictive effect of EFL teachers' instructional innovativeness on their students' behavioral and emotional engagement, as well as the potential moderating effects of several background factors such as teachers' educational status, field of graduation, and gender. First and foremost, teachers' ratings regarding their instructional innovativeness being above the average suggests that they may be receptive to adopting new pedagogical advances and innovations, and this could enhance and enrich their teaching strategies and pedagogical instruments. This readiness can facilitate the integration of digital tools, collaborative teaching methods, and personalized learning experiences (Robles, 2013). This way, formal instructional processes likely turn into more interactive sessions which adapt to diverse learning styles, resulting in overall learning effectiveness and satisfaction (Lee, 2011). While readiness to adopt new methods is a valuable instructional asset, it is also essential to acknowledge potential barriers such as resource limitations, resistance from within educational institutions, or a lack of continuous support (Avdeenko, 2020; Rahmat, 2020). Meeting these challenges is crucial for effectively implementing innovative teaching methods, and creating an environment where teachers feel encouraged and supported can lead to a more dynamic and responsive educational system. As evidenced in Makhaya and Ogange (2019), lecturers embrace eLearning not only through knowledge management procedures but also through the institution's efforts to support the community of eLearning.

Moreover, the participating teachers perceived their students to be more emotionally engaged than behaviorally engaged. The case might be that students may feel emotionally connected without necessarily showing high levels of behavioral engagement. Emotional engagement, a kind of involvement linked to motivation, interest, and a sense of belonging (Finn, 1989), involves students' feelings toward different components of the learning ecosystem (Yazzie-Mintz, 2007). Emotions are pivotal elements of student engagement, representing the affective responses students have in the classroom (Fredricks et al., 2004). As suggested by Skinner and Belmont (1993), teachers' actual behavior in the classroom has the strong potential to affect students' emotional engagement. Accordingly, teachers' instructional innovative actions, embedding motivational sustenance into the classroom, might well be one of these engaging patterns. Emotional engagement could also serve as an antecedent of behavioral engagement, which refers to participation in education-related activities such as attendance, involvement in class, and completion of assignments. In

parallel, emotional discomfort could be followed by behavioral disengagement (Wentzel et al., 2010). Altogether this might explain why teachers perceive emotional engagement as more salient, as it could exert more influence on students' motivation and satisfaction with their learning experiences.

In addition to the supplementary insights in the preceding text, the primary finding of the study, confirming Hypotheses 1 and 2, revealed that EFL teachers' innovativeness was a significant predictor of students' both behavioral and emotional engagement. This finding highlights the interconnectedness between teaching practices and student engagement. Innovative teaching practices have the potential to attract students' interest, stimulate their curiosity, and create a supportive learning environment conducive to emotional and behavioral investment (Casado et al., 2012; Lim et al., 2011). As a result, students may exhibit higher levels of participation, and overall engagement with the subject matter. This finding corresponds to a wide array of research findings which define innovation within the boundaries of ICT integration and computer innovations (Eteokleous, 2008; Loogma et al., 2012). As a case in point, the majority of Dutch MA students felt more engaged during lectures when incorporating ICT tools into the learning environment (Zweekhorst & Maas, 2015). Moreover, Wong and Yang (2017) showed the effectiveness of ICT in enhanced students engagement, autonomy, and collaborative efforts. Likewise, Tabatabaei and Gui (2011) revealed the academically engaging and motivating influences of technology use. With specific reference to the research on L2 domain, De Souza et al.'s (2021) study showed that as Filipino teachers of English increasingly embraced student-centered pedagogy for integrating technology into language instruction, students demonstrated heightened engagement and motivation in their learning endeavors.

In the present study, Hypothesis 3 was partly confirmed whereas Hypotheses 4 was totally rejected. In other words, the relationship between teachers' instructional innovativeness and students' behavioral and emotional engagement is not significantly influenced by their field of graduation or gender. However, educational status does play a moderating role. Specifically, when comparing EFL teachers with BA and PhD degrees, the impact of instructional innovativeness on students' behavioral engagement is stronger for teachers with BA degrees. Notably, this moderating effect is not observed in the case of emotional engagement. One possible explanation could lie in the differences in pedagogical training and practical classroom exposure between BA and PhD programs. BA programs often place a greater emphasis on fostering practical teaching skills, instructional innovations, and hands-on experiences. This focus on applied pedagogy may better equip BA-level teachers to effectively implement innovative instructional techniques that directly influence students' behavioral engagement. In contrast, PhD programs typically prioritize theoretical and research-oriented aspects of education, with a stronger emphasis on academic discourse and scholarly inquiry. While this advanced training is undoubtedly valuable, it may not directly translate into enhanced abilities to implement instructional innovations that capture students' behavioral engagement in the classroom setting. This

study also found that the moderating effects of teachers' educational status, gender, and field of graduation were not observed in the relationship between their innovativeness and students' emotional engagement. It is possible that the impact of innovativeness on emotional engagement may be more dependent on teachers' interpersonal skills, emotional intelligence, or rapport building (Huang, 2023; Quin, 2016), rather than their specific demographics or educational credentials.

## CONCLUSION AND IMPLICATIONS

Overall, the main finding of the study that EFL teachers' instructional innovativeness predicts their students' behavioral and emotional engagement underscores the importance of fostering a culture of innovation in L2 settings and cultivating a growth mindset among practitioners. By fostering a mindset that values experimentation, innovation, and continuous improvement, teachers can enhance their ability to effectively engage students and promote L2 outcomes. Moreover, interventions that enhance emotional engagement, such as fostering a supportive classroom climate and offering curriculum relevant to students' lives, the sine qua non in L2 settings, can also indirectly boost behavioral engagement by making students more willing to participate actively in classwork.

It is worth noting that the study's findings should be interpreted within the specific context in which it was conducted. Replication studies across diverse educational settings and subject areas would be valuable in further validating and generalizing these results. Furthermore, future research could explore the potential interactions between EFL teachers' personal and psychological dynamics, instructional practices, and other contextual factors, such as school resources, organizational support, and professional development opportunities. Understanding these complex interrelationships could inform support systems to enhance teachers' innovativeness, resulting in increased engagement, motivation, and satisfaction among L2 learners.

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### Data Availability Declaration

Data Availability Upon Formal Request:

The primary dataset utilized in this study is not publicly accessible; however, it is available to researchers upon a formal request.

### Author Contributions

*Author Contributions:*

The sole author of this research, Yusuf Demir, was responsible for the conceptualization, methodology formulation, data collection, analysis, and interpretation. Furthermore, Yusuf Demir took charge of drafting the initial manuscript, revising it critically for vital intellectual content, and finalizing it for publication. The author has read and approved the final manuscript and takes full accountability for the accuracy and integrity of the work presented.

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# Flipped Learning: An Innovative Model for Enhancing Education Through ChatGPT

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## Abstract:


The limitations of traditional education models and the advancement of technology have revealed the need to transform the learning experience. The “Flipped Learning” approach, born out of this need, is a model where students study learning materials in advance and participate in more interactive and hands-on activities in the classroom. This research discusses how the Flipped Learning model can be combined with ChatGPT. ChatGPT is a language model developed by OpenAI, and it can interact with students thanks to its natural language processing capability. In this way, combined with the Flipped Learning model, it can provide students with a more individualized and interactive learning experience. From this viewpoint, in this research, a model called “ChatGPT Aided Flipped Learning Model (CAFLM)” has been developed, which enables ChatGPT to be used in the “Flipped Learning” learning environment. CAFLM has three main phases: 1) Preparation, 2) Outside classroom teaching, and 3) inside classroom teaching. At these phases, the tasks of the student and the teacher are explained in detail. Sample activities and use cases are provided on how ChatGPT can be integrated into the Flipped Learning model and help students. To experience the model, activities developed for mathematics and science lessons were carried out using ChatGPT. The experiences have shown that the Flipped Learning model can be combined with Chatbots such as ChatGPT to provide students with a more effective and personalized learning experience. CAFLM can enable students to be more active in the learning process and contribute to innovative approaches in education.

**Keywords:** Flipped learning, chatgpt, 5E learning model, chatbot


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## INTRODUCTION

Flipped learning is a model that tries to improve students' learning experiences by reversing the traditional classroom structure. In this model, students watch video lectures recorded or prepared by the teacher at home and learn the course materials in advance. Class time becomes more interactive, and students work in class to consolidate their learning, understand concepts, and solve problems. In this model, teachers can track students' progress and become more involved in the student's learning process. Flipped learning positively affects students' success (Gross et al., 2015) and their learning motivation (Su & Chen, 2018).

The flipped learning model is an effective method for improving students' learning experiences. Chatbot technology has also played an important role in diversifying learning experiences recently. Chatbot technology can provide feedback and learning materials and help students track their learning progress (Vanichvasin, 2021).

ChatGPT, an artificial intelligence chatbot, can be used in a learning environment compatible with the flipped learning model. Students can ask questions on ChatGPT and get answers right away. ChatGPT can be used to present students' learning materials and can help students track their learning progress. Students can also reinforce their learning processes through assignments and quizzes offered by ChatGPT.

Combining the flipped learning model and ChatGPT can improve students' learning experiences. In this way, students can gain more learning motivation by making learning processes more interactive. This model may also allow teachers to monitor students' learning progress more effectively. This research focuses on how ChatGPT can be combined with the flipped learning model and how students' experience with this model can be improved.

### Flipped Learning

Flipped learning constitutes an instructional strategy in which students are exposed to preparatory materials, such as videos, readings, or interactive content, before the traditional classroom instruction. This pedagogical approach aims to foster students' autonomy and accountability for their learning, enhance their engagement and the effectiveness of face-to-face interactions, and cultivate a more immersive and rewarding learning environment (Covill, Patel, & Gill, 2013; Hwang, Lai, & Wang, 2015). The flipped learning methodology is becoming increasingly prevalent across diverse educational institutions, encompassing primary and secondary schools, higher education institutions, and professional settings (Abd Rahman, Yunus, & Hashim, 2019). Flipped learning can be employed across various academic disciplines and educational levels. Nonetheless, further longitudinal investigations are imperative to ascertain the enduring impacts of implementing the flipped learning approach.

F-L-I-P mainly focuses on four elements. These are a flexible environment, a learning culture, an intentional context, and a professional educator (Sezen-Yüksel, 2020). A flexible environment means that the teacher can create a group work and independent working environment while teaching a topic or concept. It can adapt the learning environment with physical arrangements and provide flexibility to help students learn what and when. Learning culture refers to an environment in which the student discovers knowledge. The course is devoted to more in-depth research and enrichment activities of the subjects. The student plays an active role in the creation of knowledge. The intentional context enables the teacher to use the activities in the lesson process best. Depending on the topic, it uses deliberate content to organize student-centered, active learning strategies. The professional educator takes on a more responsible role than it appears in the flipped classroom. Responsible for managing tasks such as observing students, providing feedback, and making assessments throughout the course process.

The flipped learning model changes learning environments and combines technology and face-to-face activities (Nover & Orhan, 2018). The flipped learning model is generally defined as an approach where the course process and homework are replaced (Çakır & Yaman, 2018). Although the application of the flipped learning model differs from class to class, the basic principle is the learning process and the situation in which the student first encounters the course material. While in a traditional classroom, the student encounters the course material during the course, in this model, the first contact with the material is provided outside the classroom, online, and with the opportunities offered by technology (Murphy, Chang, & Suaray, 2016).



**Figure 1.** Traditional vs. Flipped Classrooms, Source:

<https://teaching.washington.edu/topics/engaging-students-in-learning/flipping-the-classroom/>

In a traditional classroom setting, teaching often occurs as students read textbooks, work on assignments outside the classroom, and listen to lectures in class. However, in the flipped classroom model, while students learn most or all of the content outside the classroom, teaching in the classroom is carried out with group work and cooperation under the teacher's guidance (McBride, 2015). In the flipped learning model, students do the expected homework and participate in activities by accessing teaching resources outside of

school (Figure 1). The student is expected to be ready for the lesson by acquiring basic information about the subject outside the school. Class time is realized with activity and a student-oriented approach (Bergmann & Sams, 2012). The student's access to essential information outside of the classroom provides the teacher with learning opportunities to develop the student's high-level thinking skills, such as discussion, activity, and problem-solving in the classroom (Noysever & Orhan, 2018). In addition, the teacher takes the role of guiding students in the classroom. The teacher can provide immediate feedback and correct misconceptions by following students' work closely. The teacher plays an essential role in learning compared to a traditional classroom (Carter, Carter, & Foss, 2018).

Studies have pointed out that flipped learning has advantages and challenges. Akçayır and Akçayır (2018) found that student learning performance improvement is the most frequently mentioned benefit of flipped learning. However, there are also challenges related to out-of-class activities. Gündüz and Akkoyunlu (2019) indicated that students felt more responsible for their learning and experienced greater instructional flexibility. However, some people expressed dissatisfaction with the slow Internet access outside the classroom and the lack of immediate feedback while watching videos. Straw et al. (2016) emphasized that flipped learning encouraged students to take ownership of their education, learn at their own pace, and expand their knowledge and understanding. However, challenges included access to technology and the appropriateness of online resources. Fisher, LaFerriere, and Rixon (2020) found that flipped learning has positive and negative attributes and that flipped learning strategies must be conceptualized and understood as influencing or facilitating learning. Overall, the papers suggest that flipped learning can be an effective pedagogy but requires careful planning and considering potential challenges.

Studies have shown that flipped learning helps increase students' academic success. Simko et al. (2019) indicated that a flipped approach to a second-year engineering course resulted in higher marks, improved engagement, and overall student satisfaction. Låg and Sæle (2019) examined studies that compared flipped classroom teaching to traditional, lecture-based teaching. They discovered a little benefit for the flipped classroom regarding learning, pass rates, and student satisfaction. Purwaningtyas, Hidayanto, and Prabowo (2020) reviewed the success factors in flipped learning and found that applying technology and the framework used are important factors in student engagement. Bormann's (2014) literature review revealed that flipped learning has the potential to create a highly engaging educational setting, resulting in enhanced academic performance and improved readiness for the demands of 21st-century learning and professional environments. Gross et al. (2015) conducted a study in which flipped learning environment was preferred instead of the regular teaching environment. The research results showed that the flipped learning format led to a significant increase in the test scores of female and low-GPA students, improved significantly.

Flipped learning increases student success and positively affects students' desire to learn. Vliet, Winnips, and Brouwer (2015) found that flipped-class pedagogy enhanced

critical thinking, task value, and peer learning. Su and Chen (2018) indicated that flipped learning and student question generation positively impacted students' learning motivation, attitudes, and engagement. Haghegh and Nugroho (2021) found that flipped learning positively predicted students' learning motivation, attitudes, and engagement. Chung and Lee (2018) found that flipped learning improved learning motivation and attitudes. Nevertheless, Vliet et al. (2015) underscored that the impact of flipped classes was not enduring, prompting the recommendation for incorporating flipped classes repeatedly within the curriculum to ensure long-term sustainability.

During the COVID-19 pandemic from 2020 to 2022, as in-person education was suspended in schools worldwide, the use of flipped learning practices increased significantly. Even though we live in a digital age, the limited use of technology in education before the COVID-19 pandemic, along with teachers' lack of experience with online and hybrid teaching methods, left many countries unprepared for the educational challenges brought by the pandemic. Lo et al. (2021) highlighted that during the pandemic, teachers expressed concerns and desires for more detailed instructions, advanced questions, and interactive exams, emphasizing the significant need for open access flipped learning resources. Aljarvi et al. (2024) found that flipped learning during the COVID-19 pandemic contributed to students' academic success and their attitudes towards learning. López-Belmonte (2023) showed that using pedagogical methods like flipped learning during periods of health restrictions like COVID-19 created improved competencies in students. Specifically, the learning process experienced by students who followed the flipped learning course effectively benefited them in two of the three analyzed dimensions: self-regulation and decision-making. Paragoo and Sevnarayan (2024), found that pedagogy of flipping the classroom for engaged learning had a positive effect on students. Cevikbas and Kaiser (2023), in their literature review of 97 articles, stated that flipped learning is an innovative pedagogy with the potential to engage students in mathematics education through hybrid learning, combining online and in-person instruction, which is especially important during a pandemic. Their review found that flipped learning offers numerous benefits for teaching and learning mathematics.

### Chatbots and ChatGPT

Chatbots are computer programs that interact with users using natural language. They have many applications, including education, information retrieval, business, e-commerce, and customer service. According to Suta et al. (2020), the functionality of chatbots involves a three-stage process, which includes comprehending natural language input, generating automated and appropriate responses, and constructing natural language responses that are both realistic and fluent. The industry's current bottleneck in designing artificially intelligent chatbots is a lack of natural language processing capabilities. Maher, Kayte, and Nimbhore (2020) explain that chatbots use natural language processing techniques to simulate human conversation and can be applied to business, telecommunications, banking,



health, customer call centers, and e-commerce. It can also be used as a machine conversation, virtual agent, dialogue, and information retrieval system.

ChatGPT, developed by OpenAI, is a recently popular chatbot featuring a conversational artificial intelligence interface. Renowned as one of the most advanced applications in artificial intelligence, ChatGPT has garnered significant global attention (Tlili et al., 2023). OpenAI, a research lab specializing in artificial intelligence, introduced ChatGPT, a Generative Pre-trained Transformer, in November 2022. This conversational AI interface employs natural language processing (NLP) to engage in realistic interactions, encompassing the ability to respond to follow-up questions, acknowledge its errors, challenge erroneous assumptions, and reject inappropriate requests (OpenAI, 2023). While the primary objective of ChatGPT is to emulate the human conversation, it possesses capabilities that extend well beyond that scope. It can generate various forms of creative content, such as poems, stories, or even novels, and effectively assume different roles within its capacity.

As ChatGPT continues to make its way into our lives, with a wide range of uses already emerging, we are seeing an increasing number of studies on its use in the field of education. According to Lo (2023); ChatGPT has the potential to serve as an assistant for educators, such as creating teaching materials and providing suggestions, and as a virtual teacher for students, such as answering questions and facilitating collaboration. However, when used for educational purposes, it can pose various issues, such as generating incorrect or fake information and bypassing plagiarism detectors. Therefore, it would be beneficial to consider updating assessment methods and institutional policies in schools and universities to ensure the appropriate use of ChatGPT in educational settings. Furthermore, it is essential to provide education support to teachers and students to enhance the appropriate use of ChatGPT in educational settings.

In his literature review, Sallam (2023) aimed to investigate the benefits and potential limitations of ChatGPT in health education, research, and applications. He found that in 85% of the articles he examined, ChatGPT's benefits were mentioned. These benefits include: (1) Enhanced scientific writing and research inclusivity and versatility, (2) Benefits in health research, including effective analysis of datasets, code generation, literature reviews, timesaving for focusing on experimental design, and drug discovery and development, (3) Benefits in healthcare services, including workflow organisation, cost-saving, documentation, improvement of personalised medicine and health literacy, (4) Benefits in health services education, including enhanced personalised learning and focus on critical thinking and problem-based learning.

As chatbots such as ChatGPT become more prevalent and their capabilities increase in tandem with technological advancements, the lives of individuals who integrate them into their daily routines will undoubtedly change. This will lead to a greater need for studies on how chatbot-style tools should be effectively used in daily life.

## Integrating ChatGPT into Flipped Learning Model

Chatbots such as ChatGPT can be integrated into education systems to provide quick and personalized services to students and institutional employees. Okonkwo and Ade-Ibijola (2021) present a systematic review of previous studies on using Chatbots in education, highlighting the benefits and challenges of implementing Chatbot technology in education. Hiremath et al. (2018) proposed an automated system that uses neural networks, NLP, pattern matching, and data mining algorithms to enhance the performance of Chatbots in education. Clarizia et al. (2018) present a prototype of a Chatbot in the educational domain that uses natural language processing techniques and ontologies to provide answers to students. Jalil et al. (2023) evaluated how well ChatGPT answers typical problems from a well-known software testing curriculum. The studies reveal that ChatGPT can offer answers and explanations that are entirely or partially accurate. However, more research is required to assess the potential benefits and risks of chatbot use by students and instructors.

Many studies provide insights into the use of ChatGPT in different learning methods. Huang, Hew, and Gonda (2019) discuss implementing and evaluating three chatbot activities enhanced by IBM Watson in a flipped graduate course. Jalil et al. (2023) investigated how well ChatGPT performs when attempting to answer common questions from a popular software testing curriculum. Bang et al. (2023) proposed a framework for evaluating interactive LLMs such as ChatGPT using publicly available datasets and found that ChatGPT outperforms LLMs with zero-shot learning on most tasks. Finally, Mattas (2023) discusses the potential benefits and ethical considerations of conversational AI models such as ChatGPT. Overall, the papers suggest that ChatGPT can enhance flipped learning, but further research is needed to understand its potential and limitations fully.

Chatbot technology can be an effective tool for providing feedback and learning materials to students. Vanichvasin (2021) found that using a chatbot in an educational setting led to positive learning outcomes and provided students with a better-personalized learning experience. Cunningham-Nelson et al. (2019) identified potential use cases for chatbots in education, including FAQ chatbots for answering commonly asked student questions and short response quiz chatbots for providing automated feedback based on student responses. Sandu and Gide (2019) suggested that chatbot technology can improve productivity, communication, and learning in the educational sector. Bii (2013) proposed integrating chatbot technology into the teaching-learning environment to enable students to acquire 21st-century skills in a developing country. Rudolph, Tan & Tan (2023), reveals that the greatest benefit of ChatGPT is its ability to enable students to learn by doing and experiencing. By using ChatGPT, students can evaluate different strategies and approaches about problem-solving and goal achievement through game-based learning or other student-centered pedagogies. Additionally, the students who prefer hands-on and experiential learning will use ChatGPT as a learning aid. Overall, the studies suggest that

chatbot technology has the potential to enhance the student learning experience by providing personalized feedback and learning materials.

### Using 5E with Flipped Learning

The 5E learning model, developed by Rodger Bybee, is frequently used to apply the constructivist learning theory that enables students to actively use their knowledge and skills (Akkaya, 2019; Bıyıklı, 2009; Bybee, 2009). The 5E model delineates a comprehensive framework for teaching and learning, consisting of five sequential stages: Engage, Explore, Explain, Elaborate, and Evaluate. Notably, the 5E model seamlessly integrates all essential 21st-century skills, commonly called the 4Cs - create, critically think, communicate, and collaborate - and the effective use of technology (Mairc, 2020).

According to Cheng-jun (2010), the emphasis on students' self-construction is the core of the 5E teaching model. Students are the subject of the learning activities, whereas teachers are mentors and helpers. The teacher does everything to facilitate the students to inquire and acquire scientific concepts.

Many studies have revealed that the 5E learning model allows students to practice and develop competencies. The 5E model is effective in helping students practice and nurture competence in teaching natural science (Wui Nyugen & Lee, 2022). According to Bui Ngoc Phuong et al. (2021), the 5E teaching model is effective in helping students practice and nurture competence. Moreover, according to Nurdini et al. (2021), the learning environments based on the 5E learning cycle model effectively improve students' mastery of electrolyte and non-electrolyte solution material concepts and skills.

However, many studies show that the 5E learning model increases academic achievement. Gök and Tufan (2014), demonstrated that the levels of academic achievement and retention were higher in the experimental group taught with the 5E model than in the control group taught with traditional methods. Karlı and Ünsal (2008) revealed that the experimental group students who used the 5E model were more successful than the control group students who used the traditional method. They developed a more positive view of the topic. Bakri (2021) reveals that using the 5E learning model can improve mathematical learning. Kozcu Cakir (2017) revealed that the 5E learning model affected the student's academic achievement, attitude toward science, and science process skills.

According to Bybee (2009), the phases of the 5E learning model are as follows:

1) Engagement: the instructor or a curricular assignment examines the learners' existing knowledge. It assists them in becoming involved in a new idea by using brief tasks that foster curiosity and elicit past knowledge. The activity should integrate previous and present learning experiences, disclose prior assumptions, and arrange students' thinking toward current activity learning objectives.

2) Exploration: Exploration experiences offer students a standard set of activities for identifying present concepts (i.e., misunderstandings), processes, and abilities, as well as

facilitating conceptual change. Learners may participate in lab activities that allow them to apply past knowledge to develop new ideas, investigate questions and possibilities, and design and conduct a preliminary inquiry.

3) Explanation: During the explanation phase, students focus on a particular aspect of their engagement and exploration activities. This phase allows students to demonstrate their conceptual understanding, procedural skills, or application of knowledge. Additionally, teachers can use this phase to introduce new topics, techniques, or skills. Learners are encouraged to articulate and express their understanding of the concept. A teacher's or curriculum's explanation may assist students toward better comprehension, a critical aspect of this phase.

4) Elaboration: Teachers develop students' intellectual knowledge and skills. Students gain more profound and broader knowledge, information, and appropriate abilities due to new experiences. Students put their knowledge to use by participating in extracurricular activities.

5) Evaluation: The assessment phase plays a crucial role in enabling students to evaluate their understanding and skills while also providing teachers with a means to measure student progress toward educational objectives.

Studies have pointed out that the 5E and flipped learning models can be combined to create effective teaching strategies. Schallert (2020) created a design heuristic based on the 5E inquiry model for flipped classroom scenarios, and it was used in an online professional development course for secondary mathematics teachers. Asiksoy (2017) found that a flipped classroom approach based on the 5E learning cycle model improved student achievement in physics. Romero (2019) conducted a poll-based study on the impact of the flipped learning model in online-based education for secondary teachers, finding that it enhanced active and autonomous learning and improved student performance. Lee (2013) suggested instructional design methods to improve flipped learning that depend on previous knowledge and emphasize a flexible learning environment, a change in how people learn, purposeful classroom material, and teachers with professional expertise. The papers suggest that combining the 5E learning model with flipped learning can lead to effective teaching and learning strategies.

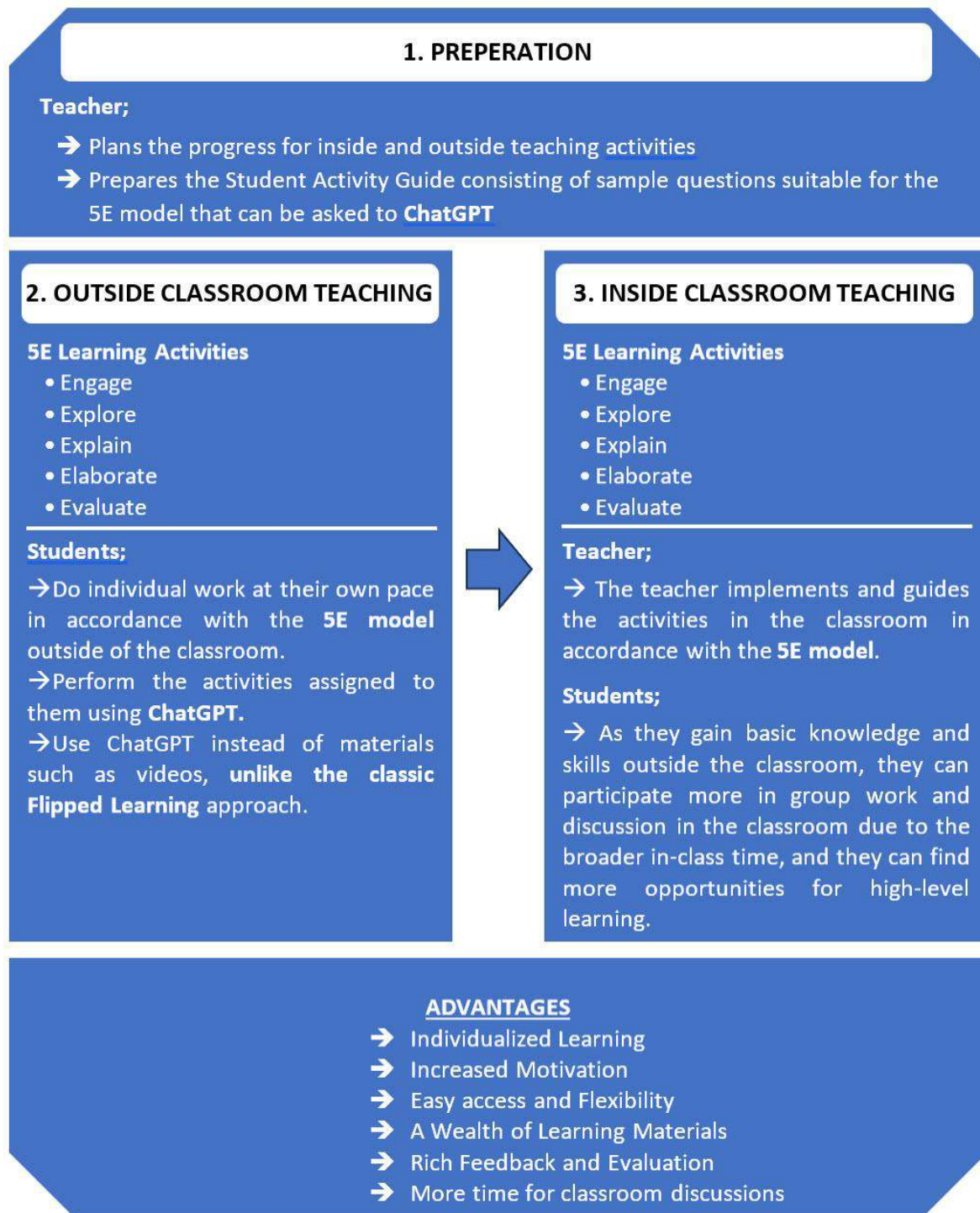
### Purpose of the Study

This research aims to develop a model that recommends using ChatGPT together with the 5E model in flipped learning environments. Flipped classrooms consist of outside-classroom activities as well as inside-classroom activities. In the scope of outside classroom activities, the teacher shares materials such as videos that were prepared before with the students. Students perform self-study, and they become ready for classroom activities. In the scope of inside-classroom activities, teaching is carried out under the guidance of the teacher. Students engage in routine activities that raise their academic performance.

This research developed a model that proposes using ChatGPT instead of the videos used in outside classroom parts of the flipped learning approach. In this model, the teacher prepares guiding activities that enable students to work with the support of ChatGPT instead of offline videos. The implementation of these activities is carried out according to the steps of the 5E learning model. Sample activities were prepared for some achievements related to Mathematics and Science lessons, and the application process was explained step by step.

### **ChatGPT Aided Flipped Learning Model (CAFLM)**

This section explains the “ChatGPT Aided Flipped Learning Model (CAFLM)”, developed in line with the purpose of the study and application process. The model can be applied to secondary and high school education levels. Within the scope of the research, sample application activities were prepared for mathematics and science lessons at the secondary school level. The model showing how ChatGPT is integrated into the Flipped Learning environment with the phases of the 5E learning model is shared in Figure 1. In the proposed model, the teaching process, both outside and inside the classroom, is prepared following the stages of the 5E model.



*Figure 2.* ChatGPT Aided Flipped Learning Model (CAFLM)

### Preperation Stage

At this stage, the teacher plans the teaching process and prepares out-of-class teaching activities, considering the achievements of the course. Sample questions are prepared so students can ask ChatGPT to make them curious about the knowledge and skills related to the lesson's target. The questions should be appropriate for students to explore their

knowledge and skills and explain the concepts they have learned. In addition, the prepared questions should be such as to enable the students to associate what they have learned with daily life and to deepen their knowledge and skills. Appropriate instructions are given so that students can evaluate what they have learned. The questions in the prepared student activity guide should be flexible. Students should be encouraged to learn the subject from ChatGPT with different questions besides these questions in the student activity guide.

At this stage of traditional flipped learning environments, the teacher provides preparation materials (video, article, sound recording, etc.) to enable students to study before the lesson. 5E model activities are presented in the proposed model, and ChatGPT is used as preparation material. In this way, students can easily access content richer than the videos and materials the teacher can prepare. For example, student activity guides are prepared and shared for mathematics and science lessons in the next step.

### Outside Classroom Teaching

At this stage, students do individual work outside the classroom and perform the activities assigned to them using ChatGPT. Supporting the outside classroom teaching phase of Flipped Learning with ChatGPT will provide students with the following benefits:

*Individualized learning:* An AI model like ChatGPT can offer students an individualized learning experience. Students can work independently and access learning materials according to their needs. ChatGPT can answer students' questions, explain, and recommend customized learning resources.

*Increased motivation:* ChatGPT can potentially increase student motivation to learn. ChatGPT can also attract and retain students' attention by providing an interactive learning environment. The responses of ChatGPT to students make the learning process more interactive and engage students.

*Easy access and flexibility:* ChatGPT during the outside classroom teaching phase allows students to access learning materials quickly and flexibly. Students can access ChatGPT anytime and anywhere. This allows students to devote more time to learning and to manage their learning processes more flexibly.

*A wealth of learning materials:* ChatGPT can offer students various learning materials. Materials in different formats, such as texts, videos, sound recordings, and simulations, can be presented to students. This allows students to select materials based on their learning styles and preferences, allowing them to learn more effectively.

*Rich Feedback and Evaluation:* ChatGPT can give students better feedback and evaluation. Students can follow their development process by asking questions and getting answers on ChatGPT. Students can also identify their weak points and evaluate their progress continuously with the help of ChatGPT's suggestions and guidance.

During the outside classroom teaching phase, the student is expected to have completed the activity the teacher gave using ChatGPT.

### **Inside Classroom Teaching**

At this stage, in-class teaching continues according to the learning steps of the 5E model. In addition, it would be more appropriate to create discussion environments and focus on group work at this stage. Students can participate in different activities to deepen their out-of-classroom learning. In the classroom, the teacher may lead discussions, group projects, problem-solving activities, or projects with students. Students are expected to participate in classroom activities actively using the knowledge they have gained from the student activity guides prepared by the teacher. During this phase, the teacher identifies the students' weaknesses and strengths, monitors their progress, and provides feedback. Feedback can be given to students individually or in groups. Various assessment methods can be used to determine the learning level of the students.

With this model, students can be supported more efficiently to develop their high-level thinking skills in the classroom because they will acquire basic knowledge and skills in an out-of-class learning environment. In addition, teachers can devote more time to high-level activities such as application, analysis, and synthesis.

### **Sample Student Activity Guides for Mathematics and Science Lessons**

The subject of "Algebraic Expressions and Identities" was chosen in the Mathematics lesson. Within the scope of this subject, a sample student activity guide has been prepared suitable for the acquisition of "Understands and writes simple algebraic expressions in different formats". Moreover, the "Electrical Loads and Electrification" subject was chosen for the Science lesson. Within the scope of this subject, an example of a sample student activity guide has been prepared suitable for the acquisition of "Classifies objects in terms of their electrical loads". The questions of these sample student activity guides are shared in Tables X and Y.

The first phase of the model is the preparation stage. An activity has been prepared for this stage to enable students to perform individual studies. This activity was developed following the steps of the 5E learning model. Below are the sample student activity guides that enable students to do individual work outside the classroom before the math and science lesson with the teacher in the classroom.



**Table 1**

*The Questions Used in Sample Student Activity Guide for Mathematics Lesson*

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**Lesson:** 8th Grade Mathematics

**Subject:** Algebraic Expressions and Identities

**Learning Outcome:** Understands and writes simple algebraic expressions in different forms.

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### 1) Engage

Have you ever heard of the concept of algebra introduced by Al-Khwarizmi, a Muslim Turkish scholar? Do you know in which areas and how we use algebra, which can be used as a communication language, in daily life? Can you research ChatGPT by asking questions such as the following? If there are other concepts that you do not understand, you can ask ChatGPT to explain them as well.

- In which areas is algebra used in daily life?
  - How can algebra be used as a language of communication?
- 

### 2) Explore

Imagine talking to your friend about how much water you can fill in a cylindrical plastic bottle at home. What kind of expression would you use to generalize about the amount of water, the volume, that similarly shaped plastic bottles of different sizes can hold and tell your friend about it? So how can the volume of a cylinder be expressed algebraically? Try to discover it by asking ChatGPT. For this, you can ask the following sample questions.

- How can I express the volume of a cylindrical plastic bottle algebraically?
  - Can I express this algebraic expression another way?
  - Can you teach algebra through a game?
  - Can you teach me the subject of algebra through the game?
- 

### 3) Explain

When we look at algebraic expressions, we can see that some letters, characters, or symbols represent unknown values and numerical values. This difference is expressed in an algebraic expression by different concepts. Let's try to learn these concepts by asking questions to ChatGPT listed below.

- Which different parts are there in an algebraic expression?
  - Could you explain and provide an example of what the terms variable, constant, and coefficient mean in algebraic expressions?
  - Can you teach me algebra by playing a game?
  - How can we simplify complex algebraic expressions?
- 

### 4) Elaboration

When we examine the equations in algebraic expressions, we see that equality is achieved for some values of the variables. These values are referred to as the equation's solution set. Sometimes we see equality provided for each value that the variable can take. These algebraic equations are also known as identities. At this point, consider these algebraic expression features, deepen your work, reach generalizations, and integrate what you learn into your knowledge. You can do this by asking ChatGPT similar questions and evaluating the outputs.

- How to write identities for algebraic expressions?
  - How can you explain the identity  $-a^2-b^2 = (a-b)(a+b)$  to me?
  - Can you visualize this algebraic expression?
  - How can I develop a model to understand the same algebraic expression by cutting papers to appropriate sizes?
  - What is the difference between the square of the difference of two terms  $(a-b)^2$  and the difference of squares  $(a^2-b^2)$  in algebraic expressions? Can you explain with examples?
- 

### 5) Evaluation

Ask ChatGPT to ask you different types of questions about algebraic expressions. After you answer it yourself, ask ChatGPT to say the answers and compare them with your answers.

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- Can you write three questions about algebra?
  - $105^2 - 5^2 = ?$  Can you show me how to solve the question using the “difference of two squares identity”?
  - Can you ask practice questions similar to these?
- 

**Table 2**

*The Questions Used in Sample Student Activity Guide for Science Lesson*

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**Lesson:** 8th Grade Science

**Subject:** Electrical Loads and Electrification

**Learning Outcome:** Classifies objects in terms of their electrical loads.

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### 1) Engage

Sometimes when we approach objects around us to touch them, we hear a crackling sound and feel a tingling sensation in our fingertips. Even if the object we touch is not an electrical device, we say, “We got shocked”. How do these objects shock us, despite not being electrically powered? You can ask ChatGPT questions similar to the following to investigate. If there are any terms you don’t understand, you can also ask ChatGPT to explain them.”

- What causes non-electrical objects to shock us?
  - Could you please explain electrical load and electrostatic briefly?
  - Could you please explain positive and negative loads briefly?
  - Could you please explain briefly how an electrostatic charge is formed?
  - Could you please explain briefly how electrification occurs?
- 

### 2) Explore

At this point, you are expected to discover what electrification is and the types of electrification. Regarding this, you can try to explore the subject by asking questions to ChatGPT, such as the following:

- What are electrification types?
  - Can you recommend a simple electrification experiment for me?
  - Can you suggest a simple experiment with electrifying by touch and electrifying by effect?
  - Can you teach me electrification by friction through a game?
- 

### 3) Explain

At this point, you need to review the subject by learning about how positive and negative loads affect electrification, what are the differences between the types of electrification, make comparisons and reach concepts. For this purpose, you can obtain information about the subject by asking the following questions to ChatGPT:

- What are the similarities and differences between electrification by friction, touch, and impact?
  - How is the electrification affected if the positive and negative charges on the objects are equal?
- 

### 4) Elaboration

At this point, it is expected that you have a thorough understanding of the subject’s specifics and the ability to apply what you have learned to other spheres of your life. You can use ChatGPT to inquire about the following things:

- What are the factors affecting the electrification event? Can you explain briefly?
  - Which electrification method lasts longer?
  - What are the applications of electrification in technology and natural events?
  - How is electrification related to atmospheric behaviors and natural events? Can you explain briefly?
- 

### 5) Evaluation

At this point, you can ask ChatGPT to ask questions to evaluate the information you have learned. While doing this, you can ask ChatGPT to ask you multiple-choice and open-ended

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questions about different sub-dimensions/sections of the subject. After answering the questions in your own way, you can also ask ChatGPT to give the answers to these questions and compare your own answers with the answers given by ChatGPT.

- Can you write five multiple-choice questions about the topics discussed in this session?
  - What are the answers to these questions?
  - Could you write three open-ended questions about the topics discussed in this session?
  - What are the answers to these questions?
- 

The activities developed during the preparation phase are shared with the students. Students perform individual studies outside the classroom in line with the instructions in the student activity guide. At this point, students are expected to control their learning processes and create their own notes and questions about the subject. Students are encouraged to come to class with their notes and questions about the subject.

The final phase of the CAFLM model is inside classroom instruction. At this phase, the teacher teaches following the steps of the 5E model. In this direction, the questions that the students take notes on during the out-of-class process at the entrance stage are discussed under the guidance of the teacher. In this process, the active participation of students is ensured by holding large and small group discussions. In the exploration phase, the teacher continues to guide. Provides instant feedback to students during the implementation of classroom activities. At this point, informal evaluations are included. Since students come to class prepared, the exploration activities carried out in the classroom are expected to be higher level. In the explanation activities, students explain the concepts and theories they have discovered. They discuss using the knowledge and skills they have acquired because of individual studies. In the deepening phase, the teacher encourages students to apply what they have learned in different situations. Tasks with different situations are given following the level of the students. Students are expected to use what they have learned in new situations. In the evaluation activities, the teacher evaluates the student's learning process. Students are allowed to self-assess. It may be appropriate to use formative assessment techniques.

## CONCLUSION AND RECOMMENDATIONS

This research aims to develop a model that recommends using ChatGPT together with the 5E model in flipped learning environments. This model aims to increase the quality of the out-of-class teaching phase of flipped learning and encourage students to do individual research. In this context, ChatGPT was chosen as the chatbot, and how to use it in the flipped learning model was explained step by step with sample applications. The developed ChatGPT Aided Flipped Learning Model (CAFLM) consists of 3 basic steps: 1) Preparation Stage, 2) Outside Classroom Teaching, and 3) Inside Classroom Teaching. In the scope of preparation stage activities, outside classroom teaching instructions (student activity guide) are developed to guide students and shared with them. At the outside classroom teaching

step, students do individual studies using ChatGPT. At this stage, students interact with ChatGPT in line with the instructions suggested in the activities instead of the digital materials used in the classical flipped learning model. Using ChatGPT, students will have more opportunities for individualized learning, higher motivation, easy access and flexibility, richness in learning materials, and effective feedback and assessment. In the classroom teaching step, which is the last step of the model, the teaching service is expected to continue under the guidance of the teacher. Since students are expected to come to the classroom prepared, it is expected that the teaching process for the classroom will be at a higher level. Students can have a more prosperous learning environment by doing group work in the classroom and participating in the discussion environment. Since teachers will not have to transfer basic knowledge and skills in the classroom, they will have more time for a more qualified education.

In this research, sample activities developed for mathematics and science lessons within the scope of CAFLM were carried out using ChatGPT. The answers given by ChatGPT are shared in the images below (Figure 3). When the obtained outputs are examined, it is striking that the answers given by ChatGPT at the engage phase are at a level that can attract the student's attention and increase their desire and curiosity to learn. In the explore phase, it can be said that the answers given by ChatGPT are at a level that supports the students' in-depth learning of the subject. Interaction with ChatGPT at this stage can help students develop their ideas, knowledge, and understanding. It has been understood that ChatGPT has the potential to include richer explanations compared to materials such as video used in the classical flipped learning approach. In the explanation phase, ChatGPT's answers to the questions are at a level that can enable students to understand the concepts. When appropriate questions are asked, ChatGPT has been observed to clarify points that are not understood and provide adequate answers. In the elaborate phase, the questions asked, and the answers given by ChatGPT are at a level that can enable students to deepen their learning and gain different perspectives. In the last phase, the evaluation phase, it has been observed that ChatGPT can ask questions that examine the achievements of the course.

<p><b>Ders:</b> 8. Sınıf Matematik <b>Konu:</b> Cebirsel İfadeler ve Özdeşlikler <b>Kazanım:</b> Basit cebirsel ifadeleri anlar ve farklı biçimlerde yazar.</p> <p><b>1) Giriş</b> Bir müdüman Türk bilgini olan El-Harezmi tarafından ortaya çıkarılan Cebir kavramını daha önce hiç duydunuz mu? Bir letişim dili olarak kullanılabilen cebir' günlük hayatta hangi alanlarda ve nasıl işe kullandığımızı biliyor musunuz? ChatGPT'ye aşağıdaki benzer sorular sorarak araştırabilir misin? Başka anlamadığın kavramlar olursa ChatGPT' den onları da açıklamasını isteyebilirsin.</p> <p>Cebir günlük hayatta hangi alanlarda kullanılmaktadır?</p> <p>Cebir, günlük hayatta birçok farklı alanda kullanılan matematiksel bir araçtır. İşte cebirin kullanıldığı bazı alanları:</p> <ol style="list-style-type: none"> <li><b>Finans:</b> Cebir, finansal işlemlerde kullanılır. Örneğin, kredi hesaplamaları, faiz oranları, yatırım getirileri gibi finansal konuları anlamak ve analiz etmek için cebirsel denklemler kullanılır.</li> <li><b>Mühendislik:</b> Mühendislikte cebir, yapısal analiz, elektrik devreleri, sinyal işleme, kontrol sistemleri gibi birçok alanda kullanılır. Cebirsel denklemler ve matrisler, mühendislik problemlerinin çözümünde önemli bir rol oynar.</li> <li><b>Bilgisayar Bilimi:</b> Bilgisayar biliminde, cebir programlama, algoritma analizi, veri yapıları ve yapıya zeka gibi konularda kullanılır. Özellikle matrisler ve vektörler, bilgisayar grafikleri ve görüntü işleme gibi alanlarda yaygın olarak kullanılır.</li> <li><b>İstatistik:</b> İstatistiksel analizlerde cebirsel yöntemler kullanılır. Veri toplama, veri analizi, elastik hesaplamaları gibi istatistiksel problemler çözülürken, denklemler, matris operasyonları ve istatistiksel modellerin cebirsel temelleri kullanılır.</li> <li><b>Fizik:</b> Fizik, cebir birçok alanda kullanılır. Hareket denklemleri, elektrik ve manyetizma problemleri, termodinamik hesaplamaları gibi fiziksel fenomenlerin modellenmesi ve analizi için cebirsel yöntemler kullanılır.</li> <li><b>Gratik ve Tasarım:</b> Grafik ve tasarım alanında cebir, perspektif projeksiyonları, geometrik şekillerin analizi, 3D modelleme gibi konularda kullanılır. Matrisler ve vektörler, grafiksel nesnelerin yerini ve yönünü belirlemek için kullanılır.</li> </ol> <p>Bu sadece birkaç örnek olup cebirin kullanıldığı alanlar oldukça geniştir. Cebir, matematiksel modelleme, problem çözme ve analitik düşünme becerilerini geliştirmede önemli bir rol oynar ve birçok farklı alanda uygulanabilir.</p>	<p><b>Ders:</b> 8. Sınıf Fen Bilgisi <b>Konu:</b> Elektrik Yükleri ve Elektriklenme <b>Kazanım:</b> Cisimleri, sahip oldukları elektrik yükleri bakımından sınıflandırır.</p> <p><b>1) Giriş</b> Bazen çevremizdeki eşyalara dokunmak için elimizi yaklaştırdığımızda bir şit sesi duyuyor ve parmak uçlarımızda bir acı hissediyoruz. Bu durumda dokunduğumuz eşya elektrikle çalıyor bir alet olması bile "elektrik çarptı" deriz. Bu eşyalar, elektrikli olmadıkları halde bizi nasıl çarpıyor? ChatGPT'ye aşağıdaki benzer sorular sorarak araştırabilir misin? Başka anlamadığın kavramlar olursa ChatGPT' den onları da açıklamasını isteyebilirsin.</p> <p>Elektrikli olmayan eşyalar bizi nasıl çarpıyor?</p> <p>Elektrikli olmayan eşyaların bizi nasıl çarpıtına dair birkaç senaryo vardı. İşte yaygın olanlardan bazıları:</p> <ol style="list-style-type: none"> <li><b>Statik elektrik:</b> Elektrikli olmayan eşyaların bazıları parçalanmış ve yaygın nedenlerden biri statik elektriktir. Statik elektrik, yüksek voltajdaki elektrik yüklerinin birikmesi sonucu oluşur. Bu durumda, elektrik yükleri bir yüzeyde birikir ve başka bir yüzeye dokunduğumuzda yükler bize geçer, çünkü yükler arasında potansiyel fark vardır. Örneğin, halıya dokunduktan sonra bir metal kapı kolu veya başka bir kişiye dokunduğumuzda küçük bir statik elektrik çarpması hissedebilirsiniz.</li> <li><b>Metalen iletkenliği:</b> Elektrik yüklerinin serbestçe hareket edebildiği ve iletken bir malzemeden yapılmış eşyalara dokunduğumuzda elektrik çarpması yaşanabilir. Örneğin, bir elektrik kablosu üzerindeki bakır tellere dokunursanız, elektrik akımı etinizi geçebilir ve çarpmaya neden olabilir.</li> <li><b>Kimyasal reaksiyonlar:</b> Elektrikli olmayan bazı kimyasal maddeler, temas ettikleriyle reaksiyona giren elektrik akımı üretirler. Örneğin, bir pozitif ve negatif uçları arasında dokunursanız, pilin içindeki kimyasal reaksiyon nedeniyle elektrik akımı oluşabilir ve çarpmaya neden olabilir.</li> </ol> <p>Bu tür çarpmalar genellikle elektrik akımının geçtiği nesneye bağlı olarak farklı şiddetlerde olabilir. Elektrik çarpması ciddi bir durum olabilir ve tehlikeli sonuçlara yol açabilir, bu nedenle elektrikli olmayan eşyalara dokunmak önemli değildir. Elektrikle çalıyor eşyaları kullanırken ve elektrikle ilgili sorunlar olduğunda bir uzmana başvurmanız her zaman en güvenli seçenektir.</p>
<p>Bir cebirsel ifade hangi farklı öğelerden oluşur?</p> <p>Bir cebirsel ifade genellikle aşağıdaki farklı öğelerden oluşur:</p> <ol style="list-style-type: none"> <li><b>Değişkenler:</b> Değerleri değişebilen sembol veya harflerdir. Temel etkileri bilinmeyenleri veya incelikleri ifade ederler. Örnek olarak, "x", "y" veya "a" gibi değişkenler kullanılabilir.</li> <li><b>Sabitler:</b> Değerleri sabit olan sayılardır. Örnek olarak, 2, 5, -3 gibi tam sayılar veya <math>\pi</math> (pi), e (Euler sayısı) gibi irasyonel sayılar sabitlerdir.</li> <li><b>Katsayılar:</b> Değişkenlerin önüne çarpılarak çarpma işleminde katılan sayılardır. Katsayılar, değişkenin etkisini ve büyüklüğünü belirler. Örnek olarak, <math>2x</math> ifadesinde "2" katsayıdır.</li> <li><b>İşlemler:</b> Cebirsel ifadelerde kullanılan matematiksel işlemleri temsil eden sembollerdir. Örnek olarak, toplama (+), çıkarma (-), çarpma (<math>\times</math>), bölme (<math>\div</math>) işlemleri gibi işlemler kullanılır.</li> <li><b>Üstler:</b> Bir sayının kuvvetini veya üssünü ifade eden sembollerdir. Örneğin, <math>x^2</math> ifadesinde "<math>2</math>" üs sembolüdür ve x'in karesini ifade eder.</li> <li><b>Parantezler:</b> İfadelerin önceliklerini belirlemek veya gruplamaları ifade etmek için kullanılan sembollerdir. Parantezler <math>{}_{}</math>, köşeli parantezler <math>{}_{}</math>, veya süslü parantezler <math>{}_{}</math> şeklinde olabilir.</li> <li><b>Terimler:</b> Cebirsel ifadedeki bölümlere denir. Terimler, değişkenlerin veya sabitlerin birleşimiyle oluşur ve işlemlerle ayrılır. Örneğin, <math>2x + 5x^2 - 3</math> ifadesinde <math>2x</math>, <math>5x^2</math> ve <math>-3</math> terimlerdir.</li> </ol>	<p>Silindirin şeklindeki bir pet şişenin hacmini cebirsel olarak nasıl ifade edebilirsiniz?</p> <p>Silindirin şeklindeki bir pet şişenin hacmini cebirsel olarak ifade etmek için aşağıdaki adımları izleyebilirsiniz:</p> <ol style="list-style-type: none"> <li>Silindirin hacim formülünü hatırlayın: Silindirin hacmi, taban alanının yükseklikle çarpımına eşittir. Hacim (V), taban alanı (A) ve yükseklik (h) arasındaki ilişki şu şekildedir: <math>V = A \cdot h</math>.</li> <li>Silindirin taban alanını bulun: Silindirin tabanı bir daire şeklindedir. Taban alanını (A) bulmak için dairenin yarıçapını (r) kullanabilirsiniz. Dairenin alanı <math>(\pi r^2)</math> olduğundan, taban alanını şu şekilde ifade edebilirsiniz: <math>A = \pi r^2</math>.</li> <li>Cebirsel ifadeyi oluşturun: Taban alanını yukarıdaki formülde bulduktan (<math>A = \pi r^2</math>), hacim formülüne yerleştirerek, silindirin hacmini cebirsel olarak ifade edebilirsiniz: <math>V = (\pi r^2) \cdot h</math>.</li> </ol> <p>Bu şekilde, silindirin şeklindeki bir pet şişenin hacmini cebirsel olarak ifade edebilirsiniz. Burada r, taban yarıçapını, h ise silindirin yüksekliğini temsil eder.</p>
<p>Sürtünme ile elektrikleşmeyi bana oyun yoluyla öğretebilir misin?</p> <p>Tabii ki! Sürtünme ile elektrikleşmeyi öğrenmek için basit bir deney yapabilirsiniz. İşte adımlar:</p> <p><b>Malzemeler:</b></p> <ol style="list-style-type: none"> <li>Bir plastik tüp veya boru</li> <li>Bir parça kuru kumaş veya yün</li> <li>Bir parça kağıt veya hafif cisimler (örneğin, küçük parçacıklar halinde kesilmiş kağıt parçaları)</li> </ol> <p><b>Adımlar:</b></p> <ol style="list-style-type: none"> <li>Plastik tüpü veya boruyu elle al ve uçlarından birini hafifçe kuru kumaşa veya yüne sürt.</li> <li>Sürtmeyi yaklaşık 10-15 saniye boyunca devam ettir.</li> <li>Sürttüğün yüzeye yakın bir şekilde, kağıt parçalarını veya hafif cisimleri tutarak plastik tüpe veya boruya yaklaştır.</li> <li>Kağıt parçalarının veya hafif cisimlerin plastik tüpe veya boruya çekildiğini göreceksin. Bu, sürtünme sonucu plastik tüpün veya borunun elektrikleşmesinden kaynaklanır.</li> </ol> <p><b>Açıklama:</b> Sürtme sırasında, plastik tüp veya boru ile kuru kumaş veya yün arasında elektron alışverişi gerçekleşir. Plastik tüp veya boru, elektronlarını kumaşa veya yüne aktarır ve negatif yükli hale gelir. Bunun sonucunda, plastik tüp veya boru elektrikleşir. Negatif yük taşıyan plastik tüp veya boru, pozitif yüklü cisimlere (örneğin, kağıt parçaları) çekim etkisi yapar.</p> <p>Bu deney, sürtünme ile oluşan elektrikleşme etkisini gösterir. Sürtme sonucu elektrikleşen nesnelere, başka cisimleri etkileyebilir ve çekime veya itme etkisi yaratabilir. Bu deneyi farklı malzemelerle de tekrarlayabilir ve sonuçları karşılaştırabilirsiniz.</p>	<p>Elektrikleşmeyi anlatan basit bir deney önerebilir misin?</p> <p>Tabii ki! Elektrikleşmeyi anlatmak için basit bir deney önerebiliriz. İşte adımlar:</p> <p><b>Malzemeler:</b></p> <ol style="list-style-type: none"> <li>Bir plastik tarak veya fırça</li> <li>Bir parça kağıt veya hafif cisimler (örneğin, kesilmiş kağıt parçaları veya ping pong tenisi)</li> <li>Bir ipik veya naylon kumaş (örneğin, bir ipik eşya veya naylon çorap)</li> </ol> <p><b>Adımlar:</b></p> <ol style="list-style-type: none"> <li>Plastik tarak veya fırçayı eline al ve saçlarını veya kıyafetlerini tarayarak bir süre sürt.</li> <li>Tarak veya fırçayı bırakmadan önce sürtünme işlemine devam et.</li> <li>Sürtünme sonucunda elektrikleşen tarak veya fırçayı yaklaşık 1-2 cm mesafede tutarak kağıt parçalarını veya hafif cisimleri yaklaştır.</li> <li>Kağıt parçalarının veya hafif cisimlerin tarak veya fırçaya doğru çekildiğini göreceksin. Bu, sürtünme sonucu tarak veya fırçanın elektrikleşmesinden kaynaklanır.</li> </ol> <p><b>Açıklama:</b> Sürtünme sırasında, plastik tarak veya fırça ile saç veya kıyafetler arasında elektron alışverişi gerçekleşir. Plastik yüzey elektroniğini sahip olurken, saç veya kıyafetler elektroniğini kaybeder. Bu süreç sonucunda, plastik tarak veya fırça negatif yükli hale gelir ve elektrikleşir.</p> <p>Elektrikleşen plastik tarak veya fırça, pozitif yüklü cisimlere (örneğin, kağıt parçaları veya hafif cisimler) çekim etkisi yapar. Bu durum, elektrik yüklerinin zıt kutupları arasındaki çekim kuvvetinden kaynaklanır. Tarak veya fırçayı kağıt parçalarına yaklaştırdığınızda, negatif yükü taşıyan tarak veya fırça, pozitif yükü taşıyan kağıt parçalarını kendine doğru çeker.</p> <p>Bu deneyde, sürtünmeyle oluşan elektrikleşme etkisini gözlemleyebilirsiniz. Deneyi farklı malzemeler veya kumaşlarla tekrarlayarak sonuçları karşılaştırabilirsiniz.</p>

Figure 3. Some images from the sample student activity guide prepared for Mathematics and Science lessons.

The findings derived from the implementation of sample activities designed for mathematics and science courses suggest that CAFLM is positioned at a level capable of enhancing the quality of the flipped learning-teaching process. Implementing this model can positively affect students' success, motivation, and the permanence of their knowledge. Quantitative and qualitative studies are needed to evaluate the developed model's aspects. Experimental research can be conducted by comparing classical flipped learning teaching with CAFLM. In addition, qualitative research can be conducted to reveal student and teacher experiences related to CAFLM.

In this research, mathematics and science courses were selected to show the application steps of CAFLM. Further research could explore the use of CAFLM in different courses. In this research, sample applications were carried out using the free version of ChatGPT. The paid version and plugins of ChatGPT can help create more prosperous learning activities.

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