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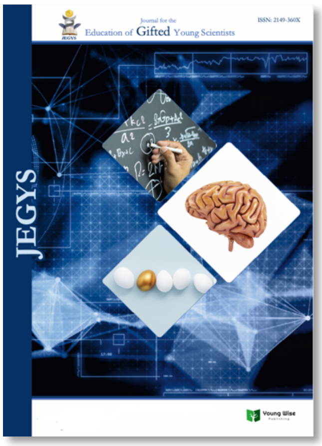

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From the Editor

Dear Education Researchers,

We are delighted to present the latest issue of the Journal for the Education of Gifted Young Scientists (JEGYS), a platform dedicated to enriching educational discourse through innovative, metadisciplinary, and data-driven approaches. Our mission remains steadfast: to explore and share the most effective and forward-thinking practices in the field of education, especially as they relate to gifted and advanced learners.

In this issue, we bring together a diverse collection of scholarly works that reflect the current trends and critical inquiries shaping the educational landscape:

Oğuzhan Tekin explores how the Scientific Literacy Workshop contributes to shaping high school students' research attitudes.

Murat Demirekin and Seda Sur examine the impact of language learning strategies on technology addiction and coping skills in gifted adolescents—an intersection of language acquisition, well-being, and digital life.

Seyhan Canyakan introduces us to the SozyAI Model, revealing how AI-supported 3D virtual instructors can enhance educational experiences and student engagement.

Mehmet Akif Demirelli investigates the tendencies of parents of gifted children in guiding them toward scientific disciplines—a critical insight into family dynamics and future STEM pathways.

Finally, Michael F. Shaughnessy brings us an inspiring conversation with Johannes Addido, highlighting the NASA-commissioned NWAY project and its implications for the scientists of the future.

We believe this issue will inspire educators, researchers, and policymakers alike to reflect, rethink, and reshape educational practices for the benefit of gifted and talented youth across the globe.

As always, we warmly invite researchers, practitioners, and emerging scholars to submit their work to JEGYS. We are also currently welcoming applications for our Editorial Board. If you are passionate about advancing gifted education and want to contribute to shaping the future of this field, we encourage you to join us.

Warm regards,
JEGYS Editorial

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Research Article

The contribution of the "scientific literacy workshop" on high school students' research attitudes

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Keywords
High school students
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Abstract

This study aims to examine the contribution of the Scientific Literacy Workshop on high school students' research attitudes. To that end, Scientific Literacy Workshop Project was planned and implemented over 10 weeks. This study was designed within the framework of the project. The mixed research method was employed, and the exploratory sequential design was utilized. The study group consisted of 42 high school students studying in a province center in the Central Black Sea Region of Turkiye in the 2021-2022 academic year. The data were collected through a semi-structured Interview Form and Scale of attitude towards Scientific Research. In the analysis of the quantitative data, pared samples t-test and ANOVA were used, and content analysis was used in the analysis of the qualitative data. Results revealed that the Scientific Literacy Workshop positively contributed to participant students' research attitudes. Students emphasized that scientific research was not as complicated as they thought, and it could be carried out by anyone who has enough interest and knowledge. Based on the results, we recommended that projects which would encourage students to research like the Scientific Literacy Workshop should be conducted at all grade levels.

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Introduction

The source of science is knowledge. Heimsoeth (1986) claimed that a discipline is unimaginable that is not based on any knowledge. Knowledge, with the common definition, is the period of change that occurs in the cognitive structure of a person as a result of observations and experiences (Bateson, 1972). Knowledge has three basic components intelligence, experience, and intuition. Knowledge is not readily available in nature, there are objects and events in nature. Only humans can create, produce, and turn knowledge into action (Jones, 2004). Today, in the information age, societies that produce and export knowledge have been described as developed societies and have stepped forward. Therefore, the ability to access information and product knowledge has become very important for societies and individuals. There are five basic ways of accessing knowledge: Individual experience, authentic, mystical, rational, and scientific method. Knowledge-based on individual experience is the information that individuals obtain as a result of interaction with the environment through their senses. In the authentic method, individuals try to gain knowledge by forming a consensus with other individuals as well as their own experiences. In the mystical method, expert opinion is sought to access reliable information. In the rational method, it is tried to reach reliable information with the help of reasoning or logic. On the other hand, the knowledge obtained through the scientific method has certain sources, is produced according to a certain systematic, and the accuracy, validity, and reliability can be confirmed repeatedly or in different ways when necessary.

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According to Millar (1994), the scientific method is the most reliable way of solving factual problems and producing knowledge with common and certain processes. Because scientific knowledge has the characteristics such as being factual, systematic, rational, cumulative, valid, and relative, and can only be produced through the scientific method. Thus, countries take necessary measures for students at all grade levels to understand and internalize the scientific method. Within this scope, Turkish National Education tries to gain knowledge and skills about scientific methods for students at all levels of formal education with the Scientific Research Methods course. In this way, it is tried to ensure that students use the scientific method to access information, produce knowledge, and solve problems encountered.

However, the positivist approach and the post-positivist approach conflict in terms of their perspectives on scientific knowledge. According to the positivist approach, the only valid way of knowledge construction is assumed to be the scientific method. The scientific method seeks regularity in nature by detecting the relationship between some event groups. That is, the laws of nature are based on experimentation and observation, in which the attributes of beings or their reproducible relations are put forward with mathematical expressions, and there are no mythological or fictional explanations. According to Guénon (2005), scientific theories are just credible truths, not immutable ones. Because scientific theories always have the potential to develop and change. The modern understanding of science has tried to make it worthless by denying everything that transcends the sciences or at least declaring them unknown. However, it should be noted that although this understanding considers the knowledge we obtain with our senses the most reliable one we can obtain, many philosophers doubted the certainty of this knowledge in principle (Cleland, 2001; Khun, 1970; Woodcock, 2014). Today, many thinkers reject a sharp distinction between scientific concepts and other belief systems, because scientists are affected by human characteristics, beliefs, and social structure. Instead of the hypothesis that science is a cumulative process and rises continuously and linearly on what has been known until now, it has been put forward that scientific knowledge rises in leaps based on paradigms (Au, 2018; Nola & Sankey, 2000; Woodcock, 2014). Because, the scientific method is only one of the ways that make it possible for people to reach accurate information, and people have various ways of knowing, and reaching knowledge.

Therefore, in the current study, the scientific method is not seen as the only way of reaching knowledge but is considered a valid method for reaching and producing knowledge. In this context, this study focused research concept which is one of the important stages of the scientific method, and attitude towards research that is seen as a significant psychological factor affecting research behavior.

Scientific Method

Every discipline aims to make generalizations that will create judgments about the explanation of observed events, and the relationships of events. These explanations and generalizations are reached through rational arrangements named the scientific method. The scientific method is a reasoning process in solving problems and performing research or a study (Çaparlar & Dönmez, 2016). First conceptualized by Descartes in the 16th century, the scientific method is essentially a synthesis of Bacon's inductive method and Aristo's deductive method (Bauer, 1994). The scientific method creates a system of supervision and evaluation that will minimize dilemmas in providing information. Thus, biases are reduced and validity reaches the highest level. In this respect the scientific method is considered to be the most reliable way of problem-solving, producing knowledge, and accessing information through common and specific processes (Karagözoğlu, 2006).

Scientific laws are cause-effect relationships, while theories explain how things happen. Scientific laws express regularities in nature and tell us what happens in the universe, but they do not offer any explanations. They are used to say that a phenomenon that exists only exists. We construct and test hypotheses to explain these regularities. If these hypotheses are not falsified, they become valid and provide a model for explaining scientific laws. These models are called scientific theories. Scientific theories are networks thrown to capture (explain) reality in general (Popper, 2010). Theories are abstract generalization systems because they explain the relationships and generalizations observed factually by making use of some non-observational concepts. Theories never take their final form, because there is a dynamic development process for every theory as a result of new data and hypotheses. In this respect, scientific development is an endless and dynamic process, consisting of removing the theories that are inadequate in the light of new experiments, and replacing them with those that seem more valid (Bauer, 1994).

Experimental sciences often use induction, a method that leads from facts to laws. The inductive method tries to make inferences about the future based on the regularities in the past. In other words, they use past observations to predict the future. Therefore, we need to consider that we cannot be sure of the future based on previous observations alone and that there may always be exceptions to the patterns or regularities we observe. This is called the induction problem. This also ensures that science is always open to change. On the other hand, the deductive method adopts falsification concepts and approaches. Accordingly, a rational or observational generalization (hypothesis/experiment) is tried to be falsified with logical conclusions based on observations or related inferences. In this approach, it is tried to reach the right information by finding and explaining the wrong information (Popper, 2010).

As understood, the scientific method is the most valid way of accessing information and solving problems. In this context, students need to have full knowledge of scientific process skills to develop a basic scientific understanding (Aktamış & Ergin, 2007). We can not expect all students to be a scientist, but every individual should observe, ask questions, analyze data, understand a problem case, and solve the problems, to survive. Gaining scientific process skills is not special to scientists or scholars. Because these skills are as important in the scientific and academic fields, and in the success of daily activities and business life (DebBurman, 2002). Therefore, knowledge and skills of the scientific method are important that should be gained by all students in the formal education process. However, many researchers emphasized that it is not sufficient for individuals to have knowledge and skills about scientific processes, at the same time, they should have also psychological characteristics such as a positive attitude, motivation, and self-efficacy, to set the scientific process (Hook, 2020; MacNamara, Button & Collins, 2010; Miyazaki & Taylor, 2008; Rutjens, Heine, Sutton & van Harreveld, 2018). Because attitude towards research is an important variable that affects the research behavior, as well as research competency, research anxiety, and research experience.

Research Attitude

The attitude, which was seen as an internal factor that predicts human behaviors (Zan & Martino, 2007), also plays a significant role in the formation of research behavior. Research-oriented attitudes generally includes feelings about research. These feelings include negative thoughts and negative emotions such as anxiety, fear of failure, inadequacy, and lack of interest (Bolin, Hag Lee, GlenMaye & Yoon, 2012; Taşgın, 2018). Many researchers claim that attitude is a more important factor in research behavior than cognitive factors such as knowledge, skills, experience, and academic preparation (Butt & Shams, 2020; Mutz & Daniel, 2013; Swindoll, 2012). Accordingly, we can claim that attitude towards research is an important concept for individuals to act on their knowledge and skills about the scientific process. According to Papanastasiou (2005), determining research-oriented attitudes is important for the development of a positive attitude among students, and this case helps to ease their learning. Because, in today's world, research is one of the important behavior that plays a key role in individuals' academic and professional success.

Unfortunately, the previous literature tells us that students' research-oriented attitudes are either not at the desired level (Amoo & Gbadamosi, 2021; Butt & Shams, 2013; Henry, Ghani, Hamid, & Bakar, 2020; Papanastasiou, 2005; Shaukat, Siddiquah, Abiodullah, & Akbar, 2014). Addams and Holcomb (1986), emphasized that students find the scientific process difficult and boring,- and, therefore develop a negative attitude. According to some researchers, although students have theoretical knowledge and skills about the scientific process, they have developed a negative attitude, because they have had not a chance to turn this theoretical knowledge into practice (Belgrave & Jules, 2015; Butt & Shams, 2020; Byman, Krokfors, Toom, Maaranen, Jyrhämä, Kynäslahti, & Kansanen, 2009). In addition, there are findings in the previous literature stating that students have difficulties understanding scientific jargon and that they develop negative attitudes because they see scientific knowledge that they could not easily understand as useless (Shkedi, 1998). Even if students are aware of the importance of research, they are anxious about the research process, they are afraid of conducting research, and they feel weak. The reasons for students' avoidance behavior and negative thoughts about research arise from the justifications stated above.

Importance of Study

We believe that if students develop good research skills and attitudes which are essential for learning and generating their reflections and ideas, they can be successful both academically and in daily life. Therefore, we attach great importance to the development of students' research attitudes, as well as their knowledge and skills about the scientific process. Various studies have found attitudes toward scientific research as a result of previous literature reviews. Many of these studies examined directly students' attitudes toward scientific research (Korkmaz, Şahin, & Yeşil, 2011; Küçükoğlu, Taşgın, & Çelik, 2013; Saracaloğlu, Varol, & Ercan, 2005; Yenilmez & Ata, 2012). Some studies examined the relationship between attitudes toward scientific research and various variables. For example, Aşiroğlu (2016) examined the relationship between pre-service teachers' research attitudes and their success in a scientific research course. Baş (2017) examined the relationship between teachers' following status of educational research and their research attitudes. In some studies, the relationship between research attitudes and level of anxiety (Bökeoğlu & Yılmaz, 2005; Duygu & Şahin, 2019), epistemological belief (Kürşad, 2015), and research competencies (Saracaloğlu, 2008) was examined. As can be understood from the previous literature review, there are many findings about determining the research attitudes and examining its relationship with various variables. However, none of the previous studies are concerned with improving students' research attitudes. We can consider that no study focuses to improve research attitudes as a deficiency of the related literature. We attach great importance to developing research attitudes which are seen as an effective variable in the formation of research behavior. The current study did not only contented to determine students' research attitudes but also focused to develop them. This feature makes the current study unique. In this context, a project titled "Scientific Literacy Workshop" which is expected to contribute to the development of students' research attitudes has been planned. This project aims to develop the interest, motivation, and attitudes of high school students toward scientific papers, and to encourage them for carrying out scientific research. The current study was designed within the scope of this project.

Aim of the Study

Within this scope, the current study aimed to examine the effect of the "Scientific Literacy Workshop Project" on high school students' attitudes toward research. With this main purpose, the research questions that guided this study are as follows:

- What is the contribution of the "Scientific Literacy Workshop" on high school students' research attitudes?
- Do high school students' research attitudes differ according to the demographic characteristics?
- How are high school students' views about scientific process?

Method

In the current study, the mixed method which combines research results with quantitative and qualitative data collection techniques was used. The mixed method enables to presentation, analysis, and combining of results within a framework using various methods. According to Ivankova, Creswell, and Stick (2006) using mixed methods is better for understanding research problems than using qualitative and quantitative approaches alone. In this study, a mixed method was preferred to examine the research questions in depth.

Research Model

In this study, "exploratory sequential design", one of the mixed research methods was allowed. The main feature of this design is to explain the data collected and analyzed with the quantitative method, with the data collected and analyzed with the qualitative method. Therefore, in this design, quantitative data is collected and analyzed first, and then qualitative data is used to support and explain quantitative data (Creswell & Plano Clark, 2011). In the quantitative dimension of the study, a controlled non-group pretest-posttest quasi-experimental design was allowed. According to Büyüköztürk (2004), the experimental pattern is the only way to determine the effects of a variable and is the most reliable method in testing cause-and-effect relationships. In this study, the experimental pattern was used to examine the effect of the independent variable (Scientific Literacy Workshop) of the research on the dependent variable (Research attitude). In the qualitative dimension, students' views about the scientific process were collected through semi-structured interview forms at the end of the workshop, to support and explain the quantitative data. In this context, in the qualitative dimension, the basic qualitative research design was employed. This research method focuses on how people make sense of themselves and their experiences rather than cause-and-effect relationships. In this design, an inductive strategy is adopted, descriptive results are obtained, the data are presented with direct quotations, and discussed by comparing with the related literature (Merriam, 2002). We employed the basic qualitative research design because this study focused on revealing the student's research-behaviors, thoughts, and feelings about scientific research, and the change in these perceptions at the end of the workshop.

Participants

The study was conducted with a total of 42 high school students studying at public high schools in a province center in the Central Black Sea region of Turkey, in the 2021-2022 academic year. A purposive sampling technique was employed in the determination of the study group. This technique allows for in-depth research by selecting information-rich situations depending on the purpose of the studies and is preferred when it is desired to work in one or more special cases that meet certain criteria or have certain characteristics (Tongco, 2007). In this study, we employed convenience sampling among the purposive sampling techniques, because there were special cases that the study group had to meet, such as participating in the Scientific Literacy Workshop and being volunteered. Table 1 presents the participants' demographic features.

Table 1. Biographical data of participants

Variable	Sub-Group	Frequency	Percentage	Total
Gender	Girls	23	54.76	42
	Boys	19	45.24	
School	Academic High School	27	64.28	42
	Vocational High School	15	35.72	
Grades	9th Grade	9	21.42	42
	10th Grade	10	23.80	
	11th Grade	13	30.98	
	12th Grade	10	23.80	

As seen in Table 1, participant students were 23 girls, and 19 were boys. While 27 students study at academic high schools, 15 students study at vocational high schools. In Turkey, high schools that accept students with an entrance examination are named academic high schools, and high schools that accept students without an examination are named vocational high schools.

Data Collection Tools

In the data collection procedure, a "Demographic Information Form", "Interview Form" and "Scale of attitude towards Scientific Research" were employed.

Demographic Information Form and Interview Form

To determine the demographic characteristics of the participants, and to reveal their perceptions about scientific research, a form consisting of two sections was created by the researcher. The first section of the form includes questions to determine the demographic characteristics of the participants such as gender, school, and grade level. The second section consists of open-ended and semi-structured questions that aimed to reveal participants' views about scientific research in depth. In qualitative research design, data are collected with interviews, observation, or document analysis methods. In this study, online interviews were adopted, and a semi-structured interview form was developed by the researcher. The preparation procedure of the form began with the relevant literature reviewed (Akay, 2013; Baykara, 2019; Çınar & Köksal, 2013; Miller, Slawinski Blessing, & Schwartz, 2006; Sarı, 2006; Senler, 2015; Woitkowski, Rochell, & Bauer, 2021). Based on the relevant literature review, the 9-item draft interview form was developed, and submitted to the opinions of two scholars (who had a PhD. in Curriculum and Instruction) who are experts in qualitative studies, to achieve content validity. As a result of the opinions of the experts, the number of questions in the form was reduced to 6. In addition, to test the comprehensibility of the interview form, it was applied to three students in the 10th grade. In this way, the content and face validity of the interview form was tried to be ensured. In the interview form, students' perspectives on scientific research and research behaviors were questioned, and the contribution of the Scientific Literacy Workshop to their academic and intellectual development was tried to be examined.

The scale of Attitude towards Scientific Research

The scale of Attitude towards Scientific Research (SASR) was developed by Korkmaz, Şahin, and Yeşil (2011), contains a total of 30 items, and consists of four sub-dimensions: Unwillingness to Help Researchers (1-8 items), Negative Attitude towards Research (9-17 items), Positive Attitude towards Research (18-23 items), Positive Attitude Towards Researchers (24-30 items). The scale is in a 5 points Likert type, and scored between "(1) Strongly disagree" and "(5) "Completely agree". Korkmaz, Şahin, and Yeşil (2011) calculated the Cronbach Alpha reliability coefficients for the whole scale as .89. For sub-dimensions Cronbach Alpha reliability coefficients were calculated for Unwillingness to Help Researchers as .85, Negative Attitude towards Research as .81, Positive Attitude towards Research as .80, and Positive Attitude Towards Researchers as .76. In the scoring of the scale, the negative sub-factors Unwillingness to Help Researchers and Negative Attitudes towards Research were coded in reverse. As a result of this coding, the alpha value was calculated as .86 in all measurements, indicating a high score reliability.

The Scientific Literacy Workshop

We planned a project titled "Scientific Literacy Workshop", which is expected to contribute to the development of students' research attitudes. This project aims to develop the interest, motivation, and attitudes of high school students toward the scientific process, to encourage them to conduct research activities through the scientific process. Before starting the project, an information meeting and a case study were held with the study group including how to read an article, what to pay attention to and about the evaluation process. Within the scope of the project, 10 papers from different fields were selected by the project team, the selected papers were shared with the students, and the authors and students were brought together in online meetings to discuss the articles. The online meetings lasted 10 weeks, and every meeting included an article discussion with the author. In the online meetings, the students met with the authors whose papers they read, exchanged information, and asked the questions they had prepared beforehand about the paper and its process. Thus, by closely examining scientific jargon, students had the opportunity to follow the articles which are among the most valuable scientific publications from the primary source, and meet with academics and authors. By this means, it has been tried to ensure that students learn the important stages of a scientific paper such as planning, literature review, data collection, analysis, and reporting directly from their authors and observe the scientific process on site. These article review meetings continued for 10 weeks. At the end of the process, students were asked to prepare a portfolio file that included identifying a problem situation, developing suggestions for solving this problem, determining a method, and writing down possible results and suggestions. Portfolio files prepared by the participants were evaluated by the project team, and successful students were rewarded. We assumed that by observing the scientific process from primary sources, students' prejudices, anxieties, and fears about the scientific process will be broken, and their attitudes toward research will also improve.

Before the Scientific Literacy Workshop began, the Scale of Attitude towards Scientific Research was administered to the students as a pre-test. The Scientific Literacy Workshop project was started one week after the pre-test application. The project team selected 10 articles that are suitable for the academic level and interests of the students and shared these articles with the students once each week. Students were asked to read the article, take notes, and prepare the questions they would ask. Afterwards, article authors and participant students were brought together online to evaluate and discuss each article. Each online meeting is planned to last two hours in two sessions. In these online meetings, students had the opportunity to meet the authors, listen to the article directly from the author, ask questions, follow the scientific processes on-site, and make evaluations about scientific processes. These article review meetings continued for 10 weeks. At the end of the process, students were asked to prepare a portfolio file that included identifying a problem case, developing suggestions for solving this problem, determining a method, and writing down possible results and suggestions. The portfolio files prepared by the participants were evaluated by the project team, and the successful students were rewarded. One week after the end of the project, the Scale of Attitude towards Scientific Research was applied to the students as a post-test. Thus, the analysis process of quantitative data was started.

Analysis

One of the assumptions for performing parametric tests in the analysis is the normal distribution of the data (Buyukozturk, 2004). Therefore, in the current study, before starting the data analysis process, all data obtained have been tested by the Shapiro-Wilk test whether showing normal distribution. The other main assumption for normal distribution is to look at the kurtosis and skewness values of the data. The data obtained from the Scale of Attitude towards Scientific Research (SASR) were close to normal distribution since the kurtosis and skewness values were between -1 and +1, and according to the Shapiro-Wilk test results (p>.05), (Buyukozturk, 2004). Descriptive statistics such as frequency, percentage, arithmetic mean, and standard deviation were used to describe participants' demographic characteristics (gender, school, and grade level). In addition, procedural statistics such as pared samples t-test, independent samples t-test for gender and school type variables, and one-way variance analysis (ANOVA) for grade level variables were performed. All results were interpreted at p<.05 significance level.

Qualitative data were collected through focus group discussions in 2 groups with a total of 12 randomly selected students, after the application of the post-test. Bowling, (2002) defines focus group discussions as obtaining in-depth information and producing thoughts, using the effect of group dynamics in an unstructured or semi-structured interview, and discussion between a small group and a leader. According to this definition, focus group discussions are mostly used to reveal surface information. The important thing is not to reach the information that will lead to generalizations, but to describe the views and perspectives of the participants. In this context, the interviews were held online in two sessions, each session lasted approximately 1.5 hours and all interviews were recorded. The recorded data were later transcribed and transferred to an excel file. In the analysis of the data, the content analysis method was performed. To describe the findings as clearly and visualize as possible, the display format shown in Figure 1 (Maviş Sevim & Akın, 2021) was used for the theme, sub-themes, and codes. Using Figure 1, firstly the raw data were carefully read in content analysis, and the views of the participants were coded. Then, coded opinions were collected under sub-themes with similar characteristics. Finally, considering the research questions, sub-themes were combined under themes. When making direct quotations, participant students' names did not use, instead codes used that were created for each participant [Student(S), Girl (G), Boy (B), S1G-S12B].

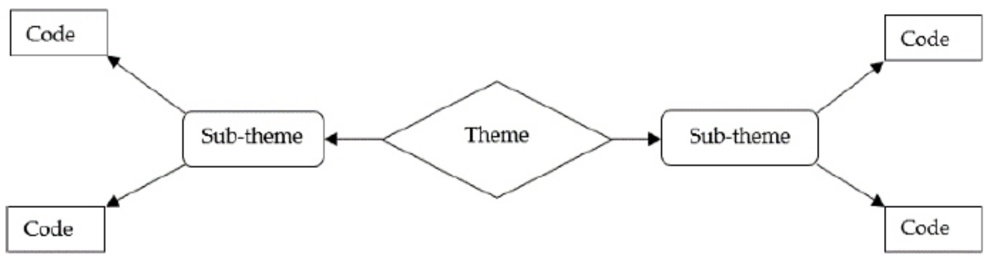

Figure 1. Presenting System of Qualitative Data

Validity and Reliability Study

According to Merriam (2009), the concepts of validity and reliability in quantitative research are replaced by the concepts of credibility, confirmability, transferability, and consistency in qualitative research. In this study, some measures have been tried to be taken to provide the specified elements. To ensure the credibility of the study, all interviews were recorded with a voice recorder with the permission of the participants, the recorded data were turned into written documents, and direct quotations were often included in the findings. Thus, detailed description and depth-oriented data collection were tried to be achieved. To ensure confirmability, findings and results obtained as a result of the analysis were shared with two of the participant students, students were asked whether the results reflected the facts of their expressions, and their confirmation was obtained. To ensure the transferability, of the information of the study group, all processes related to data collection and analysis were explained in detail. To ensure consistency of the study, content, and face validity were taken for the semi-structured interview form. The collected data were shared with another researcher and common themes and sub-themes were created. Miles and Huberman's (1994) "Consistency Percent = Consistency / Consistency + Inconsistency" formula was used to determine the agreement percent of these two analysis. According to this calculation, the analysis of the researcher and the other expert were found to be substantially consistent (.83).

Results

The results are presented in two sections quantitative results and qualitative results. Firstly, the quantitative results covering the first two research questions are given, and then the qualitative results are presented.

Quantitative Results

The findings regarding to the first and second research questions of the study are summarized and presented in this section. The first research question was examining the effect of the "Scientific Literacy Workshop Project" on high school students' research attitudes. For this purpose, the mean scores of the students from the pretest and posttest applications of the Scale of Attitude towards Scientific Research were examined with the paired samples t-test, and the results are presented in Table 2.

Table 2. Paired samples t-test results for attitude towards research

	Groups	N	$\bar{X}$	Sd	Shx	T-test			r
						t	df	p	
Total Mean Score	Pre-test	42	2.68	.33	.051	-18.98*	41	.000	.78
	Post-test	42	3.30	.26	.038				
Not Helping Researchers	Pre-test	42	2.98	.19	.025	-21.82	41	.876	
	Post-test	42	3.07	.12	.012				
Negative Attitude Towards Research	Pre-test	42	2.21	.51	.001	-16,68*	41	.000	.75
	Post-test	42	3,18	.27	.014				
Positive Attitude Towards Research	Pre-test	42	2.69	.24	.027	-22.17*	41	.000	.71
	Post-test	42	3.65	.16	.040				
Positive Attitude Towards Researchers	Pre-test	42	2.41	.23	.053	-19.23*	41	.000	.77
	Post-test	42	3.98	.30	.066				

*p<.05

Table 2 presents paired samples t-test results regarding the pretest-posttest mean score of students from the Scale of Attitude towards Scientific Research. As seen students' pretest mean score was $\bar{X}$=2.68 (Sd=.33), and the posttest mean score was $\bar{X}$=3.30 (Sd=.26). The results of the paired samples t-test performed to test the change of students' pretest-posttest mean scores showed that, there was a statistically significant difference [t(41)=-18.98, p<.05] in favor of the posttest, in a high effect size (r=.78). As a result of the pre-test and post-test application of the scale, "Not Helping the Researchers" dimension did not show a significant difference, while the "Negative Attitude Towards Research", "Positive Attitude Towards Research" and "Positive Attitude Towards Researchers" showed significant differences (p<.05).

The second research question was examining if students' post-test mean scores on the Scale of Attitude towards Scientific Research differ according to demographic characteristics. To test whether the post-test mean scores of the students differ according to the gender and school variable, independent samples t-test was performed, and the results are presented in Table 3.

Table 3. Independent samples t-test results of the gender variable

	Groups	N	$\bar{X}$	Sd	t	Df	p
SASR Mean Score	Girls	23	3.35	.22	1.337	40	.189
	Boys	19	3.24	.27			
SASR Mean Score	Academic HS	27	3.57	.32	.988	40	.0389*
	Vocational HS	15	3.02	.18			

*p<.05

While girls' SASR mean score was $\bar{X}$=3.35 (Sd=.22), boys' mean score was $\bar{X}$=3.24 (Sd=.27). Independent Samples T-test showed that girls' and boys' post-test mean scores did not statistically differ according to the gender variable [t(40)=1.337, p>.05]. While Academic High School students' SASR mean score was $\bar{X}$=3.57 (Sd=.32), Vocational High

School students' mean score was X̄=3.02 (Sd=.18). Independent Samples T-test showed that Academic High School students' mean score was statistically higher than Vocational High School students' mean score [t(40)=.988, p<.05]. To test whether the post-test mean scores of the students differ according to the school variable, independent samples t-test was performed, and the results are presented in Table 4.

Table 4. ANOVA test results of the grade level variable

		Sum of Squares	Df	Mean Square	F	p
SASR Mean Score	Between Groups	.138	3	.046	.722	.545
	Within Groups	2.420	38	.064		
	Total	2.558	41			

The ANOVA test results shown in Table 5 revealed that, the posttest mean scores of the students did not statistically differ according to the grade level variable (F=.722, p>.05).

Qualitative Results

Students' perceptions about the scientific research

Firstly, participant students were asked to describe the scientific research process with a few words, and results of the content analysis regarding this question are summarized in Figure 2.

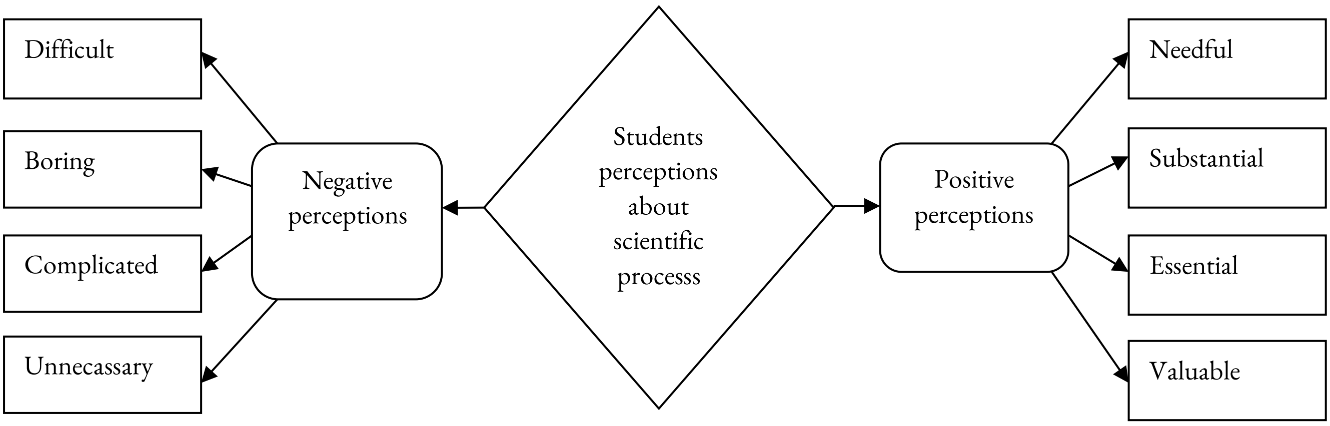

Figure 2. Students' perceptions about the scientific process

As symbolized in Figure 2, students described the scientific research process under two sub-themes as positive and negative perceptions. More than half of the students (f=7) expressed positive perceptions while describing the scientific research process. According to these students, scientific research is a necessary process for technological development and knowledge generation. In addition, students described scientific research as needed for their self and academic development. For example: *"Scientific research is needful for the civilization advent of human being, and it is very important in producing new information... (S4,G)" and "If we want to develop ourselves as personally and academically, we must give much attention to the scientific research... (S11,B)".* Some of the students perceived scientific research as substantial and valuable by emphasizing the value of the knowledge obtained as a result of the scientific process. In addition, scientific research is perceived as essential, because it is seen as the most common way of accessing information and solving problems. Following statements can be given as examples of these perceptions: *"Scientific research is substantial because the most accurate and valid information can be reached with this method... (S2,B) and "Scientific research is essential because it teaches us ways of solving problems we encounter both our daily life and lessons... (S3,G).*

In addition to these positive perceptions, some of the students (f=5) also expressed negative perceptions about the scientific research by emphasizing both deficiencies of themselves and the disadvantages scientific method. As known, the scientific process is a long and exhausting process that requires great labor and time. Some of the participant students emphasized this aspect of scientific research and described it as difficult and boring. For example: *"There are many difficulties in conducting scientific research. Although we have theoretical knowledge about the process, conducting research scares me... (S1,B) and "For me, scientific research is the matter of scientists and scholars as it requires a lot of technical knowledge and skills. It's boring for me to deal with so much technical procedure... (S9,G)".* Some of the students stated that the language of scientific papers was too heavy and incomprehensible, and therefore they perceived the scientific process as complicated. Therefore, the papers that students have difficulty in understanding and internalizing are seen as unnecessary. Following statements can be given as examples of these perceptions: *"I don't understand why the language used in scientific papers is so complex. It's as if these papers were written so that no one would understand... (S5,B)"* and *"Information that I do not understand clearly or that I have difficulty in understanding is unnecessary for me. Information should be clear, concise and understandable... (S7,G)".*

Students' perceptions about the importance of the scientific research

Then, participant students were asked about the importance of scientific research, and results of the content analysis regarding this question are summarized in Figure 3.

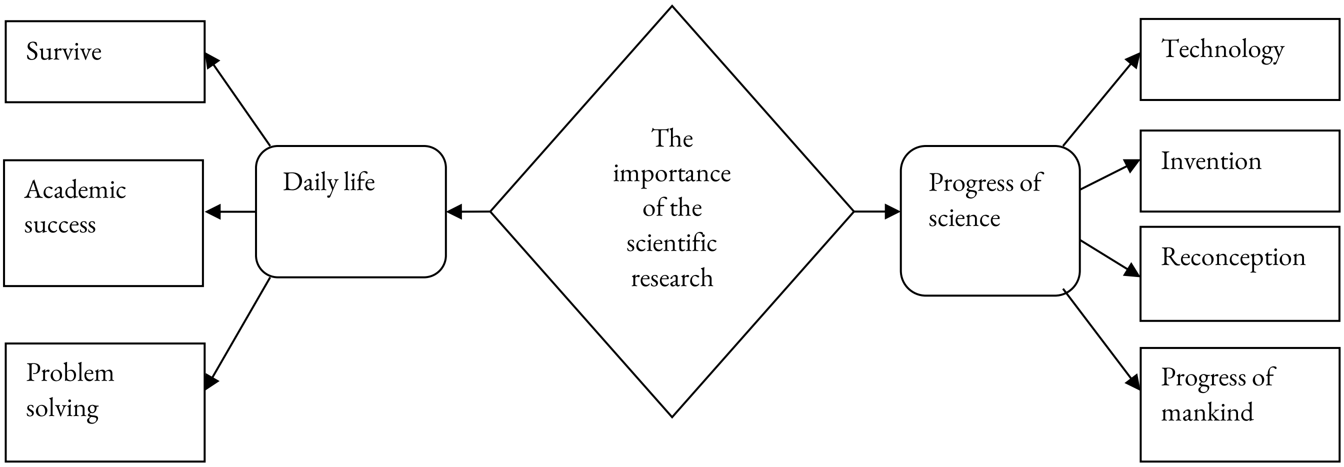

Figure 3. Students' Views about the Importance of the Scientific Research

A majority of the participant students stated that scientific research are more related to the progress of science (f=8). According to these students, scientific research results are effective in technological development, the development of inventions, the emergence of reconception, and the progress of mankind. For example: *"I can say that technology has developed as a result of scientific research and research-development activities... (S9,G), "Scientific research played a pioneering role in the emergence of new inventions... (S7,G)", "Scientific research results have helped to break stereotypes, and create an innovative way of thinking... (S4,G)" and "Mankind owes the current level of civilization to the scientific research... (S10,B)".*

One-quarter of the students (f=4) emphasized the benefits of scientific research to daily life while explaining its' importance. Some of the students claimed that the scientific process is not only effective in the progress of science but also that it is a dynamic process necessary for survival in nature and society. For some students, scientific research is seen as a necessary tool to be successful both in school and academic life. However, a few students argue that scientific process knowledge and skills are effective in solving the problems encountered in every aspect of life. The following statements can be given as examples of these views: *"Mankind needs scientific research results to survive both in nature and in society... (S1,G), "Conducting scientific research can make us distinguished in school life and that may enable us to be academically successful... (S5,B)" and "Not only scientists use the scientific method, but every human uses it to solve the problems they encounter, even if they are not aware of it... (S11,B)".*

In addition to these positive perceptions, some of the students (f=5) also expressed negative perceptions about the scientific research by emphasizing both deficiencies of themselves and the disadvantages scientific method. As known, the scientific process is a long and exhausting process that requires great labor and time. Some of the participant students emphasized this aspect of scientific research and described it as difficult and boring. For example: *"There are many difficulties in conducting scientific research. Although we have theoretical knowledge about the process, conducting research scares me... (S1,B) and "For me, scientific research is the matter of scientists and scholars as it requires a lot of technical knowledge and skills. It's boring for me to deal with so much technical procedure... (S9,G).* Some of the students stated that the language of scientific papers was too heavy and incomprehensible, and therefore they perceived the scientific process as complicated. Therefore, the papers that students have difficulty in understanding and internalizing are seen as unnecessary. Following statements can be given as examples to these perceptions: *"I don't understand why the language used in scientific papers is so complex. It's as if these papers were written so that no one would understand... (S5,B)" and "Information that I do not understand clearly or that I have difficulty in understanding is unnecessary for me. Information should be clear, concise and understandable... (S7,G)".*

Students' views about their own scientific method knowledge and skills

Participant students were asked to evaluate themselves about the scientific method knowledge and skills, and results of the content analysis regarding this question are summarized in Figure 4.

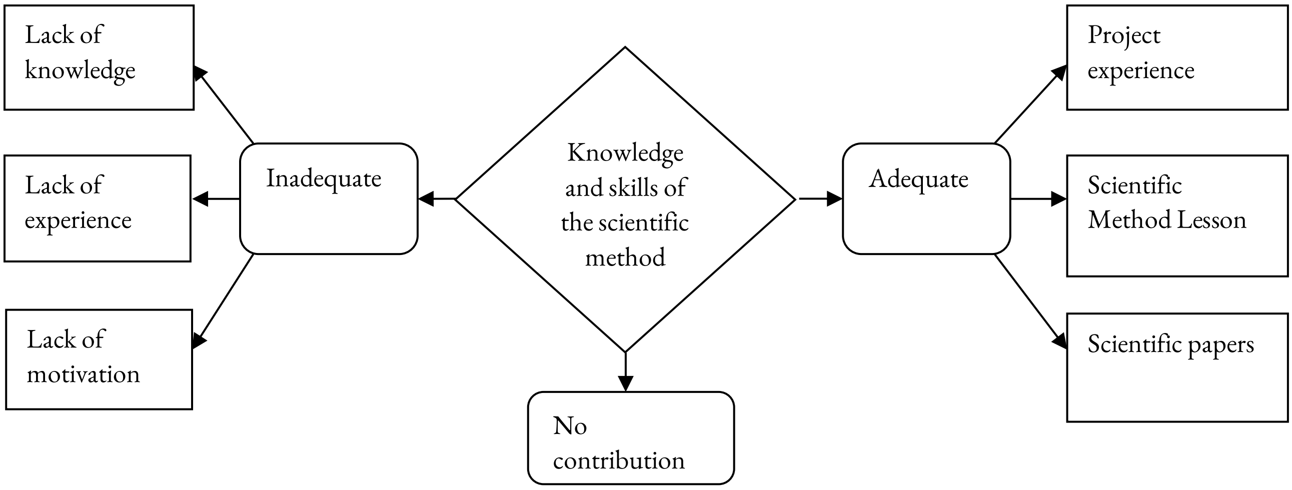

Figure 4. Students' views on their adequateness about the scientific method

Half of the participant students (f=6) evaluated themselves as inadequate in the scientific method. These students linked the inadequacy of the scientific method with a lack of knowledge, experience, and motivation. Some of the students stated they do not have enough knowledge about the scientific method, due to the course content being an insufficient and unqualified educators, although they take lessons about the scientific method. Some of the students stated that they see themselves as inadequate in the scientific method due to they had no chance to experience scientific research. Some of the students emphasized lack of motivation as the most important reason for their inadequacy in the scientific method. The following statements can be given as examples of these views: *"We have been taking scientific method courses since middle school. However, I could not learn much because the content of the courses was empty, and the trainers were insufficient in this regard... (S7,G), "I did not have a chance to practice my knowledge about the scientific method, so I forgot it... (S4,G)" and "Most of our time at school is spent preparing for the university entrance examination. I consider myself inadequate because our teachers do not lead and encourage us to conduct scientific research... (S5,B)".*

About 33% of participant students (f=4) evaluated themselves as adequate about the scientific method. These students stated that they had project experience before, they learned necessary information in the scientific method course, and they follow scientific papers regularly. Some of the remarkable statements of these views are as follows: *"I have been assigned TUBITAK projects several times before. Therefore, I consider myself sufficient in the scientific method... (S10,B)", "I think scientific method courses was very productive for me. I learned too much in these lessons, so I see myself adequate about the scientific method... (S9,G)" and "I regularly read scientific papers that interest me. Therefore, I think that I have sufficient knowledge about the process... (S3,G)".*

Two students did not report an opinion about their competencies, stating that they had never been assigned to a scientific project before, they did not have the opportunity to test their knowledge, and the scientific processes did not interest them.

Students' views about the scientific literacy workshop

Lastly, participant students were asked about how was the Scientific Literacy Workshop, and how was it effected their approach to the scientific method. Results of the content analysis regarding to this question are summarized in Figure 5.

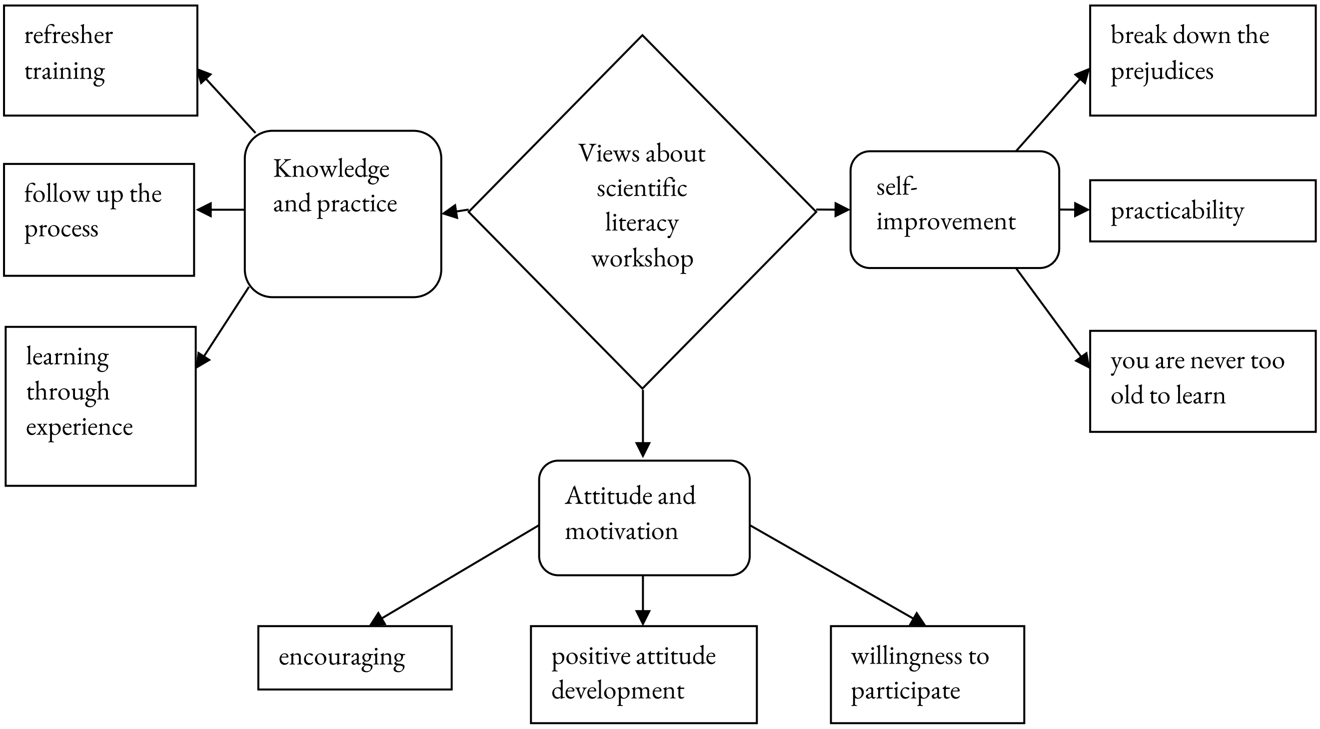

Figure 5. Students' views about the scientific literacy workshop

As seen in Figure 5, the Scientific Literacy Workshop helped to develop students' scientific knowledge and practice, self-improvement, attitude, and motivation. According to the majority of the students this Project helped them to refresh their knowledge about the scientific process. For example: *"I remembered the knowledge and how the scientific process works, thanks to the Scientific Literacy Workshop... (S9,G)" and "Thanks to the project, I had the chance to remember and understand how the scientific process works, as well as reviewing articles... (S5,B)".* Students emphasized that the project enabled them to observe the whole process of a scientific paper from planning to publishing first hand. This observation helped students to assimilate and comprehend the scientific process. Some of the remarkable statements of these views are as follows: *"We observed directly from the author about the process from planning to publishing of an article. Thus, it was a useful activity for taking into practice to my knowledge about scientific processes... (S3,G)" and "I clearly understood which sections should be in a scientific paper and what these sections should contain... (S2,B)".* In addition, students emphasized the Project helped to develop their scientific literacy, by learning through experience. For example: *"During the project, I had the chance to put the scientific process knowledge I learned theory into practice. In this way, I think I internalized the scientific process better... (S7,G)".*

Students stated that the project also contributed to their self-improvement by helping them to break down prejudices, understand that the process is practicable, and realize that they are never too old to learn. Some of the remarkable statements of these views are as follows: *"I used to think that the scientific method is a difficult and complex process. During this project, I realized that the scientific process was not as difficult and complex as I had thought, it was just a prejudice... (S6,B)", "In this project, I had the opportunity to closely observe a scientific process, and be involved in it. In this way, I realized that the scientific process is a practicable procedure that can be conducted by anyone... (S4,G).*
Students also stated that the Project encouraged them to follow and conduct scientific research, helped them to develop positive attitudes, and helped them to be a willingness to participate in scientific research. Some of the remarkable statements of these views are as follows: *"This project was important in terms of encouraging me towards scientific processes. Because being involved in the process and actively following it personally encouraged me... (S11,G), "During the project, my perceptions about scientific research positively changed. I realized that the scientific process is not threatening and difficult, on the contrary, it is a process that can be performed by every individual... (S7,B) and "Before that, I was hesitant to participate in scientific studies. Thanks to this project, I can now volunteer to participate in scientific research... (S1,G)".*

Conclusion and Discussion

Current findings revealed that students' research attitudes observably improved at the end of the Scientific Literacy Workshop. According to this result, we can claim that the Scientific Literacy Workshop positively contributed to participant students' research attitudes. This might be through the opportunities provided by the Project for the students. One of these advantages which the Project presents was helping students to put their scientific process knowledge and skills into practice. During the Project, students had the chance to observe the whole process of a scientific paper from planning to publishing. In this way, students were able to experience how the scientific method they learned theoretically works in practice. The students had the chance to experience the scientific process at first hand, realized that the process was not as difficult and incomprehensible as they thought. Therefore, this awareness stage may have changed students' perspectives about scientific processes and helped them to develop positive attitudes. This claim is supported by students' views too. Initially, students described the scientific process as boring, difficult, complicated, and unnecessary, and emphasized that scientific research is the business of scientists and scholars. However, it was observed that students' perceptions of scientific research positively changed during the Project. Students stated that scientific research was not as complicated as they thought, and it could be carried out by anyone who has enough interest and knowledge. In addition within the Project scope, students had the chance to refresh their scientific method knowledge and skills and stated that they learned better through experience.

Another opportunity provided by the Scientific Literacy Workshop to the participant students was bringing them together with scholars and authors. By this means, the students had the chance to meet the authors whose papers they follow, discuss the articles, and observe the scientific process first hand. This case may have encouraged students about the scientific method and scientific research and may have positively affected their attitudes too. Previously, students had a prejudiced approach towards scholars and authors, because they did not have the opportunity to meet any of them. They also thought that scientists were isolated from society and that scientific jargon was incomprehensible. The students, who had the opportunity to meet scholars and authors from different fields within the scope of the Project, realized that the situation was not as they thought. During the Project, students came together with authors and scholars in online meetings, discussed the articles, and refreshed their scientific process knowledge and skills. Students stated that they learned scientific terms through these meetings, and realized scientific jargon was not as incomprehensible as they thought. Thus, it is thought that eliminating students' prejudices against scholars and scientific jargon positively affected their attitudes toward research. The negative impact of prejudices on human behaviors and attitudes toward a phenomenon is already known (Harell, Soroka, & Iyengar, 2016; Hurwitz, 2008).

In the previous literature, many findings revealed attitudes toward the research of students at various educational levels. The reported results in these studies are often very diverse. In some studies, it was revealed that students' attitudes toward research were at a moderate or high level (Kakupa & Xue, 2019; Karadaş & Özdemir, 2015; Park, McGhee, & Sherwin, 2010; Polat, 2014; Shaukat, Siddiquah, Abiodullah, & Akbar, 2014; Siamian, Mahmoudi, Habibi, Latifi, & Zare-Gavgani, 2016). Contrary to this result, some findings indicated that students' attitudes toward research were at a low level (Addams & Holcomb, 1986; Amoo & Gbadamosi, 2021; Butt & Shams, 2013; Henry, Ghani, Hamid, & Bakar, 2020; Papanastasiou, 2005; Shaukat, Siddiquah, Abiodullah, & Akbar, 2014). It is quite clear that most of the previous studies focused on students' attitudes towards research tried to reveal the present condition, and far from the concern of developing it. This study focused not only on the revealing present condition of students' attitudes towards research but also on developing it. Therefore the results of the current study are considered important in contributing to the related literature.

This study also explored the effects of demographic variables on the students' research attitudes. It was found that male and female students perceived research attitudes were not significantly different. Research is a substantial component of every profession and student. Today almost every profession demands good skills in research. These professions are not usually gender oriented. Therefore, both female and male students have to be components of research skills. A similar attitude towards research in the males and the females in the current study may be due to the reason that all the students can realize the practicality and importance of scientific research. This claim was also supported by students' opinions. Both female and male students stated that they realized the scientific process is practicable to everyone during the Project process, and scientific research can support them both personally and academically. This result is in contrast to the results of previous studies which suggested that female students have less interest and involvement in research activities than males. For example, Shaukat, Siddiquah, Abiodullah, and Akbar (2014) stated that male students had more positive attitudes toward research than females. According to Costello (1991), males held more positive attitudes toward research than females because research is a male-dominated domain. Butt and Shams (2013), explained the males' positive attitudes with the fact that the males assume that the research is useful for their professional careers. According to Lindsay, Breen, and Jenkins (2010), the reason for the positive attitudes of males toward the research may be that they are more inclined toward mathematics, statistics, and economics than females. In the previous literature, there are also findings overlapping current results (İlhan, Çelik, & Aslan, 2016; Kakupa & Xue, 2019; Siamian, Mahmoudi, Habibi, Latifi, & Zare-Gavgani, 2016).

Another finding of this study is that students' research attitudes did not statistically different according to the grade level variable. According to this finding, students' research attitudes were similar regardless of grade level. All high school students in Turkey receive scientific method courses at any grade level. Therefore, we can assume that high school students at all levels have scientific method knowledge and skills. It is thought that the attitudes of students at different grade levels with similar scientific method knowledge and skills, may be similar too. This result was supported by Kakupa and Xue (2019)'s findings indicated that there was no significant difference in research attitudes of students from different age groups. Results also showed students' research attitudes were statistically different according to the type of school they attended. Perceived attitudes of students studying at academic high schools were higher than students studying at vocational high schools. We can say that in Turkey, students studying at academic high schools are relatively more successful than students studying at vocational high schools (Berberoğlu & Kalender, 2005). Students who are academically more successful may have more interest and involvement in scientific research. It can be considered as an expected result that the attitudes of the students who have more interest and involvement in scientific research are also higher.

We believe that if students develop good research skills and attitudes, which are essential for learning and generating their reflections and ideas, they can be successful both academically and personally. Therefore, we attached great importance to the development of students' research attitudes, as well as their knowledge and skills about the scientific process. As a result, we can assume that the current study which was carried out with the concern of developing students' research attitudes, achieved its purpose. Feedback from students also supports this assumption. Students stated that they were encouraged to be involved in the scientific process thanks to the Project and that they would now participate in scientific research voluntarily. Therefore, it is thought that the Scientific Literacy Workshop would be a pioneer project for educators, and the results of this study would be a good example for further studies that focus on developing students' research attitudes.

Recommendations

Recommendations for Teachers

As can be seen, it is not sufficient to provide students with scientific method knowledge and skills. Students should be encouraged about scientific processes, and they should be offered the opportunity to turn their theoretical knowledge into practice. With this intention, we recommended that projects such as the Scientific Literacy Workshop should be implemented by teachers for students at all grade levels.

Scientific research is important for students' academic and self-improvement as well as professional careers. Therefore, teachers should improve themselves with effective strategies and pedagogies for developing positive attitudes toward research among their students.

Recommendations for Further Studies

Measuring students' research attitudes is essential to investigate the interest and involvement of students in research. It is suggested that further studies should not only be contented with measuring students' research attitudes, but also take measures to improve it.

The limitation of this study was that the sample size was not adequate; the study group consisted of only 42 high school students who participated in the Scientific Literacy Workshop. Thus students' research attitudes at other teaching levels remain unknown, which limits the generalization of the current findings. In further studies, it may be beneficial to conduct similar studies with larger participants and at different teaching levels in terms of increasing the generalizability of the results.

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Research Article

Impact of language learning strategies on technology addiction and coping skills in gifted adolescents

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Abstract

Aim of this study is to examine the effect of language learning strategies on technology addiction and coping skills in gifted adolescents. In this regard, relational screening model was implemented in this study. The study group of the research consisted of 246 adolescents between the ages of 10-18 who were studying in Science and Art Centers and who volunteered to be included in the present research. The relevant data were obtained by applying 'Demographic Information Form', 'Technology Addiction Survey', 'Language Learning Strategies Inventory', and 'Coping Scale for Adolescents'. Independent sample t-test was used to compare the averages of two groups in demographic variables; One-way ANOVA test result was used to compare more than two independent groups. Both univariate and multivariate regression analyses were used to evaluate the predictability of the dependent variable by the independent variable(s). Pearson correlation coefficient was calculated in the relationship analysis of the scales. The analysis of the data revealed that the level of technology addiction of adolescents was significantly high. Negative coping and avoidant coping levels of adolescents were significantly high. Active coping levels were found to be significantly low. According to the results obtained when technology addiction and coping skills of gifted adolescents were investigated, we determined a negative and significant relationship between technology addiction and active coping. There was a positive and significant relationship between technology addiction and negative coping. Some demographic variables significantly affected the development of technology addiction and coping strategies. In the current study, the importance of guiding gifted adolescents and developing awareness about language learning strategies for the development of active coping strategies was emphasized respectively. It is anticipated that the data obtained in the study will create an important information infrastructure in interventions related to technology addiction and coping skills in gifted adolescents.

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Introduction

Gifted adolescents have extraordinary intelligence, creativity, and problem-solving abilities. These characteristics enable them to generate innovative ideas in a wide range of fields from art to science, from mathematics to engineering (Mudrak & Zabrodska, 2015). Supporting and encouraging such talents is of great importance for the progress of society. Gifted adolescents may have a high potential for academic success. Raising gifted adolescents in a healthy educational environment can form the cornerstones of scientific and technological progress. These individuals can make significant contributions to the scientific knowledge of society with their future academic and professional achievements

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(Jonathan, 1988). Gifted adolescents can pioneer important changes and innovations in various fields of societies. Their capacity to come up with solutions to social problems, develop innovative business ideas, and lead social projects is critical for supporting social development (Clark, 2015). In addition, these young people can be a source of inspiration for their environment. Their achievements and talents can provide motivation for other individuals to discover their potential and achieve their goals. Their success stories can set a strong example in the fields of education and personal development (Worrell et al., 2018). Providing opportunities for gifted adolescents to realize themselves may enhance both their individual development and social welfare. The support provided in education and personal development helps these young people to express themselves in the best way and maximize their social potential (Robinson, 2008). Particularly supporting them in the use of rapidly developing technological tools can enable them to access data rapidly (Tortop, 2022).

Gifted adolescents often have a natural interest in digital technologies owing to their high cognitive capacities and deep passion for learning (David, 2023). Technological devices and digital tools allow gifted adolescents to satisfy their intellectual curiosity, access information quickly, and work on various creative projects (Gül & Ayık, 2023). Internet, software applications, and various technological tools foster gifted adolescents' ability to solve problems and develop new ideas. This interest contributes to their success in the rapidly changing digital world and producing innovative solutions in the field of technology (Çubukcu & Tosuntaş, 2018). The special interest of gifted adolescents in technological devices and digital tools provides an opportunity for them to discover their own talents through technology and the Internet. Online education platforms may offer the opportunity to develop their talents in areas such as coding tools, digital art, and game development. These tools can further promote their creative and analytical thinking skills and contribute to their success in their careers (Ogurlu et al., 2021).

The special interest of gifted adolescents in technological devices and digital tools involves both great opportunities as well as some risks. It is important for these young people to use technology in an efficient and balanced way so that they can realize their potential in the best way, however, this increased interest may also pose some challenges (Kurnaz & Tepe, 2019). In particular, over-reliance on technology can lead to distancing from social interactions or time management problems. This may have negative effects on the academic achievement, and general mental health of gifted and talented adolescents (Siegle, 2015). The high cognitive capacities of these young people and their intense interest in technology may also lead to reduced social interactions and difficulties in face-to-face interactions. The development of social skills is often based on real-life experiences, and limited interactions in the digital environment can cause deficiencies in social skills (Karabulut-Coşkun & Akar, 2022). In addition, technology addiction can have negative effects on academic performance. Prolonged screen time can potentially result in distraction and time management problems, which can negatively interfere with academic achievement and the learning process. Technology addiction in gifted adolescents may also trigger physical health problems. Extended periods of sitting and screen time can bring about eye health problems, posture disorders and general physical health disorders (Tsai & Lin, 2003). Nevertheless, there may also be risks in terms of mental health. Excessive engagement with technological devices in technologically gifted adolescents can trigger psychological problems such as anxiety, depression, and low self-esteem. Such emotional difficulties can negatively influence the overall quality of life and happiness of adolescents. Moreover, this addiction may increase the tendency to develop addictions and pave the way for the formation of other harmful habits (Zimlich, 2016). Similarly, technology addiction may restrict adolescents' creative and problem-solving skills. Excessive use of technology can hinder these young people's ability to solve real-world problems and their creativity because such skills often require a variety of physical and social interactions (Peterson et al., 2009). For these reasons, understanding and managing the risks of technology addiction in gifted adolescents is critical to support healthy development in both individual and societal domains. It is essential to develop gifted adolescents' skills to cope with technology addiction and other behavioral problems (Ersoy & Deniz, 2016).

Coping skills in gifted adolescents are defined as behavior, thought, or feeling patterns to protect the internal integrity at the highest level, to calm oneself, and to sustain daily life at an optimal rate in stressful situations encountered in life (Parker & Endler, 1992). Since coping is all of the cognitive and behavioral efforts of adolescents to overcome the demands from themselves or their environment in the face of a stressful situation or circumstances, there is a significant relationship between technology addiction and the development of coping skills (Anda et al., 2000). Coping is associated with the ability to eliminate the harmful effects of stress and to use stress as a tool for development (Vucenovic et al., 2023). Davis and Humphrey (2012) suggest that the personal resources of adolescents can be evaluated in eight categories by considering their resilience, coping, and adaptation. These categories are innate intelligence, knowledge and skills, personality traits, physical, mental, and emotional resilience, sense of dominance, the belief that there is constant control in life conditions, self-esteem level, sense of consistency, ethnic identity and cultural background. In addition, there are studies indicating that the inability to use time appropriately, postponing work, leaving tasks to the last moment, and being under time pressure are important sources of stress (Baker, 1995; Eren et al., 2018; Pfeiffer, 2002). Therefore, one can argue that coping skills are related to the emotions, cognitions, and behaviors of gifted adolescents in stressful situations and conditions.

Gifted adolescents also use coping skills when employing language learning strategies. Language learning strategies should be determined based on their high cognitive capacities and learning skills. Gifted adolescents frequently need personalized learning plans that are appropriate to their learning pace and style. This makes the language learning process more motivating and effective. These young people may be interested in developing language learning strategies with advanced resources beyond standardized materials. In particular, using language-related resources such as advanced language books, academic articles, literary works, and specialized language learning software can help them develop their language skills in more depth (Chamot, 2005). To make language learning more effective for gifted adolescents, it is crucial to use a language in its natural context. Reading books, watching movies, listening to music, and practicing speaking in a foreign language can be effective in the development of language learning strategies of gifted adolescents (Tam, 2013). Utilizing problem-solving and analyzing skills in the language learning process can be useful for gifted adolescents. Analyzing grammatical structures, identifying linguistic structures, and investigating how these structures are used in various contexts can deepen the language learning process of gifted adolescents (Peterson et al., 2009). Gifted individuals tend to learn better through interaction and practice/exploration (Jonathan, 1988). Thus, it is important for them to engage in social and cultural interactions that can enrich the language learning process.

In the process of language learning, gifted adolescents can effectively use technology. Digital tools such as language learning applications, online courses, language learning games, and virtual classrooms can help them improve their language skills (Weinstein & Mayer, 1986). Interactive methods such as creative writing, speaking projects, drama plays, and language games can make the learning process more fun and effective (Tam, 2013). Assessing their own progress regularly and receiving feedback is an important part of the language learning process. Identifying strengths and weaknesses through self-assessment can help improve learning strategies (Chamot, 2005). These strategies to support the language learning process of gifted adolescents will enable them to make the best use of their high potential and develop their language skills effectively, and considering the use of technological devices and coping skills in this process is also critical for a successful language learning experience. Based on this information, it is necessary to examine the role of language learning strategies, technology addiction, and coping skills in gifted adolescents.

Method

Research Design

In this study, the relational screening model was applied to detect the mediating role of language learning strategies, technology addiction, and coping skills in gifted adolescents. Relationships between concepts are investigated through relational analysis implemented in quantitative research. The relationships between the concepts determined in line with the fundamental purpose are the situation that helps the researcher answer the research questions (Akarsu & Akarsu, 2019, p. 59). In quantitative research, relational screening models specify the presence and/or level of change between two or more variables (Şavran, 2010).

Study Group

The participants of the present research consisted of adolescents between the ages of 10-18 who were studying in Science and Art Centers (SACs) in Konya province and who volunteered to participate in the study. The criteria for inclusion in the study were determined as (1) being between the ages of 10-18 (2) being a student at SAC (3) volunteering to participate in the study. The total sample of this study consisted of 246 participants aged between 10 and 18 years. The socio-demographic variables of the participants are presented in Table 1.

Table 1. Socio-demographic variables of the participants (N=246)

Variables		n	%
Gender	Female	122	49.6
	Male	124	50.4
Age	10-12	91	37.0
	13-18	155	63.0
Number of Children	Single Child	35	14.2
	2 Children	125	50.8
	3 Children	73	29.7
	4 Children	13	5.3
Birth Order	First Child	147	59.8
	Middle Child	38	15.4
	Youngest Child	61	24.8
Age of Mother	40 and below	130	52.8
	41 and above	116	47.2
Age of Father	40 and below	66	26.8
	41 and above	180	73.2
Education of Mother	High School and below	63	25.6
	University and above	183	74.4
Education of Father	High School and below	49	19.9
	University and above	197	80.1

The sample of this study consisted of 246 participants, 122 (49.6%) girls and 124 (50.4%) boys. Of the participants, 91 (37.0%) were children and 155 (63.0%) were adolescents. A total of 35 (14.2%) of the participants were only children. 125 (50.8%) came from families with 2 children, 73 (29.7%) with 3 children and 13 (5.3%) with 4 or more children. Among the participants, 147 (59.8%) were the first child, 38 (15.4%) were the middle child and 61 (24.8%) were the youngest child. Of the participants' mothers, 130 (52.8%) were 40 years of age or younger and 116 (47.2%) were 41 years of age or older. Among the fathers of the participants, 66 (26.8%) were 40 years old or younger and 180 (73.2%) were 41 years old or older. Among the mothers of the participants, 63 (25.6%) had a high school education or below, 183 (74.4%) had university degree or above. Of the participants' fathers, 49 (19.9%) had a high school education or lower, while 197 (80.1%) had a university education or university and higher degrees.

Data Collection Tools

In this current study, which was conducted to examine technology addiction and coping skills in gifted adolescents, data were obtained by applying 'Demographic Information Form', 'Technology Addiction Survey' and 'Coping Questionnaire for Adolescents'.

Demographic Information Form

Information about the age, gender, number of siblings, birth order, age of the parents, and educational status of the parents of the children and adolescents in the study group was obtained with this form.

Technology Addiction Scale

The scale was analyzed for validity and reliability in Turkish by Aydın (2017) and consists of 24 items and 4 sub-dimensions. The scale has 4 sub-dimensions as 'using social networking (6 items), instant messaging (6 items), playing online games (6 items) and using websites (6 items)'. The highest score to be obtained for the whole scale was determined as 120 (24×5) and the lowest score was set as 24 (24×1). While interpreting the arithmetic averages of the whole scale; 0-

24 range of points was determined as 'not dependent', 25-48 range of points as 'low level dependent', 49-72 range of points as 'moderately dependent', 73-96 range of points as 'highly dependent' and 97-120 range of points as 'fully dependent'.

Coping Scale for Adolescents

The validity and reliability of the Turkish version of the scale were conducted by Bedel, Işık, and Hamarta (2014). The relevant study was conducted on a total of 453 students from 7th, 8th, 9th, 10th and 11th grades. To test the construct validity, the previously proposed one-factor, two-factor, three-factor, and four-factor structures were tested via Confirmatory Factor Analysis, and it was observed that the Turkish form of the scale consisting of 15 items was best compatible with the three-factor structure. Criterion-related validity was confirmed by moderate correlations between the sub-dimensions of the scale and trait anxiety. The scale has three sub-dimensions: active coping (items 3, 6, 8, 10), negative coping (items 4, 5, 7) and avoidant coping (items 1, 2, 9, 11). In the scale, a 4-point Likert-type assessment is applied as 'Never', 'Occasionally', 'Most of the time' and 'Always' and it is scored with 0, 1, 2, 3 points. The average score range that can be obtained from the scale is 0-3 points. A minimum of 3 and a maximum of 33 points can be obtained from the scale.

Strategy Inventory for Language Learning (SILL)

This data collection tool was applied in order to examine the meaning-making situations of the participants in the study group from vocabulary level to pragmatic language use. Within the scope of the research, firstly, the necessary permissions were obtained from Rebeca Oxford, the developer of the language learning strategies measurement tool, and the researchers who adapted the 'language learning' scale into Turkish. The measurement tool consists of two different Likert-type scales measuring the frequency of strategy use of adolescents in five dimensions. Both questionnaires administered under the name of language learning strategies consist of six different categories. In the Language Learning Strategies Inventory, there are 9 items in A-Memory strategies, 14 items in B-Cognitive strategies, 6 items in C-Compensation strategies, 9 items in D-Higher cognitive strategies, 6 items in E-Affective strategies, and 6 items in F-Social strategies.

Data Evaluation

SPSS v26.0, one of the statistical analysis programs, was used to analyze the data. Descriptive statistics, including frequency, percentage, arithmetic mean, standard deviation, maximum, and minimum values, and normality distribution assessment, were performed to analyze socio-demographic variables and scale scores. Since the kurtosis and skewness values were between the reference values (±2), parametric statistical tests were used. Independent sample t-test was used to compare the means of two groups in demographic variables; One-way ANOVA test results were utilized to compare more than two independent groups. For ANOVA test, Levene test was used for homogeneity of variance and for group differences, Tukey HSD and LSD were used if homogeneity of variance was provided ($p \geq 0.05$), and Tamhane multiple comparison test was employed if homogeneity of variance was not provided ($p < 0.05$). In the assessment of the prediction of the dependent variable by the independent variable(s), both univariate and multivariate regression analyses were used respectively. The Pearson correlation coefficient was computed in the investigation of the link between the scales. Thus, all statistical analysis test results were considered at 0.05 significance level.

Findings

In this study, the data obtained from the Technology Addiction Scale, Strategy for Language Learning Inventory, and Coping Scale for Adolescents were presented to investigate language learning strategies, technology addiction, and coping skills in gifted adolescents. Regarding the research variables, the lowest-highest values, mean-standard deviation values, and skewness- kurtosis values were analyzed. The findings are presented in Table 2.

Table 2. Lowest-highest values, average-standard deviation values, and skewness-skewness values of the research variables

Variables		Lowest	Highest	Mean	F	Skewness	Kurtosis
Technology Addiction Scale	Technology Addiction	21	112	50.65	17.73	.71	.15
	Using Social Networking	6	30	13.72	5.19	.61	-.13
	Instant Messaging	6	30	12.16	4.97	.81	.28
	Playing Online Games	6	30	13.00	5.61	.70	-.29
	Using Websites	6	30	11.87	5.59	.81	.83
Coping Scale for Adolescents	Negative Coping	0	9	2.57	1.62	.66	.81
	Active Coping	0	12	6.80	2.48	-.38	.35
	Avoidant Coping	0	12	5.98	2.23	.29	.68
Strategy Inventory for Language Learning	Memory strategies	5	45	32.18	3.71	.57	.11
	Cognitive strategies	7	42	38.62	3.62	.49	.9
	Compensation strategies	7	39	46.31	5.61	.62	.14
	Metacognitive strategies	6	42	33.95	5.59	.54	.8
	Affective strategies	8	37	40.18	3.84	.68	.12
	Social strategies	4	46	43.36	3.36	.39	.9

Table 2 demonstrates that the mean of technology addiction was 50.65±17.73, the mean of social networking was 13.72±5.19, the average of instant messaging was 12.16±4.97, the average of playing online games was 13.00±5.61, and the average of using websites was 11.87±5.59. In addition, the mean of negative coping was calculated as 2.57±1.62, the mean of active coping as 6.80±2.48, and the mean of avoidant coping as 5.98±2.23. In the language learning strategies of the study group, memory strategies were found to be 32.18±3.71; cognitive strategies 38.62±3.62; compensation strategies 46.31±5.61; metacognitive strategies 33.95±5.59; affective strategies 40.18±3.84 and social strategies 43.36±3.36. Skewness and kurtosis values of the research variables were between -1.00 and +1.00. These results show that the data have met the normality assumption. A series of independent sample t-tests were conducted to compare the participants' technology addiction, language learning strategies, and coping levels according to gender. The findings are indicated in Table 3.

Table 3. Comparison of technology addiction, language learning strategies, and coping levels by gender

	Variables	Gender	Mean	F	LB	UB	*t*	*p*
Technology Addiction Scale	Technology Addiction	Female Male	48.71	17.64	42.96	61.26	-1.699	.091
Coping Scale for Adolescents	Negative Coping	Female Male	52.55	17.68	43.05	47.58	.280	.780
	Active Coping	Female Male	2.60	1.67	46.18	46.31		
	Avoidant Coping	Female Male	2.54	1.58	43.41	33.95		
Strategy Inventory for Language Learning	Memory Strategies	Female Male	6.67	2.41	2.40	40.18	1.547	.123
	Cognitive strategies	Female Male	6.94	2.54	1.93	32.18		
	Compensatory strategies	Female Male	6.20	2.36	2.01	38.62		
	Metacognitive strategies	Female Male	5.76	2.09	2.37	46.31		
	Affective strategies	Female Male	6.67	1.58	6.33	46.31		
	Social strategies	Female Male	6.94	2.41	6.09	33.95		

LB: Lower Bound **UB**: Upper Bound

The results obtained with Table 3 show that there is no significant difference between the groups in terms of the mean of any variable (p>.05). In order to compare the participants' technology addiction, language learning strategies, and coping levels by age group, a series of independent t-tests were conducted, and the findings are presented in Table 4.

Table 4. Comparison of technology addiction, language learning strategies, and coping levels by age group

	Variables	Age	Mean	F	LB	UB	*t*	*p*
Technology Addiction Scale	Technology Addiction	10-12	45.27	14.60	-12.99	50.18	-	.000
		13-18	43.84		-11.93	49.98	3.682	
Coping Scale for Adolescents	Negative Coping	12	53.74	18.65	-1.23	24.46		
		13-18	50.29		-0.98	27.02		
	Active Coping	12	2.05	1.46	1.08	23.05	-	.000
		13-18	2.38		1.17	22.18	3.920	
	Avoidant Coping	12	2.87.	1.64	1.28	24.23		
		13-18	2.66		2.02	23.05		
Strategy Inventory for Language Learning	Memory Strategies	12	7.41	2.49	12.1	28.41		
		13-18	6.39		14.3	28.58		
	Cognitive strategies	12	6.45	2.41	20.14	23.05		
		13-18	5.38		17.29	20.58		
	Compensatory strategies	12	5.57	1.83	18.03	24.23	2.964	.003
		13-18	4.98		16.77	23.48		
	Metacognitive strategies	12	6.21	2.41	15.17	28.41		
		13-18	5.58		14.98	26.73		
	Affective strategies	12	7.41	2.49	21.02	24.23		
		13-18	6.94		19.58	23.05		
	Social strategies	12	6.45	2.46	18.69	28.41		
		13-18	5.88		17.93	28.58		

LB: Lower Bound **UB**: Upper Bound

The obtained results in Table 4 indicate no significant difference between the groups in terms of the mean of any of the variables (p>.05).

A series of one-way ANOVAs were conducted to compare the participants' technology addiction, language learning strategies, and coping levels according to birth order. The findings are presented in Table 5.

Table 5. A comparison of technology addiction, language learning strategies, and coping levels based on birth order

	Birth Order	Mean	F		LB	UB	*t*	*p*
Technology Addiction Scale	First	51.86	17.62	3.05	48.96	54.5	.832	.436
	Middle	49.08	18.33	2.94	43.05	55.10		
	Youngest	48.75	17.65	3.16	44.23	53.28		
Coping Scale for Adolescents	First	2.68	1.70	2.40	2.96	27.16	.861	.424
	Middle	2.42	1.48	1.93	2.91	27.75		
	Youngest	2.39	1.50	2.01	2.78	24.46		
Strategy Inventory for Language Learning	First	6.75	2.54	6.33	7.16	23.05	.100	.905
	Middle	6.92	2.53	6.09	7.75	24.23		
	Youngest	6.87	2.33	6.27	7.46	28.41		

LB: Lower Bound **UB**: Upper Bound

Table 5 indicates that there is no statistically significant difference among the relevant groups regarding the mean of any variables (p > .05).

A series of independent sample t-tests were conducted to compare the participants' technology addiction, language learning strategies, and coping levels according to the participants' mother's age. The findings are presented in Table 6.

Table 6. Comparison of technology addiction, language learning strategies, and coping levels by mother's age

	Variables	Mother's age	Mean	F	LB	UB	*t*	*p*
Technology Addiction Scale	Technology Addiction	40 and younger	51.86	17.62	48.96	54.5	.832	.436
		41 and older	48.36		42.90	56.03		
Coping Scale for Adolescents	Negative coping	40 and younger	2.68	1.70	2.96	47.16	.861	.424
		41 and older	2.94		2.47	46.28		
	Active coping	40 and younger	2.42	1.48	2.91	47.75		
		41 and older	2.02		2.37	46.05		
	Avoidant coping	40 and younger	2.39	1.50	2.78	54.46		
		41 and older	2.46		2.17	53.93		
Strategy Inventory for Language Learning	Memory Strategies	40 and younger	39.75	2.54	7.16	43.05	.100	.905
		41 and older	37.48		6.29	44.18		
	Cognitive strategies	40 and younger	41.92	2.53	7.75	44.23		
		41 and older	40.02		6.88	43.28		
	Compensatory strategies	40 and younger	36.87	2.33	7.46	48.41		
		41 and older	34.94		6.84	46.66		
	Metacognitive strategies	40 and younger	49.08	18.33	4.23	53.28		
		41 and older	46.06		4.38	52.63		
	Affective strategies	40 and younger	48.75	16.28	3.05	55.10		
		41 and older	44.98		3.48	54.29		
	Social strategies	40 and younger	41.92	17.15	4.92	51.47		
		41 and older	40.87		4.06	50.96		

LB: Lower Bound **UB**: Upper Bound

As shown in Table 6, the results indicate that there is no statistically significant variation in any of the variable means between the groups (p > .05).

In order to compare the participants' technology addiction, language learning, strategies and coping levels according to the participants' father's age, a series of independent sample t-tests were conducted. The findings are presented in Table 7.

Table 7. A comparison of technology addiction, language learning strategies, and coping levels by father's age

	Variables	Father's age	Mean	F	LB	UB	*t*	*p*
Technology Addiction Scale	Technology Addiction	40 and younger	50.16	10.12	48.96	51.53	-1.43	.153
		41 and older	48.36		42.90	52.07		
Coping Scale for Adolescents	Negative coping	40 and younger	2.68	1.20	2.96	46.83	-1.29	.197
		41 and older	2.94		2.47	46.28		
	Active coping	40 and younger	2.42	1.52	2.91	44.58		
		41 and older	2.02		2.37	46.05		
	Avoidant coping	40 and younger	2.39	1.50	2.78	53.66		
		41 and older	2.46		2.17	53.93		
Strategy Inventory for Language Learning	Memory Strategies	40 and younger	39.75	2.06	7.16	42.19	1.801	.073
		41 and older	37.48		6.29	41.84		
	Cognitive strategies	40 and younger	41.92	2.13	7.75	42.23		
		41 and older	40.02		6.88	48.29		
	Compensatory strategies	40 and younger	36.87	2.33	7.46	48.41		
		41 and older	34.94		6.84	46.66		
	Metacognitive strategies	40 and younger	49.08	18.33	4.23	52.28		
		41 and older	46.06		4.38	51.63		
	Affective strategies	40 and younger	46.75	13.28	3.05	55.10		
		41 and older	44.98		3.48	54.29		
	Social strategies	40 and younger	41.92	17.15	4.92	51.47		
		41 and older	40.87		4.06	50.96		

LB: Lower Bound **UB**: Upper Bound

The findings in Table 7 reveal no significant difference between the groups in terms of the mean of any variable ($p > .05$).

Pearson correlation analysis was conducted to examine the relationship between the scales applied in the study. The data are presented in Table 8

Table 8. The relationship between technology addiction and coping levels

Variables		Technology Addiction	Emotion Regulation	Active Coping	Negative Coping	Avoidant Coping
Technology Addiction	*r*	1				
	p	-				
Emotion Regulation	*r*	,290***	1			
	p	,000	-			
Active Coping	*r*	-,144*	,192**	1		
	p	,024	,002	-		
Negative Coping	*r*	,475***	,219**	-,235**	1	
	p	,000	,001	,000	-	
Avoidant Coping	*r*	,375***	,558****	,050	,368***	1
	p	,000	,000	,434	,000	-

LB: Lower Bound **UB**: Upper Bound

According to the results obtained in Table 8, there is a negative and significant relationship between technology addiction and active coping ($r = -.144$, $p < .05$). On the contrary, there is a positive and significant relationship between technology addiction and negative coping and avoidant coping ($r = -.475$, $p < .001$; $r = .375$, $p < .001$, respectively).

Discussion

In this study, the data obtained from the study conducted to examine technology addiction and coping skills in gifted adolescents are discussed in line with the literature in this section.

Discussion of Findings Related to Technology Addiction in Gifted Adolescents

This present study has shown that the level of technology addiction of adolescents is significantly high. The mean level of technology addiction was calculated as 50.65±17.73, the mean level of using social networks as 13.72±5.19, an average level of instant messaging was 12.16±4.97, an average level of playing online games as 13.00±5.61, and an average level of using websites as 11.87±5.59. The technology addiction levels of the participants were compared in terms of gender, number of children in the family, birth order, mother's and father's age, mother's and father's education level, and the results showed that there was no significant difference between the groups in terms of the mean of any variable. The results of technology addiction and coping skills of gifted adolescents a negative and significant relationship between technology addiction and active coping. On the contrary, there was a positive and significant relationship between technology addiction and negative coping and avoidant coping. There is also a positive and significant relationship between technology addiction and emotion regulation.

The purposes of using technological devices, which seem to be an indispensable element of the lives of gifted adolescents, tend to vary for each gifted child. While the Internet offers a wide research area for them with its speed of access to information, it also comes with risks. One can regard that the steps to be taken for the prevention and intervention of these risks are important. A study has shown that lifestyle effects caused by increased access and use of screen-based digital media devices cause poor sleep hygiene in individuals (Ersoy & Deniz, 2016). One may claim that the moderate level of technology addiction of specially gifted adolescents in the study group within the scope of the research has a negative effect on sleep quality; this situation may be associated with the fact that the adolescents participating in the study have various technological tools and use them for a long time.

Despite the studies reporting a significant relationship between technology addiction and age, there are also studies that do not find a significant difference in terms of age. Şahin's (2018) study, which investigated the impact of internet and computer game addiction on the social behaviors of gifted children in school, revealed that boys engaged in internet use and computer gaming for longer durations than girls. In addition, whereas the total score of internet and computer use and the sub-dimension score of internet use differed according to the age variable, the sub-dimension score of computer game playing time did not make a difference. It was revealed that the total score of internet and computer use and the sub-dimension score of internet use increased with age. Yavuz (2018) analyzed online and gaming addiction alongside perceived social support levels in gifted adolescents, investigating the addiction scores in relation to multiple variables. As a result of the research, internet addiction did not differ according to gender variable, while game addiction scores were higher in males. Internet and game addiction levels differed according to the age variable. The scores of students aged 12-17 years were higher than the scores of adolescents aged 9-11 years. Although game addiction did not differ in terms of weekly internet use, we determined that the internet addiction levels of individuals who used the internet for 21 hours or more per week were higher than those who used the internet for 7-13 hours per week. Both Internet addiction and game addiction were found to differ based on the purpose of Internet use variable. The internet addiction scores of those who use the internet for chat-social sharing, games, listening to music, and watching videos were found to be higher than those who use the internet for homework-research purposes, but no differentiation was found between the other groups. As a result of the study conducted by Taşdemir (2017), in which the relationship between the attitudes of gifted adolescents towards computers and their self-learning with technology was examined, it was revealed that the attitude scores of male students towards computers were higher than the scores of female adolescents. Usta (2016) examined internet addiction in gifted adolescents according to different variables and found that internet addiction of gifted adolescents did not vary with regard to parental education level, socioeconomic level, having internet at home, and having a tablet, whereas it differed with regard to gender, age, parental relationship status, having a smartphone and computer, purpose of internet use and daily internet usage time. Accordingly, we may claim that the internet addiction levels of male adolescents are higher than those of female adolescents, the internet addiction levels of adolescents aged 12-17 are higher than those of adolescents aged 7-11, and the internet addiction levels of adolescents whose parents are separated are higher than those of adolescents whose parents are together. Considering the prevalence and risks together, we are of the opinion that implementing intervention programs for technology addiction could reduce developmental risks and enhance prospects for adolescents.

Discussion of Findings Regarding Language Learning Strategies by Gifted Adolescents

In our study, we revealed that demographic variables such as age, gender, birth order, and parental age did not affect the language learning strategies of gifted adolescents. Language learning strategies are specific skills that help gifted adolescents make the best use of their high cognitive capacities and learning abilities. Gifted adolescents often exhibit different needs in terms of speed and depth in their learning processes. Therefore, there are research results suggesting that creating personalized learning plans will enable individuals to develop their language strategies in the best way (Tam, 2013; Weinstein & Mayer, 1986).

Concerning the use of language learning strategies by gifted adolescents, Hsiao and Oxford (2000) emphasize that they should be adapted to the gifted adolescent's current level of knowledge, interests, and learning style. Such adolescents often need more advanced resources that can go beyond standardized materials. In the process of language learning, they develop new and better language-learning strategies by using rich content such as complex texts, academic articles, and literary works (Chamot, 2005). In addition, gifted adolescents benefit from creative learning methods while learning a new language. These methods make the language learning process more interesting and meaningful. Since role-playing games, creative writing tasks, digital projects, and language-based games make learning fun and effective, gifted adolescents combine language learning strategies with different teaching styles (Alhaisoni, 2012). In addition to learning a language, it is also essential to understand the culture of that language. Gifted adolescents have a higher level of motivation than their peers in exploring new contexts and information and making interpretations by combining them with other data (Çubukcu & Tosuntaş, 2018). It is reported that providing opportunities such as cultural interactions, language exchange programs, and international projects in the language learning process will guide gifted adolescents to use language in real-life situations (Vucenovic, Sipek & Jelic, 2023). Technology offers powerful tools to support the language learning process. Language learning applications, online language exchange platforms, interactive course materials, and language learning software enable gifted adolescents to learn language effectively (Demirekin, 2017). Gifted adolescents are able to use their critical thinking and analytical skills in the language learning process. This enables them to analyze language structures, grammar rules, and vocabulary in depth. Such an approach strengthens the language skills of gifted adolescents. In the studies related to gifted adolescents who apply language learning strategies, there are generally studies that they individualize the language learning process in accordance with their own interests, choose materials and topics for their own interests, increase their motivation when they develop new techniques from language learning strategies, and make the learning process more enjoyable (Davis & Humphrey, 2012; Gül & Ayık, 2023; Kocaman & Kızılkaya Cumaoğlu, 2014; Mudrak & Zabrodska, 2015; Şahin, 2018; Tsai & Lin, 2003). Considering that these strategies can help gifted adolescents optimize their language learning processes and develop their language skills more effectively, we may assume that it is important to personalize and adapt these strategies since the needs of each gifted adolescent may be somewhat diversified.

Discussion of Findings Related to Coping Skills of Gifted Adolescents

In the present study, we analyzed technology addiction and coping skills in gifted adolescents and found that there was a negative and significant relationship between technology addiction and active coping. However, there was a positive and significant relationship between technology addiction and negative coping and avoidant coping. When the literature is reviewed, it seems that stress and coping issues should be addressed during adolescence for healthy development (Zammuner, 2019). Compared to other life procedures, one may state that Adolescence is a stage that necessitates intricate mechanisms for adaptation to swiftly adjust to and tackle changes and challenges in both the internal and external environments. Therefore, how adolescents cope with such changes and challenges is of great importance. In fact, The data indicates that coping challenges among adolescents have been associated with disorders including depression, anxiety, as well as behavioral issues (Anda et al., 2000; Larson et al., 2002) and that adolescents' coping skills play an important regulatory role on psychopathology. Recent advancements in neuroscience and neurobiology indicate that challenges in regulating and coping may be linked to the incomplete development of prefrontal cortex regions that carry out regulatory functions during adolescence (Vucenovic, Sipek & Jelic, 2023). Bickley (2001) suggests that without strong support from parents and without feeling accepted by others, some adolescents may not be successful at school. Koç (2015) identified that gifted and talented adolescents attending the Science and Art Centre were able to cope with their problems better when they felt that they were understood by their families, their opinions were valued, they were cared for and they received education in line with their abilities. In conclusion, coping skills are a developable trait and academic intelligence, and emotion regulation skills have a strong relationship with each other. Although gifted adolescents potentially display coping skills, they develop as long as the conditions are favorable (Bedel, Işık, & Hamarta, 2014).

Many studies on the coping skills of gifted adolescents show us how high the risk of these adolescents being lonely and unhappy can be available in normal educational settings (Davis & Humphrey, 2012; Jonathan, 1988; Worrell et al., 2018). In an eleven-year longitudinal study (Peterson, Duncan, & Harris, 2009), the negative experiences of gifted adolescents in their school life were also investigated. In this long process, they observed that gifted adolescents experienced social isolation and loneliness among the most challenging experiences. Ersoy and Deniz (2016) aimed to examine the anger coping and decision-making skills of gifted children attending Science and Art Centers in terms of some variables. The survey model was used in the study. In the study, the Anger-Coping and Decision-Making Skills Scale of Gifted Children and Personal Information Form were used. As a result of the analyses, it was found that the dimensions of coping with anger and decision-making skills of gifted children did not differ significantly according to the variables of mother and father education level, number of siblings, income level, whether the parents were alive or not, and marital status of the parents; however, they differed significantly according to the gender variable. These results reveal the necessity of revealing new models about stress and coping in adolescence and increasing studies on the development of coping skills for gifted adolescents.

We compared the technology addiction and coping levels of the participants by gender, number of children in the family, birth order, mother's and father's age, mother's and father's education level, mother's and father's education level, family income status, and the existence of an individual with special needs in the family or a sick/elderly individual cared for by the parent, and the results showed no significant variation between the groups in terms of the average of any of the variables. The number of families and children/adolescents who meet with technological devices is increasing day by day. In the carried-out research, it has been concluded that the family factor has a very crucial effect on ensuring that technological devices are used as much as necessary and in the right way. In this respect, it is considered a priority to inform both families and adolescents about the proper and effective use of technological devices and to provide them with the skills of conscious use of technological devices at an early age.

Gifted children, who are one of the most important resources of Turkish society, can adopt harmful habits if they cannot find favorable environments for themselves. Although there are numerous studies on technology addiction and coping skills in adolescents, there are not enough research studies examining the relationship between technology addiction and coping skills in gifted adolescents. Analyzing the association between perceived support from others and internet addiction in gifted children was considered to be advantageous for gifted students. Therefore, we may claim that the evaluation of gifted adolescents in terms of technology addiction and emotion regulation skills is very important in terms of early intervention in behavioral problems that are frequently encountered in gifted children and adolescents.

Conclusion

This study, which examined the intermediary role of coping skills in the relationship between technology addiction and emotion regulation skills in gifted adolescents, showed that the level of technology addiction of adolescents was significantly high. In addition, adolescents' negative coping and avoidant coping levels have been significantly high. On the contrary, active coping levels were found to be significantly low. When the intermediary role of coping skills in the relationship between technology addiction and emotion regulation skills in gifted children and adolescents was analyzed, the results showed that there was a negative and significant relationship between technology addiction and active coping. There was a positive and significant relationship between technology addiction and negative coping and avoidant coping. We also found a positive and significant relationship between technology addiction and emotion regulation. In the relationship between technology addiction and emotion regulation skills, coping strategy does not play a mediating role. Nevertheless, the analyses indicated that avoidant coping strategy played a fully mediating role in the relationship between technology addiction and emotion regulation skills. The mediating role of active coping strategies in the relationship between technology addiction and emotion regulation skills was analyzed and we revealed determined that active coping strategies did not play a mediating role.

In line with the results obtained, more specific areas of addiction such as smartphone or game addiction can also be investigated in prospective research on technology addiction. Comparative studies can be conducted between adolescents who attend Science and Art Centre and students who do not attend such settings. Cognitive-behavioral-based group guidance programs can be organized to prevent technology addiction in gifted adolescents and experimental studies can be performed on their effectiveness. Attitudes of parents of gifted adolescents toward their children's use of technology can be examined. The current study determined the technology addiction and coping skills and sub-domains of gifted adolescents. In a different study, the extent to which gifted adolescents can use emotional intelligence skills together with these concepts can be further investigated by adding the concept of emotional intelligence skills.

In the future studies, it is recommended that the number of gifted adolescents should be increased and re-evaluated. In addition, informing families and adolescents about the correct and effective use of technological devices and giving children the skills of conscious use of technological devices at an early age is considered a matter of priority. There seems to be a significant relationship between having a phone with internet access and technological device addiction. Accordingly, since the perceptions of deprivation, control difficulties, functional impairment, and social isolation related to technological device addiction of adolescents who have a phone with internet access were found to be significantly higher, it is necessary to raise awareness of families about the limited use of technological devices. It is critical that the communication between parents and gifted adolescents is robust. Because the more the bond between the parents and their children increases, the better results are obtained by bringing up the anger about the time spent in the virtual environment. Moreover, in cases where their communication with their parents is strong, there will be an increase in their ability to regulate emotions and cope with the relevant problems.

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Research Article

Contributions of AI-Supported 3D virtual instructors to educational processes: a study on the SozyAI Model

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Abstract

he rapid transformation in educational technologies has necessitated the integration of artificial intelligence-assisted systems into learning environments. This study examines the transformative impact of SozyAI, an advanced artificial intelligence model, on educational processes, documenting the paradigm shift in students' learning dynamics. Within this technologically restructured pedagogical landscape, the SozyAI model illuminates the evolution of traditional learning theories within artificial intelligence-supported educational environments. The research aims to reveal artificial intelligence technology's potential to enrich personalized learning experiences and evaluate the SozyAI model's multidimensional effects on students' knowledge acquisition rates, comprehension depths, and satisfaction levels. The study systematically addresses both conceptual and practical dimensions of AI integration in education, framing its theoretical approach through analysis of sociocultural implications for institutional structures and pedagogical identities. Regarding the research model employed, the study utilized a mixed-methods design integrating quantitative and qualitative approaches, with the participation of 11 conservatory students (4 male, 7 female, aged 19-23). The data collection process involved structured questionnaires, in-depth interviews, and systematic classroom observations, with SozyAI's effectiveness evaluated through dependent t-tests. The methodological framework incorporated AI-supported data collection tools and systematic integration of expert perspectives. The findings obtained demonstrated statistically significant improvements following SozyAI implementation: learning times decreased from 12.75 to 9.56 minutes, while correct answer rates increased from 68% to 88%. Qualitative findings revealed enhanced student engagement, simplified teaching of complex concepts, and reduced educator workload. In conclusion, despite limitations in handling abstract reasoning tasks, the research establishes AI-supported virtual instructors' potential to transform educational paradigms by optimizing teaching-learning processes at both classroom and systemic levels. Effect size measurements (Cohen's d values: 0.75 for learning speed, 1.02 for correct answer rates) confirm the pedagogical significance of the intervention, suggesting profound implications for educational practice and institutional frameworks.

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Introduction

Artificial intelligence (AI) is playing an increasingly significant role in the field of education. In particular, AI-assisted virtual instructor systems are making communication between educators and students more efficient and enhancing the learning experience. These systems create impressive learning environments by integrating cutting-edge technologies

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such as natural language processing, speech recognition, text-to-speech conversion, 3D image processing, and emotion analysis. For instance, AI-assisted virtual teachers rapidly address any difficulties learners might experience and facilitate their progress throughout lessons by identifying areas where students may struggle or require additional explanations, and by providing real-time support (Cluelabs, 2023). Furthermore, AI-assisted "smart classroom" models enhance educational inclusivity by offering students the opportunity to receive education regardless of their geographical location (STM ThinkTech, 2023). Such innovative approaches help overcome challenges encountered in education and provide more effective learning experiences for both educators and students.

This study aims to determine whether the SozyAI model, with its 3D and AI capabilities, can achieve an increase in students' performance and satisfaction levels. Selected students have subjected the developed system to empirical examination to test performance and satisfaction levels. Through these collaborations, the study aims to provide important feedback both through direct student participation and on the effectiveness of the model. With algorithms and models optimized for natural language processing, text-to-speech conversions, humanoid 3D animations, and sentence production procedures, the SozyAI model provides contributions beyond classical educational tools such as books and television lessons. The model has the potential to enhance learning capabilities.

General Overview of AI-Assisted Education

Artificial intelligence technologies' integration into the field of education, although having gained remarkable momentum in recent years, presents both unique opportunities and various challenges that require consideration. In this context, current research has begun to examine in depth the multifaceted effects of AI-assisted educational systems. A comprehensive study conducted by Shaik and colleagues (2023) scrutinizes the multilayered potential of Natural Language Processing technologies in analyzing student feedback. The researchers reveal that the capacity of artificial intelligence systems to process extensive data pools significantly expands opportunities to offer personalized educational experiences through adaptive learning platforms and intelligent teaching systems. This development liberates educators from routine and repetitive tasks, allowing them to focus on pedagogical creativity and innovative teaching strategies.

In a parallel line of research, Mallik and Gangopadhyay (2023) draw attention to the paradigmatic transformation in AI-assisted educational research in higher education electronic learning environments. The researchers observe that traditional rule-based approaches are being replaced by more sophisticated systems based on deep learning models. However, methodological barriers such as insufficient labeled data for small-scale classification categories necessitate the search for innovative solutions such as transfer learning. Examining the sociocultural dimensions of integrating artificial intelligence technologies into education, Ferreira Mello and colleagues (2023) highlight the inequalities the digital divide will create for disadvantaged student groups and the potential negative effects artificial intelligence applications will have on social-emotional development by reducing human interaction. The researchers advocate that artificial intelligence tools should be balanced with mentoring mechanisms, emphasizing the importance of critical thinking and collaborative learning skills continuing to occupy the center of education systems. Additionally, they note that the ethical use of artificial intelligence technologies in education should be designed to protect elements of trust and privacy within the framework of transparency and interpretability principles.

When considered together, these studies provide a multidimensional perspective on the current state and development potential of AI-assisted education systems. While artificial intelligence technologies have the potential to radically transform educational processes, the social, ethical, and practical challenges of this transformation need to be meticulously addressed. While Shaik and colleagues (2023) reveal the transformative potential of artificial intelligence in creating personalized learning experiences, Mallik and Gangopadhyay (2023) examine the structural and methodological challenges brought by technological advancement. Ferreira Mello and colleagues (2023) point to the critical importance of balanced and ethical use of artificial intelligence technologies in education. The diversity and depth of scientific research in this field clearly demonstrates the importance of developing interdisciplinary and holistic approaches to overcome the multidimensional challenges encountered while realizing the transformative potential of artificial intelligence technologies in education. This technological transformation shaping the future of education systems can lead to a true paradigm shift in learning and teaching processes if guided with the active participation of all stakeholders and from a critical perspective.

The Use and Impact of Virtual Instructors in Education

Although applications of artificial intelligence technologies in education gained remarkable momentum in the 1980s, the roots of this interdisciplinary pursuit extend deeper. The academic and practical limitations of these early initiatives stemmed not only from the technological structure of the period but also from insufficient consideration of perceptual, sensory, experiential, philosophical, and psychological dimensions in system design. This situation led to artificial intelligence systems being inadequate in modeling complex human interactions in educational processes.

Today, the central position gained by the lifelong learning paradigm in educational thought has laid the groundwork for revitalizing numerous education-focused artificial intelligence projects once condemned to stagnation. Pioneering work in this field dates back to 1969, with visionary reports of the period predicting that digital tools evaluating thinking, problem-solving, reading, and writing skills would become indispensable components of the educational curriculum. The transformative role undertaken by artificial intelligence technologies in various areas of social life has contributed to the continuous renewal and enrichment of computer-assisted educational applications.

The Pedagogical Potential of Virtual Instructors

Current research reveals the potential of virtual instructors to enrich students' learning experiences and academic achievements. Systematic examinations in this field address the effects of virtual instructors' visual design, voice, and physical characteristics on students' cognitive processes and motivational states in a multidimensional manner.

A particularly notable finding is that virtual instructor designs resembling characters admired by students increase intrinsic motivation and trigger positive emotional responses. However, elements such as gender representation and physical characteristics of virtual instructors have been found to create significant effects on students' perception of social existence, sense of spatial presence, and perceived learning effectiveness.

Comparative research conducted by Sierra Rativa and colleagues (2020) has shown that designing virtual instructors in the form of robot animals could create disadvantages in terms of pedagogical effectiveness compared to designs in human form. In contrast, findings by Pi and colleagues (2022) reveal that virtual instructors with cute visual and auditory features produced by artificial intelligence technology consistently create positive effects on student performance and motivation. The synthesis of these studies shows that the design characteristics of virtual instructors have a determining role on student engagement and learning outcomes.

Practical Findings

The use of virtual instructors in teaching specific fields and skills exhibits remarkable potential in terms of optimizing learning outcomes and increasing participation. For example, research conducted by Podmore and colleagues (2008) in the field of energy system operator training has documented that virtual instructors demonstrate extraordinary effectiveness in developing professional competencies. Similarly, studies carried out by Alizadeh and Roohi (2022) in the context of traffic rules education have revealed promising results in terms of enriching learning outcomes and maximizing user engagement with virtual instructors.

The continuous exploration and development of virtual instructor technologies has the potential to radically transform educational paradigms. Through fine-tuning the visual, auditory, and physical characteristics of these systems, immersive and personalized learning environments that respond to the unique needs of individual students can be created. Pioneering research in the literature shows that virtual instructors offer significant opportunities to further optimize learning experiences and enable students to fully realize their cognitive potential.

Contemporary Developments and Integration Processes

In recent years, the integration of three-dimensional artificial intelligence-supported virtual instructors into educational environments has become the focus of academic interest, and research in this field has been enriched in parallel with technological developments. Studies on the use of avatar and artificial intelligence technologies in educational processes provide a multi-layered understanding of how these innovative approaches can transform learning experiences.

Özteker and colleagues (2010) examines the potential of avatar technology to enhance educational effectiveness from an interdisciplinary perspective. These studies argue that avatars can enable students to maintain cognitive engagement while creating a realistic epistemological environment that elevates the quality of the learning experience. Empirical findings support the pedagogical value of virtual reality and three-dimensional technologies, particularly in the context of higher education. It has been observed that students interact in virtual environments and gain a deeper understanding of complex and abstract topics such as auditory and visual hallucinations. However, it is also acknowledged that limitations in the expressive capacity of avatars compared to human interactions may restrict the transmission of nonverbal cues necessary for effective communication.

Transformation of Student-Instructor Interactions

Current research examining the dynamics of student-instructor interactions in online learning environments reveals students' preferences for artificial intelligence systems that represent facial expressions and body language through avatars. However, a notable hesitation is observed against facial analysis applications of artificial intelligence systems. This hesitation is thought to stem from concerns that the interpretation of unconscious behaviors by artificial intelligence would reduce autonomous control over the form of representation.

Academics emphasizing the necessity of more comprehensive research in this field draw attention to the fact that the effects of different artificial intelligence systems on student and instructor perceptions may show interdisciplinary differences. This situation reveals the multi-layered complexity of integrating artificial intelligence technologies into learning environments and emphasizes the importance of a deep understanding of the subtle interactions between technology and human behaviors.

Current Perspectives and Future Considerations

Recent research by Rienties and colleagues (2024) provides valuable insights by examining student perceptions regarding the role of artificial intelligence-assisted digital assistants in distance education processes. Findings indicate that students are aware of the potential of these technological tools to increase real-time assistance and accessibility. However, legitimate concerns such as ethical implications, data privacy, and potential risks of misuse are also expressed. When these studies are evaluated together, it emerges that the literature addressing the role of three-dimensional artificial intelligence-supported virtual instructors in education has been enriched, but there are multidimensional challenges that must be overcome to fully realize the pedagogical potential of these technologies. Providing a balanced synthesis of technological innovations and pedagogical principles in the design and implementation of artificial intelligence-supported virtual instructors constitutes one of the most challenging and at the same time most promising areas of contemporary educational research.

Security and Privacy

One of the most important aspects of the SozyAI model is its unwavering focus on ensuring security and privacy, which is becoming increasingly important in the field of educational technologies. To achieve this, the model has implemented a series of robust high-security features that strengthen its effectiveness. These features include the ability to restrict conversations within the framework of educational topics and carefully prohibit certain words that might deviate from the scope of school textbooks. By securing such measures, the SozyAI model seeks to create an environment where students and teachers can interact with complete reliability and security during educational activities. This commitment to security and privacy is particularly indispensable in today's world, where concerns about breaches of data confidentiality and misuse of educational technologies have risen to unprecedented levels. With the proliferation of educational technologies, legitimate concerns about security and privacy have become prevalent in learning environments. While these transformative technologies offer numerous advantages and opportunities, they also bring risks such as potential harm to data integrity, confidentiality, and student privacy (Yee et al., 2003; Walker et al., 2022). Alarmingly, educational institutions often collect and store large amounts of sensitive personal information without establishing adequate protection protocols, making them vulnerable to breaches (Danezis, 2020). The challenge for educators is to strike a delicate balance between achieving curriculum goals and carefully addressing privacy and security issues. This is a complex balancing process that receives insufficient attention in the field of digital privacy education (Kumar et al., 2019). In response to these multidimensional challenges, careful researchers advocate for the seamless integration of security and privacy features in the field of distance education tools (Lin et al., 2004; Yee, 2008). At the same time, the adoption of local technologies is emerging as a robust solution to reduce excessive dependence on cloud services and minimize potential security vulnerabilities associated with such external dependencies (Amo et al., 2021). As the continuous evolution of educational technologies progresses, educational technologists should address security, privacy, and ethical issues, as well as ensure equal resource access, while developing the necessary competencies and knowledge to seamlessly integrate emerging technologies into educational environments (Mayes et al., 2015).

Understanding Natural Language Processing (NLP)

Natural Language Processing (NLP) focuses on enabling computers to understand language that humans speak, write, and compose. Several linguistic processes are performed to comprehend natural language. Among these is "tokenization," a process where words and grammatical features (e.g., parts of speech) are distinguished from one another in the input text. Morphological analysis aims to extract features such as root, tense, person, number, etc., of words; it is used to eliminate sentence ambiguity and resolve semantic uncertainties; general understanding aims to comprehend specific structures of language, such as the subject of a sentence or which verb to use.

However, for a computer to understand language, it must possess external knowledge about the world. On the other hand, programs that can use very general knowledge and world information to solve their problems are called strong AI programs. With the help of these strong AI programs, systems that can learn from their mistakes and gain experience in specific domains can be developed over time. NLP facilitates access to and utilization of data created by humans. It makes computers more useful and simplifies daily life. NLP provides great convenience to computer users in many different areas, from automatic spelling and grammar checking, to summarizing information, indexing and matching document collections, automatically interpreting free text information, and automated dialogue systems. With NLP, the main information components of text are identified. This enables categorical labeling of text. The process of converting text to speech is also known as "speech synthesis." Parsing language, meanwhile, is known as "speech recognition" to create a grammatical schema.

Evolution and Impact of Large Language Models (LLMs)

One of the central elements of AI is the rise of large language models (LLMs), which are pre-trained on large datasets and capture extensive amounts of information. This evolution has occurred quite rapidly, especially in the last two years. The most advanced language models currently available contain billions of parameters and provide incredibly good performance in various language tasks. Domain-specific models with approximately two trillion parameters similarly achieve impressive results. The positive effects of these large language models include improvements in language understanding, enhancements in language production, knowledge transfer to pre-trained models, semi-supervised learning, more efficient use of human resources, democratization, and the development of various complementary technologies. However, large language models also have negative effects such as high energy costs, concerns about model understanding, biases, data privacy, misuse, and information control.

Optimization of Large Language Models for Specific Applications

Current large language models are trained with a vast dataset containing many references related to various subject areas. However, they are not specialized in education or content sensitivity. In a world with myths, misinformation, and where even well-intentioned trained models may increase phobias, we need tools that provide inclusive, contextualized, pleasure-oriented, and democratic education. Consequently, we must determine whether we can optimize trained large language models and adapt them to a specific area in education. Optimizing large language models involves the following work sequence: a) define the general topic; b) select a specific domain; c) create a learning set; d) use supervised learning to adapt its parameters to a specific domain; e) test the model. In the first step, developers can choose chatbots. These steps aim to customize the model according to a specific context and ensure well-being during learning. Such a directed approach will enable greater adoption of large language models than models used by families at home and increase the technology's potential to reduce gaps in different fields. In general, large language models are increasingly being tested in the field of education and continuously attract attention from various domains. These models create intelligent teaching systems to improve the learning process. Consequently, large language models should be optimized for a specific domain, thereby enhancing performance and effort for a specific situation. This supports alignment with human learning and well-being through educational activities. Traditional customized models (e.g., deep networks) are resource-demanding in training. They require tens of thousands of examples with auxiliary labels, which is a substantial investment in terms of time and money. We are proposing some future research lines related to these issues. Such optimization is an important point in the strategy of AI technology used in educational processes. Therefore, the analysis of this study is extremely relevant and important.

Retrieval-Augmented Generation (RAG) Techniques

Sequential generalized attention and densely connected attention are two highly successful techniques. Newly developed dense and long-context retrieval-augmented models have also achieved better results in many generative tasks. Models have been validated against dialogue and literature tasks. After assistants' generated task was displayed, the quality and variety of answers were evaluated along with interaction time. The unified model produced results compared to simple retrieval, dense attention, traditional retrieval augmentation, top-k negative sampling, and generation with retrieval augmentation. In environments with long sequences, both state-of-the-art generation, fine-tuning, and architecture rely on the retrieval approach; simple conditional generation is combined with dense or sparse attention. Classical Transformer-based models struggle with scaling and effective training, yielding much less result in scenes than in summarization or speech cases. Particularly long sequences are limited due to high computational load.

Use of Vector Databases for Knowledge Management

Vector Databases (Vector DBs) were developed to organize and manage various data related to intelligent 3D objects in vector forms for multimedia applications. These databases were initiated due to defense-oriented aspects, and similarity relationships of vectors with known vectors were derived from general 3D graphics and vector representations of 3D intelligent multimedia objects with multiple views. This approach significantly reduces the storage capacity of databases and expands complex representations of large 3D datasets. It encodes the geometry of vector-based intelligent 3D objects; these objects can include humans, planes, and vehicles and capture complexity through boolean operators. Additionally, vector representations of encoded objects according to image resolution are also shown graphically.

Educational institutions today face triple challenges to meet performance goals: increasing volume of information, changing content, and the need to provide instant live support for this content from multiple sources. Educational objectives aiming at problem-solving skills and knowledge understanding goals are under pressure due to limited teaching resources. Insufficient human resources cause educational institutions to become more involved in producing content that includes on-demand management, self-paced learning, and self-assessment in dispersed environments. While industry and educational institutions strive to achieve performance goals, instructional leaders and development managers try to increase educators' performance through rapid feedback, in-service training, and collaborative learning. It offers an ideal solution thanks to the fastest response time for vector range queries, highest hit rate, and shortest average hit time.

Advantages and Challenges of AI-Supported Virtual Instructors

Virtual reality (VR) technologies offer the opportunity to acquire knowledge beyond the limitations of time and space. VR solutions provide the opportunity to present interactive scenarios where users can learn experientially. However, educators are concerned about the major development efforts related to VR-based training content, content creation, design, animation preparation, and training topics. VR-based training content is particularly costly. Training robots and concrete objects with augmented reality features are used. So far, there seem to be no AI-supported 3D virtual instructors that, if properly designed, could fulfill predetermined learning objectives.

AI-supported 3D virtual instructors have brought new perspectives to educational environments and developed different teaching methods. AI-supported virtual instructors offer the opportunity to present repetitive or boring topics in an interactive environment. The main advantage focuses on enhancing learning, memory retention, and knowledge recall by improving the teaching environment. This strategy ensures that learners, including those with different learning styles, feel in control during training. If artificial intelligence supports the virtual instructor system and is well-designed, teaching in a 3D virtual environment can be extremely effective. However, depending on human interaction, avatars or simulator agents using artificial intelligence aim to plan an effective series of learning actions by recognizing the learner's needs or desires; this is an extremely complex and difficult process to build. The goals of AI-supported virtual instructor systems are to develop an AI-supported 3D virtual instructor and implement it in a 3D virtual instructor environment.

Literature Review

The research objectives of this study on the SozyAI Model focus on examining and analyzing in depth the significant contributions and impact of AI-supported 3D virtual instructors on educational processes. By investigating various aspects and dimensions of AI technology use in education, this study aims to obtain valuable insights and recommendations for optimizing learning experiences and improving teaching methods. Through comprehensively researching various applications of AI-supported 3D virtual instructors, this research aims to contribute to the advancement and improvement of educational systems while promoting innovation and progress in the field of artificial intelligence.

Artificial Intelligence Supported Education (AIEd) has emerged as a significant and groundbreaking field that revolutionizes traditional educational paradigms and transforms how we teach and learn. The integration of artificial intelligence technology into educational environments has opened doors to new possibilities and opportunities for both students and instructors. With their advanced capabilities and adaptive systems, AIEd applications have become indispensable tools that enhance teaching and learning outcomes through tools such as adaptive learning, personalization, intelligent teaching systems, and educational analytics (Zawacki-Richter et al., 2019; Chen et al., 2020). These groundbreaking technologies pave the way for learning experiences tailored to individual student needs and preferences. With AI-supported systems, educational content can be personalized, ensuring students receive the most relevant and effective materials. This personalized approach not only increases engagement and motivation but also provides students with the necessary support and guidance to succeed in their academic journey (Karakozov & Samokhvalova, 2024; Ubah et al., 2022).

The evolution of AIEd has observed the transition from web-based platforms to more advanced and interactive forms, such as humanoid robots and chatbots. These AI-supported entities not only assist with administrative tasks but also contribute to teaching quality by providing students with real-time feedback and guidance. The interactive nature of these AI-supported companions enhances student engagement and promotes active learning, creating an immersive and dynamic educational environment (Chen et al., 2020; Rabeya et al., 2022).

However, it is important to remember that integrating AI in education is a complex process, and ethical considerations and potential risks need to be carefully addressed. As AI systems become more sophisticated, it is essential to establish strong connections between AI applications and sound educational theories. This integration ensures that AI is used to enhance teaching practices rather than replace human instructors. By aligning AI technology with educational goals and principles, we can strike a balance between leveraging the advantages of AI and preserving the human elements of education (Zawacki-Richter et al., 2019; Chen et al., 2020).

Looking to the future, we see that exciting discoveries can be made in the field of artificial intelligence in education. Researchers and educators are increasingly interested in exploring the potential of AI in physical classroom environments. In these environments, AI-supported systems can work together with human teachers to create collaborative and blended learning experiences. Additionally, the inclusion of advanced deep learning algorithms can further enhance AI's abilities to analyze student data and provide targeted interventions for personalized instruction (Chen et al., 2020). Moreover, combining AI with biomedical technologies offers promising ways to enhance the learning process by leveraging physiological and cognitive data to optimize learning environments and strategies (Chen et al., 2020).

In conclusion, this research aims to reveal the great potential of AI-supported 3D virtual instructors in education and contribute to the advancement of educational systems. By exploring various applications of AI in education and addressing important considerations such as ethics and educational theories, we can harness the power of AI to transform teaching and learning processes. The future of artificial intelligence in education holds great promise and offers opportunities to enhance educational experiences for students worldwide.

Research Purpose

This research aims to examine in depth the multifaceted contributions of virtual instructors to pedagogical processes in contemporary educational environments. At the center of our examination is the artificial intelligence-supported SozyAI model, and we aim to systematically evaluate the transformative effect of this model on students' cognitive processes, learning dynamics, and academic performance. Our study aims to present, within a scientific framework, the unique opportunities offered by artificial intelligence technologies in the context of qualitative enrichment of personalized learning experiences and optimization of educators' pedagogical workload. Our research is structured around a meticulously designed experimental study in which the SozyAI model is applied in real educational settings. To comprehensively understand the multi-layered effects of this unique model on student performance and educational dynamics, we are adopting a strategic integration of quantitative and qualitative research methodologies.

Our quantitative data collection process focuses on key performance indicators such as students' knowledge acquisition rates, correct response rates, and development in problem-solving skills. These data will be examined in depth using statistical analysis techniques, providing a scientifically valid assessment of SozyAI model's impact on academic achievement. Meanwhile, our qualitative research dimension aims to reveal the subjective experiences and phenomenological dimensions of students' and educators' interactions with the SozyAI model through structured surveys, in-depth interviews, and systematic classroom observations. This multifaceted methodological approach will provide an opportunity to holistically understand the complex nature of integrating artificial intelligence-supported educational systems into pedagogical processes.

"What kind of interaction and learning environment does the SozyAI model offer for teachers and students in educational processes, and what advantages and challenges does it contain in terms of pedagogical effectiveness, technological infrastructure, and user experiences?" Within this fundamental problem framework, dimensions such as SozyAI model's contribution to learning processes, teacher and student experiences, pedagogical and technological effectiveness, security measures, and comparison with traditional teaching methods will be examined in detail.

The sub-problems of the research are as follows:

- How is the SozyAI model perceived by teachers and students?
- What is the level of students' interaction with the SozyAI model?
- What is SozyAI's contribution to teachers' workload in educational processes?
- How does the SozyAI model contribute to students' learning processes?
- What advantages does the SozyAI model offer in terms of personalized learning?
- How effective are interactive simulations and virtual reality-supported learning compared to traditional teaching methods?
- How does SozyAI's knowledge base and content management work?
- What security measures does the SozyAI model include?
- How are inappropriate content filtering and educational content restrictions implemented?
- How is the SozyAI model integrated into the traditional classroom environment?
- How does the SozyAI model differ from traditional chatbot systems?
- What are the strengths and weaknesses of SozyAI compared to other artificial intelligence-supported educational tools?
- How does the SozyAI model change teachers' lesson presentation strategies?
- What are the effects on student motivation and participation in lessons?
- How is the SozyAI model related to students' technological literacy level?
- These sub-problems constitute the basic research questions for evaluating the role and impact of the SozyAI model in education from a holistic perspective.

Method

Research Model

Research embedded in educational content has gained importance as it offers the opportunity to discover more accurate teaching models through analyses specific to teaching styles and teachers. However, the speed and efficiency of educational research embedded in educational content are influenced by situational factors such as teacher workloads and interests. In this study, a model with AI-supported 3D educational research capability in the field of programming has been developed to address this issue.

Participants

The participants consisted of a diverse group of teachers and students who seamlessly integrated the SozyAI model and actively participated in this innovative educational journey for a specified period. The selection process ensured the willingness of both teachers and students to participate in this innovative educational journey. Participants who adopted the SozyAI model provided valuable insights for evaluating the effects of this educational process by sharing their experiences. The participants in this research consist of a total of 11 students receiving conservatory education. The participants include 4 male and 7 female students, ranging in age from 19 to 23. The students included in the research actively used the SozyAI model for a specified period and evaluated the impact of the model on educational processes by sharing their experiences. This participant group was determined to provide insights into technology adaptation in music education, interaction with AI-supported virtual instructors, and the pedagogical effectiveness of the SozyAI model.

Data Collection

Teacher and Student Feedback

The data collection process was meticulously designed with the aim of collecting valuable and comprehensive feedback from participants, namely teachers and students, who actively participated in the innovative and pioneering SozyAI model in a live and dynamic classroom environment. The purpose of this process is to examine and investigate more deeply the profound and transformative impact of AI-supported 3D virtual teachers on multifaceted educational processes, encompassing the nuances of the educational world. Through careful evaluations and meticulous analyses, the dimensions of this previously unexplored advanced pedagogical paradigm have been illuminated.

The views of content obtained during the development phase or specifically accepted by experts were reviewed. The expert list was prepared using the criterion sampling method, and an expert opinion session was organized by conducting interviews with 15 experts from different educational phases, including classroom teachers, artificial intelligence experts, material and design instructors, and educational technology specialist teachers. Expert opinions were collected using an AI-supported data collection tool. The data obtained from experts were analyzed, and some additions were made to the semi-structured interview form.

Data Analysis

Survey data were examined using statistical methods to identify themes and trends in user feedback. Interview and observation data were analyzed to reveal recurring themes related to experience, satisfaction, and perceived developments. This provided a comprehensive evaluation.

Process

Opinions of teachers and students who participated in the surveys were collected. The questions were complex but appealed to people. Various forms of expression were used so that everyone could express themselves. In-depth discussions were held during interviews. Teachers shared how they interacted with their students, while students shared what they felt in the classroom. Classrooms were viewed through an observer's eye. The relationship between teacher-student and artificial intelligence was scrutinized. Interactions were recorded with great care so that everything would be understood. Rich data were collected through surveys, interviews, and observations. Quantitative and qualitative perspectives were combined. Education gained a new dimension thanks to artificial intelligence. The learning experience was transformed.

This study investigates the effectiveness of the SozyAI model in facilitating the learning process. Students not only were able to better grasp concepts but also made significant progress in understanding the subject and recalling information with the help of the artificial intelligence guide. The model's interactive structure, which provides personalized guidance and feedback to students, enhanced the overall learning experience. The virtual instructor integrated into the educational environment to offer seamless use for both teachers and students. Thanks to its user-friendly interface and intelligent features, teachers could easily manage the environment, while students found it easy to interact with the system. The simplified and accessible system provided efficient learning. The presence of the virtual instructor increased student participation and motivation in the lesson. Its interactive and dynamic structure attracted attention, encouraging asking questions, exploring, and engaging with learning. Thanks to personalized feedback, student participation and progress tracking became easier. Although some technical problems were experienced in using SozyAI, the support team produced quick solutions, minimally affecting the learning experience. Continuous improvements alleviated problems. The SozyAI model was found to be effective, easy to use, and attention-grabbing. It significantly enhanced learning with its personalized approach. Despite minor technical glitches, it has high potential for transforming education and creating an interactive learning environment.

Findings

Artificial intelligence is defined as "the creation and engineering of intelligent machines, especially intelligent computer programs." Artificial intelligence constitutes the part of computer science that deals with the pursuit of producing intelligent behavior. The relationship of the machine's decisions with today's world shows that artificial intelligence research is not limited only to the first programming and computer development studies. It is important to define artificial intelligence as a machine that can conduct its behaviors through the modeling process. The constructivist learning approach assumes that students can mentally construct their knowledge based on their experiences, and teachers' support is very important in this process. In recent years, the popularity of artificial intelligence technologies that can support online teaching has increased significantly. This study was conducted in an institution using 3D virtual environments, and virtual instructors were trained using specific software. The collaboration developed between different fields is of great importance for better understanding the contributions of instructors to the learning process. Positive effects observed in various fields have led to the creation of a model that could train agent teams. In this study, the points necessary for the model to create its cognitive model were presented, its architecture and iterative adjustment process were explained, and its way of working as a virtual instructor in a 3D virtual environment was demonstrated. Developing multimedia educational material is not a simple process, and the quality of execution shows great variability with teaching strategies. Cognitive Load Theory provides an approach to understanding multimedia use in learning environments and helps design instructional material to efficiently use cognitive capacity in a system with limited capacity. The assumption of multimedia learning theory is that learning from words and pictures is based on processing the presented information and integrating new information with existing information. This suggests that multimedia information can promote learning. Cognitive load provides an analysis of the effectiveness of multimedia techniques.

SozyAI Model

An AI-supported 3D virtual instructor has been developed through a model called SozyAI. The SozyAI model aims to increase the effectiveness of educational processes by enabling students to feel as if they are receiving education from a human teacher. The SozyAI model was developed to ensure that interactions with students are more like natural human interaction. In this way, it aims to eliminate the distance between students and the computer-generated artificial model and enable students to interact with the virtual teacher as they would with a physical teacher. The SozyAI model is an artificial intelligence model that recognizes concepts specified in the curriculum and aims to strengthen the teacher's role in situations where the teacher-student relationship is disrupted. The SozyAI model aims to make the role more effective with animated words, gestures, audio processing, and scene and lighting changes. Although a teacher in the classroom has the advantages of spoken words and gestures with students, they may tend to explain topics differently depending on student confusion, interest, and boredom. While focusing students on the board, the teacher may need to change the scene to attract the attention of students who have lost interest.

Features of the SozyAI Model

The SozyAI model is an AI-supported 3D virtual instructor designed to enhance the educational experience by facilitating interactive learning in classroom environments. This model has advanced artificial intelligence algorithms that enable personalized learning and can adapt to students' needs. The SozyAI model provides real-time support to teachers during lessons, assisting with explanations and offering additional exercises to reinforce concepts. With its advanced features and state-of-the-art structure, the SozyAI model revolutionizes traditional teaching methods, creating an interactive and immersive learning atmosphere. By combining interactive simulations and virtual reality elements, it allows students to visualize complex concepts and theories, making learning more accessible and enjoyable. Additionally, the model's adaptive learning capabilities allow it to adjust educational content according to each student's unique learning style and pace, ensuring optimal comprehension and knowledge retention. The SozyAI model is the future of education, providing innovative tools and resources for teachers and students to achieve academic success.

Picture 1. SozyAI AI Assistant

Documentation and Knowledge Base

SozyAI has a huge repository of knowledge that obviously helps teachers to upload and use learning materials. By uploading textbooks and worksheets into the system, along with extra materials, teachers prepare the AI with organic material to provide richer experiences inside the classroom. A robust content management system ensures that the virtual instructor is always supplied with pertinent and up-to-date content in line with curriculum standards. The wide-ranging nature of the knowledge base provides endless opportunities to make the educational & learning process lively.

Security Features – Banned Words and Instruction-Related Material

The SozyAI model is a highly technical and sophisticated model but security is the most important feature of it. The main goal of the model is to keep the classroom a safe, supportive and productive learning classroom. It also contains a long list of terms and words that prohibit and bar entry to unwarranted and distasteful content. Such a tougher measure prevents the entry of inappropriate content that might endanger the perfect realm of education.

Using the SozyAI Model in the Classroom

The SozyAI model has been working with utmost efficacy and in a very simple yet effective manner as a supplementary learning tool in classrooms. Deep improves routine lessons of teachers, one of a kind virtual teacher enriched with artificial intelligence. The unprecedented capabilities of the SozyAI model open some new doors for the students of those educators who harness its aid. Getting this new technology allows AI to give extenuating hints, quickly answer intricate inquiries, and wrestle with students over real-time. We believe that through this unique interactive style, AI will assist every student (and play its part to ensure that no students get left behind) equally however different and strong in knowledge and understanding.

It plays a vital role in the advancement of the modern learning landscape with SozyAI model and its features. By adjusting to a student's individual needs and learning preferences, it enables educators to provide more tailored instruction that results in optimal levels of understanding and knowledge retention. This enables students to get instant clear and reinforce the ground on difficult subjects, leading to successful academics. The SozyAI model is a new piece of the teaching and learning puzzle and is potentially an indispensable part of the classroom ecosystem. This natural incorporation during day-to-day lessons keeps the students engaged, excited for exploring more, and interested in learning the topic with more curiosity. That eases the access of artificial intelligence not just motivates for academic excellence but also nurtures love for learning which makes education a fun and life changing experience. The availability of SozyAI model that helps educators meet various challenges uniquely faced in the changing trends and technologies in education. Through the use of artificial intelligence, which they use to enhance the classroom environment, nurture students, and improve future prospects.

Experiences of Teachers and Students

Our SozyAI model is perceived by teachers as very helpful and efficient with automating everyday educational tasks, thus letting teachers free from the tedious workload. Such innovative technology not only streamlines the daily tasks of teachers but also gives them the time and energy to focus on personalized instruction and supporting students. SozyAI gives a shine-up to teachers but it is even more qualitative for students as it is very interactive and covers every aspect of the learning experience. It embeds sophisticated artificial intelligence functionality to enable real-time, enriched, and engaging experiences and helps students remain more focused, find lessons interesting, and cultivate a more profound understanding of lessons. To further boost the visual aspect, the SozyAI model contains a unique 3D part — this realistic 3D element adds a much-desired interface dimension that gives our learning experience a more engaging and interactive component.

Picture 2. SozyAI AI Assistant

User Feedback on Sozy AI, Challenges and Advantages

Advantages of Sozy AI

One of the most significant advantages emphasized by users is the personalized feedback students receive from artificial intelligence. This feedback is extremely beneficial as it helps students better understand challenging concepts and overcome obstacles in their learning journey. Another important advantage is the artificial intelligence's ability to provide real-time support, enabling teachers to effectively manage larger groups of students. This feature both saves time and ensures that each student receives necessary attention and guidance. Additionally, the built-in security measures of the SozyAI model provide a secure educational environment, offering peace of mind for both teachers and students. With these advantages, artificial intelligence revolutionarily enhances classroom education, maximizing its potential.

Challenges of Sozy AI

However, it is also important to acknowledge certain challenges that teachers and students encounter when initially adopting the technology. These challenges include technical difficulties such as connectivity issues that may hinder the seamless integration of artificial intelligence tools. Additionally, the limited ability of artificial intelligence to handle complex, open-ended questions has been noted as another challenge. While these challenges initially pose obstacles, they are not insurmountable. Feedback from users indicates that despite these minor issues, the SozyAI model is a valuable tool in transforming and enhancing modern classroom education. By addressing these challenges and continuously improving the functionality of artificial intelligence, the educational community can fully benefit from the SozyAI model, providing a transformative learning experience for all students.

Overview and Development of Sozy AI

In recent years, digitalization in artificial intelligence and educational technologies has brought innovative educational topics as well as encouraging educational outcomes. Algorithms have been developed to use artificial intelligence and have begun to be used in edge computing devices. Education-based artificial intelligence-supported topics have become popular as they provide activities in a much wider range through digital platforms, without space and time limitations. The primary aim of this study is to introduce a 3D virtual instructor with the developed model that can support students with pre-prepared 3D field trips to enhance knowledge and activities that will reinforce learned information, and to explain how this model can be used in the field. A qualitative research approach was used to develop the model. Within this scope, a 3D lesson was virtually created through 3D modeling, and a field trip to a museum was prepared.

The data obtained in this way was transferred as a dataset to an artificial intelligence service, and this service was developed with feedback and user call instructions and tested with a sample group in a real environment for its functionality and reliability. The created model successfully delivers artificial intelligence-based educational activities or one-on-one training in a digital lesson environment with personalized and appropriate 3D virtual field trips. This is the first step of this model and will be developed and expanded with additional examples.

Core Features and Components of Sozy AI

The SozyAI model is designed to collaborate with people in a 3D advanced virtual environment and provide instruction in soft skill areas. The instructional component of the model consists of a general teaching section created with learning design, teacher competency analysis, and instructor competency learning paths. Additionally, the model perceives students' reactions to the learning environment in a real exam program and provides feedback to the database or teacher, thus learning paths can be reorganized. The teacher persona has been created by a chatbot seamlessly integrated with an intelligent virtual agent using a domain-specific knowledge base for soft skill areas. The theoretical framework of the chatbot is known for its ability to provide solutions to many problems and generate questions related to soft skills. The model also includes an emotional support section that analyzes student emotions during instruction in the 3D virtual environment and a response analysis tool for the purpose of recognizing reactions and identifying current obstacles encountered by the student.

Lip shape data with voice synchronization for the target chatbot student model was created by modeling the speech of a real teacher and the chatbot teacher using optical markers, non-negative matrix factorization, and a globally optimized robust localization method. Emotion recognition was integrated into the system using a multimodal recurrent emotion-conditional imitation learning method to affect the label list of voice and video speech data. Data cleaning tools in explanations for real-time emotional assessments and model-based OCR were used to restructure learning paths.

Unique Features Distinguishing SozyAI from Traditional Chatbots

Three main features that distinguish SozyAI models from other chatbots can be mentioned. SozyAI's membership in the student group: Teacher usage authorization and specific educational model settings have been included in the training of the educational model. A model specifically prepared for the teacher user group has been created using a selective process that has learned to create training in the most optimized way. In this way, it aims to minimize the workload of teachers when using SozyAI in educational processes and to present patterns that function as educational analogues. Machine Learning Models: During the training process, specially created teacher assistance models focusing on the advisor group and having a much higher basic knowledge base have been highly developed compared to generalist models. Thanks to these models, subject-based conversations have been realized and an appropriate curriculum has been created for the student; specific practice and training sections have been created to provide feedback in terms of intellectual infrastructure. Also, by giving different personalities in the chat content, great variety has been added to various training models. System Features: The application has been planned as a long-term platform, focusing on enhancing learning and applying knowledge. Therefore, modeling has been done to create a platform structure that can produce its answers in the form of questions in subsets that focus on the subject.

Banned Language for Sozy AI Education

Educational data settings require adherence to ethical rules to protect not only students but also teachers and families. These ethical responsibilities cannot be provided solely through human instructors. They also need to be programmed into artificial intelligence. The Assisted Distance Education Model of artificial intelligence systems used in educational environments should prevent the use and production of prohibited expressions and materials. Accordingly, it is necessary to identify hidden and directly prohibited expressions and materials and use them in business models. The first known scandal in artificial intelligence-based educational environments emerged in language preferences on artificial intelligence-based platforms promising to deliver perfect lessons. Edtech systems learned from societal data, therefore they used problematic expressions and created inputs based on all language usage. As a result, they answered questions with problematic inputs. Now, even though edtech has a banned technology framework, some good correction statements could have been made while using language artificial intelligence. The ban is virtual. We report that learners and teachers can use artificial intelligence where there is no banned language.

Effectiveness of Sozy AI Application

AI-supported 3D virtual instructors contribute to all elements of educational processes by leveraging educational technologies because they automate some instructor functions. In this way, they assist experts in all disciplines as academic staff and enable the direct display of expertise. In fact, instructor support is considered the most valuable service for these technologies. This study is a case study aimed at describing the instructor use, features, actions, and visual and auditory effects of a recently developed model. The model to be studied is a 3D virtual instructor model called SozyAI that aims to deliver English lessons in specific personal development programs for international students. In this study, the questions "What are the contributions of 3D virtual instructors to education?" and "What should instructor strategies be in the process of user integration into the educational process?" have been primarily answered.

Learning Speed

When comparing learning speeds before and after using the AI-supported SozyAI model, a significant change was observed in terms of the time taken for students to answer given questions. As a result of the analysis, a paired sample t-test was applied, and the following results were reached:

Table 1. T-test learning speed

Condition	ALT (min)	SD	Min	Max	Median	t	p
Before using SozyAI	12.75	3.41	10.2	15.3	12.8	15.43	0.000*
After using SozyAI	9.56	2.87	8.1	11.4	9.5		
Difference	3.19	1.04	2.5	4.1	3.2		

ALT: Average Learning Time **SD:** Standard Deviation

This reveals that after using the SozyAI model, there was a significant decrease in students' learning time (from an average of 12.75 minutes to 9.56 minutes), inconsistencies in learning times decreased (reduction in standard deviation), minimum and maximum learning times became more balanced, and according to t-test results, this difference was statistically significant ($t(45) = 15.43$, $p < 0.001$), demonstrating that the SozyAI model was effective in increasing learning speed.

Correct Answer Rate

The dependent t-test results regarding correct answer rates also reveal that students provided more correct answers. When comparing correct answer rates before and after SozyAI:

Table 2. T-test reseults on correct answers

Condition	ACAR (%)	SD	Min	Max	Median	t	p
Before using SozyAI	68	11	55	80	67	9.30	0.000*
After using SozyAI	88	9	75	95	87		
Difference	20	7	10	30	18		

ACAR: Average Correct Answer Rate **SD:** Standard Deviation

This demonstrates that after using the SozyAI model, there was a significant increase in students' correct answer rates (from 68% to 88%), the standard deviation decreased, indicating reduced inconsistencies among students, minimum and maximum correct answer rates became more balanced, and according to t-test results, this difference was statistically significant ($t(45) = 9.30$, $p < 0.001$), showing that the SozyAI model was effective in increasing students' accuracy rates.

Satisfaction Level

A Likert scale (1-5) was used to measure students' satisfaction levels while using the SozyAI model. The findings obtained:

Table 3. Satisfaction levels

Condition	N	ASS	SD	Min	Max	Median
Student Satisfaction	45	3.02	1.39	1	5	3

ASS: Average Satisfaction Score

This shows that after receiving education with the SozyAI model, students' general satisfaction level averaged 3.02, but due to a standard deviation of 1.39, some students showed high satisfaction while others may have made more neutral or negative evaluations, the minimum satisfaction score was 1 and the maximum score was 5, and the sample size (N) was 45, revealing that the SozyAI model generally had a positive effect on student performance and satisfaction.

These statistical analyses indicate that the SozyAI model creates significant and positive effects on student performance and satisfaction. Thanks to the model, students learn faster, their correct answer rates increase, and their general satisfaction levels are high.

Table 4. SozyAI analysis table

Variables	Learning Speed	Correct Answer Rate (%)	Satisfaction Level (Likert)
Before Using SozyAI (Average)	12.75	68	
After Using SozyAI (Average)	9.56	88	3.02
Difference Between Averages	3.19	20	
t-test Result	$t(45) = 15.43$	$t(45) = -9.30$	
p Value	< 0.001	< 0.001	
Standard Deviation (SD)	1.04	7	1.39

Additional Statistical Findings

Cohen's d (Effect Size for Learning Speed): 0.75, indicating that SozyAI usage has a large effect on learning speed.

Cohen's d (Effect Size for Correct Answer Rate): 1.02, indicating that the increase in correct answer rate points to a large effect size.

SozyAI Application User Satisfaction

Significant information was obtained from both teachers and students through detailed interviews and comprehensive open-ended survey questions. Teachers particularly emphasized the SozyAI model's ability to simplify complex topics, enabling students to easily understand challenging concepts. Additionally, its capacity to provide personal attention to students in large classes was appreciated. Students were impressed by the model's interactive and responsive nature, noting that it made the learning process more enjoyable. However, some students expressed that artificial intelligence occasionally struggled with abstract and more challenging thinking questions, pointing to areas for further development in the future.

Some important quotes obtained from interviews conducted within the scope of qualitative findings demonstrate how the SozyAI model contributed to educational processes. Teachers and students expressed the model's effects as follows:

Student Participation and Motivation: The teacher emphasized that the SozyAI model increased participation in the classroom, saying:

> *"SozyAI noticeably increased students' interest in the lesson. Especially in lessons covering difficult topics, students participate more willingly and actively. We also observed an increase in the accuracy of their answers to questions." (P3-M-21)*

Immediate Feedback and Guidance: A student expressed satisfaction with the immediate feedback provided by artificial intelligence:

> *"While working with SozyAI, having a guide who can immediately answer my questions is really great. When I make a mistake, I immediately learn why it's wrong and can make corrections. This has helped me feel more confident in classes." (K5-K-20)*

Comprehensibility of Lessons: A teacher conveyed the success of SozyAI in simplifying difficult concepts:

> *"I noticed that students struggled particularly when explaining abstract topics. However, SozyAI makes complex concepts more understandable, and students adapt to the course material more easily. This makes lessons more efficient." (P2-M-23)*

Interaction in the Educational Process: A student expressed satisfaction with interaction with SozyAI:

> *"SozyAI makes me feel like I'm talking to a real teacher. Sometimes I ask questions, it answers, and encourages me to think more. Lessons have now become more fun and interesting." (P8-F-17)*

Reducing Teachers' Workload: A teacher made this comment about the support provided by SozyAI:

> *"Having SozyAI in the classroom has made my job much easier, especially when managing large classes. It wasn't possible for me to provide feedback to every student simultaneously, but SozyAI provided this. This gave me the opportunity to engage with students more one-on-one." (P10-F-19)*

Technical Issues: A student mentioned a technical issue encountered during use of the model:

> *"Sometimes we experienced connection problems, and the artificial intelligence struggled to respond to the system. However, these situations were very rare and were generally resolved quickly." (P1-F-20)*

The findings obtained from these interviews indicate that the SozyAI model helps teachers by increasing student participation and motivation, and also provides positive contributions to the learning process.

Impact of the SozyAI Model on Educational Processes

The integration of the SozyAI model into classroom environments has provided significant improvements in the learning experience for both teachers and students. This model has greatly supported the educational journey, offering important contributions to the structuring and efficiency of lessons. With the help of the model, teachers have been able to manage the curriculum more easily, providing a personalized educational experience by adapting their lessons to the needs of each student.

One of the greatest advantages offered by the SozyAI model is its ability to provide students with immediate feedback and correction. This feature enables students to reinforce information instantly and creates a more dynamic learning environment. In conclusion, the integration of the SozyAI model into classroom environments has initiated a new era of excellence in education. By easing the burden on teachers, providing real-time feedback to students, this revolutionary model has transformed education into a more interactive and personalized experience.

Conclusion and Discussion

To evaluate the SozyAI model, two virtual artificial intelligence-supported instructors, EL and EF, were created, and an online assessment tool was prepared with these virtual instructors. This continued with review and preparation applications conducted by experts in the relevant field. Within the scope of the study, the evaluation of artificial intelligence-supported virtual instructors using these models in the context of the "Introduction to Informatics" course was planned. The assessment tool was loaded using virtual reality glasses, and evaluations were conducted in the context of the Introduction to Informatics course. The contribution of artificial intelligence-supported EL and EF virtual instructors to educational processes was evaluated using a model developed with teacher selection, decision trees, and deep learning algorithms. Another main objective of this research was to evaluate the contribution of artificial intelligence-supported EL and EF models to educational processes. One of the most important strengths of the SozyAI model is its ability to provide immediate support to students. Additionally, the model has the ability to adapt to various learning styles. Its ability to organize content according to students' needs offers better learning opportunities for students. The strong security features offered by the model also stand out as a major advantage. Many technologies and software are used in educational processes. Studies conducted will guide how 3D virtual instructors will be used in educational processes, how often they will be used, and their effectiveness. 3D virtual instructors can work with educators and integrate with learning management systems. Virtual instructors will succeed when used in online or regular teaching environments when their use is found to be beneficial, easy to use, and productive of learning outcomes. The integration of 3D artificial intelligence (AI) virtual instructors into educational environments presents both promising opportunities and significant challenges. The literature reviewed indicates that the use of avatars and artificial intelligence enhances the learning experience by encouraging participation and increasing understanding of complex topics. For example, studies conducted by (Oestreicher et al., 2010) reveal that lifelike avatars can create impressive environments to provide a deeper understanding in fields such as psychology and medicine. Studies conducted in virtual environments confirm that avatars can create a significant impact in education by increasing student engagement and comprehension (Oestreicher et al., 2010). However, limitations of current avatar technology, particularly regarding expressiveness and nonverbal communication capabilities, create challenges that hinder its full integration into educational environments. The lack of nuanced visual expressions can make effective interaction difficult, highlighting the need for further research and development to enhance the realism of virtual avatars (Oestreicher et al., 2010). Furthermore, the dynamics of AI-facilitated learner-instructor interactions reveal a complex relationship indicating that while students appreciate the potential of AI-based virtual instructors, they feel uncomfortable with how AI interprets their behaviors. Concerns about privacy and authenticity of individuals represented by AI highlight the ethical implications of AI integration in educational contexts. This suggests that AI can enhance learning, but interpersonal dynamics in educational environments need to be carefully addressed. Finally, students' perceptions of AI Digital Assistants have been discussed by (Rienties et al., 2024), and it has been observed that students express a desire for real-time help and personalized support. However, concerns such as ethical worries, data privacy, and potential misuse stand out as significant challenges that need to be addressed to create a supportive learning environment (Rienties et al., 2024). Final words: From a transformation perspective, there can be immense contribution of 3D AI virtual instructors in terms of building and improving education quality, but the elements of challenges should also be taken both seriously and proactively. Unfortunately, this means overcoming limitations in the expressiveness of avatars, understanding the ethical implications of AI interactions and prioritizing concerns about student privacy and authenticity, as in use of these technologies might lead to educational breakthroughs.

This has been more than evident in how the SozyAI works in relation to classroom dynamics. Through the usage of the model, student engagement has markedly increased, and lesson delivery time and material efficiency have greatly improved. This model most significantly is important for the element of support we provide teachers alongside dealing with large classes. Moreover, instant feedback has been a boon for students as it has enhanced their overall learning experiences. Yet and still, given the extraordinary capabilities of the AI model, a few restrictions designed to improve its ability to address more complex questions should be acknowledged. SozyAI and similar technologies can assist teachers in remote and under-resourced schools.

The melding of artificial intelligence into the classroom has brought a deep, long-lasting, paradigm shift to the way teachers teach and students learn. And this impact has laid a foundation for a new era of creativity and possibilities in education. Of all these advancements, one of the most notable is that of 3D virtual instructors. Powered by the SozyAI Model, these advanced virtual beings serve as vital resources to enhance learning experiences while offering individualized learning environments. Through integration of technology, pedagogy SozyAI Model has changed the way students digest educational material. Such model brings a unique and experiential level of interaction beyond the four walls of a classroom.

Hitting the nail on the head, this remarkable AI model is able to cater their teaching methods to the users with its intelligent algorithms and adaptive capabilities, thus attending to their strengths, weaknesses, and learning styles. This results in all the students having real time personalization and differentiated help, leading to command of understanding and knowledge retention in the subject. In addition, the SozyAI Model creates a space to engage, think critically, and collaborate. Students will explore, experiment, and ask questions (the essence of intellectual curiosity) with help from dynamic simulations and real-time feedback. The 3D visualization of virtual instructors also contribute through visual and the kinesthetic components of the learning process of adding up the extra input as the multiscensory input for learning. It promotes creativity, understanding and enhances the problem-solving ability of an individual. Therefore, the actual integration of the SozyAI Model within education environments will subsequently change the educational ecosystem forever and increasingly lead towards endless horizons in excellence, innovation, and inspiration for all aspects of both Dynamic Educators and Dynamic Learners alike.

This study is significant in that it sheds light for the first time on the roles of the newly developed AI-supported virtual tutors contributing to the educational processes in-between. Inspired by a family with successful role models who mentor students for their goals and provide care for individuals with disabilities, this system was designed. Studies that could predict the use of virtual instructors was informative until this research was conducted, experts in the field say. The study was the first of its kind to allow users a virtual instructor for guiding users in the field and promoted conducting the research across different work areas, according to the type of task users performed. Here in this context, the motivational pull of virtual instructor working techniques was seen

The SozyAI potentially makes a huge difference in how we learn. Using machine learning and artificial intelligence, it can tackle sophisticated questions and give information on a range of different subjects. Other advancements, such as user interface design updates, can also help make the generative AI system a better fit for users of all types, including learners and educators. The SozyAI model will transform education with future developments and enhancements.

This study represents the first instance of the use of an animated teacher developed through artificial intelligence technology in an educational context, and it examines the influence thereof. As seen from the results, it is concluded that the virtual teacher has a positive effect on the educational process through the expressions and behaviors of the students, and that Virtual Teacher makes lessons fun. This research concludes that animated teacher avatars have the potential of pen- etrating educational technology and enhancing the quality and efficacy of education programs. Through observing student behaviors and listening to what they said, Glotfelty identified the influence of the virtual teacher. By virtually putting themselves in the shoes of their teacher, students became more engaged and inquisitive about the lesson. In these contributions, the focus was on the attitude, gestures and eye movements that the virtual teacher makes. The results indicate that high-quality virtual instructors can fill an effective role in the learning process. The research also showed that willingness to learn and attention towards lesson content improved among students. The virtual teacher added diversity and provided context to the contents. The findings indicate that the virtual teacher has an impact on the educational process. To sum up, the results indicate that use of animated teachers can be used in the educational field which can be a potential factor for increasing student motivation. These results reinvigorate the use of virtual teachers in educational settings. The high level of influence and interaction that the 3D virtual instructors supported by artificial intelligence can show in giving voice, expression, and animation within the context of the process of education- where previously no isolated 3D virtual, humanoid embodiments existed- has led to a tremendous degree of promise and contribution of educational technologies in more recent times. Virtual instructors of the future could be more niche and personal. This research shows that the technology of virtual instructor with artificial intelligence support can offer exceptional assistance in learning-teaching processes.

Recommendations For Future Research

Future work needs to apply how the SozyAI model can include into more particular domains. It is important to note that long-term studies can be beneficial in exploring the impact of artificial intelligence-integrated learning on pupil performance. Also look into what it can do to help teachers in areas with little or no funding at the moment. The purpose of this study was to examine the role an artificial intelligence-enhanced 3D model could play in educational processes. Future research could further explore the potential of these models for personalized teaching.

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Research Article

Examining the tendencies of parents of gifted children to guide their children toward scientific fields

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Abstract

The influence of families on the career choices of gifted students is undeniable. This study aims to examine the extent to which the families of gifted students—enrolled in Science and Art Centers, which are institutions providing support education for the gifted in Turkiye—encourage their children to pursue careers in scientific fields. The participant group consisted of 278 parents (M=91, F=187) whose children are enrolled in different SACs located in Ankara. The research group was formed using a purposeful sampling method, with the primary criterion being that participants must be SAC parents. The study employed the survey model, a quantitative research method, to collect data. The SPSS program was used for data analysis. An assessment of the data revealed that it followed a normal distribution. For analyzing variables such as gender, children's grade levels, and ages, arithmetic means, standard deviations, and dependent samples t-tests were utilized. The ANOVA test was applied to examine the variables of the number of children and the parents' education levels. A significance level of p<.05 was used to determine differences between variables. The findings indicated that SAC parents exhibited high levels of guiding their children toward science, establishing a scientific foundation, introducing them to scientific concepts, and encouraging practical applications. A notable difference was observed in the level of guiding children toward science based on the number of children in the family, with parents of single children differing significantly from those with two, three, or more children. The study revealed a significant difference in the levels of orientation toward science between parents with a high school education and those with undergraduate or graduate education. However, no significant difference was found among parents with an associate degree, bachelor's degree, or higher education levels, and high school graduates. Similarly, no significant difference was observed in parents' efforts to orient their children toward science based on their gender, age, or their children's grade level.

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Introduction

In developing countries, it is known that gifted children are often directed towards science and engineering fields. This orientation is influenced not only by the societal conditions and the value attributed to specific talent areas, but also by the role and influence of their families. Although it is known that gifted individuals are present in every society, it is also stated that some gifted individuals are not identified. It is thought that gifted individuals constitute 2% of the total population. Individuals who have a higher capacity than their peers in one or more of the areas of creativity, intelligence, and academics are considered as gifted individuals or gifted individuals (Sak, 2017; Coleman et al., 2015; Colengelo &

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Davis, 2003). Giftedness refers not only to a person's intelligence but also to his/her ability to show high development in different fields such as art and aesthetics (Baykoç Dönmez, 2010). Giftedness and giftedness are preferably used interchangeably. Gifted individuals are regarded as a significant asset to the society and nation they belong to, owing to their exceptional abilities and capacities that surpass those of their peers. In this context, supporting and fostering the development of gifted individuals is crucial. Gifted individuals are classified as a group requiring special education due to their distinct characteristics compared to their peers (MoNET, 2018). The fact that the rate of gifted individuals is very low compared to the total population may cause some difficulties in both identifying and supporting the development of gifted individuals (Karadağ & Demirtaş, 2022; Hilal & Dağlıoğlu, 2018). In this regard, Science and Art Centers (SAC) were established to address the challenges students encounter in their education and to nurture and develop their existing potential.

SACs are institutions where students are entitled to receive education in the fields of intellectual, art and music by passing a two-stage exam process and where an educational content is offered to support students in the specified fields (MoNET, 2017). In the United States, institutions dedicated to the education of gifted individuals were established in the 1970s, while in Turkiye, the first Science and Art Center (SAC) was inaugurated in 1994 (Sarıtaş et al., 2018). Turkey's 2023 Education Vision outlined plans to enhance education for gifted students, including developing measurement tools for SAC admissions and improving learning environments and materials tailored to their needs (Çetin & Çetin, 2024). As a result, SACs stand out as institutions where gifted students are supported in the fields of general intelligence, art and music and benefit from them to develop themselves.

While gifted students are supported in SACs, family environments are also important in supporting their development (Guthrie, 2019; Renati et al., 2017). Smutny (2021) emphasizes that families know more about gifted children than their teachers and that they should be supported in their home environments before school, especially in terms of doing applied scientific studies. Parents of gifted children should take responsibility for developing their children's potential (Alkhawaldeh et al., 2023). Silverman (2021) mentions that parents with gifted children experience uncertainty about how to guide their children in scientific studies and that they can overcome this uncertainty with strategies that will pave the way and support them. VanTassel-Baska (2025) explains that it is important for parents with gifted children to take responsibility for supporting their children in scientific studies not only by themselves but also by interacting with the school and using the school effectively in this sense. Intelligence can be affected by both the support of education and environment and biological foundations. Therefore, it is essential for families and teachers to understand the characteristics of gifted individuals to effectively support their developmental needs. The family plays a crucial role in supporting the development of gifted individuals (Koç, 2016; Gallagher, 2003; Karakuş, 2011; Sargın & Demirelli, 2024; Tortop & Coşkun, 2017). SACs strive to identify and nurture students' interests and talents from an early age; however, since gifted individuals spend their early childhood with their families, the primary role of families in fostering the development of gifted children is indispensable (MEB, 2022). Alevli (2019) emphasizes that gifted students should be supported in learning environments in terms of readiness and learning styles since they differ from their peers. Supporting gifted individuals by their families reinforces children to realize their existing potential and to develop themselves in line with their abilities (Dağlıoğlu & Alemdar, 2010). It is observed that family attitudes predict intelligence, and gifted children with parents who exhibit democratic family attitudes and provide supportive environments have higher levels of academic achievement and openness to new experiences (Afat, 2013). It is essential for parents of gifted children to provide support in a correct and positive manner; otherwise, students may express their potential in negative ways through inappropriate channels (Çelikten, 2017). In this regard, guiding gifted students toward scientific research activities by their families can be considered one of the positive and supportive channels.

In conclusion, gifted students demonstrate higher capacities in developmental areas compared to their peers, represent a small proportion of the population, and receive education in SACs to enhance their existing potential. It is observed that the place of families is important in supporting and developing the competencies of gifted students, and that students supported by their families show positive development. SACs offer an educational program that supports students in scientific development. It is essential to assess the level of interest that parents of gifted children have in guiding their children toward science. Therefore, the aim of this study is to examine the extent to which SAC parents guide their children toward science, considering different variables. The study will describe the levels at which SAC parents encourage their children in the scientific field and offer recommendations. To achieve this overall goal, the following sub-objectives will be explored:

- What is the level of SAC parents' orientation of their children toward science?
- What is the level of SAC parents' level of creating a scientific foundation for their children?
- What is the level of SAC parents introducing their children to science?
- What is the level of science-related practice of SAC parents to their children?
- Do the levels of SAC parents' guiding their children toward science differ according to the gender of the parents?
- Does the level of SAC parents' guiding their children toward science differ according to the children's grade level?
- Does the level of SAC parents' guiding their children toward science differ based on the parents' age?
- Does the level of SAC parents' guiding their children toward science differ depending on the parents' level of education?
- Does the level of SAC parents' guiding their children toward science differ based on the number of children they have?

Method

Research Model

In this study, which examines the levels of SAC parents' guidance their children toward science across different variables, the survey model, a type of quantitative research design, was employed. In survey models, it is aimed to reach descriptive conclusions about the current situation by using various measurement tools on the sample group taken from the universe (Creswell & Creswell, 2018).

Study Group

The study group of this research includes a total of 278 SAC parents, comprising 187 women and 91 men, whose children attend various SACs in Ankara. The sample group of the study is 278 parents of SACs in Ankara province and the population is SAC parents in Turkey in general. Convenient sampling method was determined in the study. The convenience sampling method is a sampling technique where the most suitable group is selected as the sample, considering the research purpose, time, and resource constraints (Balcı, 2020). Descriptive data of the parents involved in the study are presented in Table 1.

Table 1. Characteristics of the study group

Variables	Category	Number	Percentage
Gender	Female	187	67.2
	Male	91	32.8
Children's grade level	Primary School	177	63.6
	Middle School	101	36.4
Age of Parents	25-39 years	135	48.5
	40+ years	143	51.5
Education level	High School Associate	58	20.8
	degree	41	14.7
	Postgraduate	179	64.5
Number of children	One	35	12.5
	Two	160	57.5
	Three and above	83	30

Upon examining Table 1, it is observed that 67.2% (n=187) of the 278 parents in the study were female, while 32.8% (n=91) were male. In terms of education, 63.6% (n=177) were primary school parents, and 36.4% (n=101) were secondary school parents. Regarding age, 48.5% (n=135) were between 25 and 39 years old, and 51.5% (n=143) were 40 or older. In terms of education level, 20.8% (n=58) were high school graduates, 14.7% (n=41) had an associate degree, and 64.5% (n=179) held a bachelor's or graduate degree. Regarding the number of children, 12.5% (n=35) had one child, 57.5% (n=160) had two children, and 30% (n=83) had three or more children.

Data Collection Tools

Personal Information Form

The personal information form, created by the researchers, collects details about participants, such as gender, age, education level, the number of children, and the education level of their children.

Parents' Shaping Children's Interest in Science Scale

The scale, developed by Bal and Kaya (2022), is a five-point Likert-type tool. It consists of 18 items, with no reverse-scored items, and a total score. The scale is divided into three sub-dimensions: 1) Introducing Science, 2) Building a Scientific Foundation, and 3) Practical Application. The response options are: (5) always, (4) usually, (3) rarely, (2) partially, and (1) never. The scale was validated through exploratory and confirmatory factor analysis, confirming its reliability and validity. The exploratory factor analysis (EFA) showed factor loadings between 0.521 and 0.893, a Kaiser-Meyer-Olkin value of 0.866, and explained a total variance of 62.254%. The Cronbach's alpha coefficient was 0.907. Additionally, the results of the CFA showed an X2/Sd value of 2.08 and a Root Mean Square Error of Approximation (RMSEA) value of 0.077.

Data Analysis

In this study, the arithmetic mean and standard deviation values were utilized to assess the level of SAC parents' guidance their children toward science. These values were categorized as follows: very low (1-1.79), low (1.80-2.59), medium (2.20-3.39), high (3.40-4.19), and very high (4.20-5.00). Prior to conducting the difference analysis, a normality test was carried out, and it was found that the skewness and kurtosis values of the data fell within the range of (+1 to -1). The skewness values ranged from -.664 to .146, while the kurtosis values ranged from -.348 to .291. Since both the skewness and kurtosis values fell within the (±1) range, it indicates that the data follows a normal distribution (Büyüköztürk, 2016). The independent samples t-test was applied to analyze the variables of gender, children's grade level, and age, while the ANOVA test was used to assess the variables of the number of children and education level. To identify groups with significant differences in the ANOVA test, the Tukey test was conducted. A significance level of $p < .05$ was used as the threshold in the data analysis.

Findings

This section will present the findings derived from the analyses conducted as part of the research.

Guidance towards scientific disciplines

Table 2 displays the descriptive analyses conducted to determine the level of SAC parents' guidance their children toward science.

Table 2. Descriptive data of SAC parents' levels of guidance their children towards science

Variable	Sub-dimensions	x̄	ss
Orientation of Families to Science	Total	3.76	0.57
	Creating a scientific basis Introducing	3.71	0.56
	science	3.82	0.68
	Practical application	3.66	0.81

Upon examining Table 2, it can be concluded that the mean total score for the scale measuring parents' guidance of their children toward science is high (x̄ = 3.76). Additionally, it is noted that parents exhibit high levels in the sub-dimensions of the scale, including creating a scientific foundation (x̄ = 3.71), introducing science (x̄ = 3.82), and practical application (x̄ = 3.66).

Gender

The findings from the independent samples t-test, which examined whether the level at which SAC parents guide their children toward science varies by gender, are displayed in Table 3.

Table 3. The results of the independent samples t-test on parents' levels of guiding their children towards science

Variable	Gender	Number	x̄	s	Sd	t	p
Orientation of	Woman	187	67.32	10.71	0.78	-0.902	.359
Families to Science	Male	91	68.52	9.79	1.02	-0.930	

Upon reviewing Table 3, it can be concluded that there is no significant difference in SAC parents' guidance of their children toward science based on gender (p > .05).

Age

Table 4 presents the results of independent samples t-test analyses to examine whether there is a significant difference in the level of SAC parents' guidance their children toward science based on age.

Table 4. The results of the independent samples t-test for parents' levels of guidance their children toward science based on the age variable.

Variable	age	Number	x̄	sd	Sd	t	p
Orientation of	25-39	135	67.37	10.62	0.85	-0.602	.316
Families to Science	40 and above	143	68.13	10.18	0.91	-0.605	

Upon analyzing Table 4, it can be concluded that the level of SAC parents' guidance their children toward science does not exhibit a significant difference based on the age variable (p > .05).

Grade level

Table 5 presents the results of independent samples t-test analyses to examine whether the level of SAC parents' guidance their children toward science shows a significant difference based on the factor of children's grade level.

Table 5. The results of the independent samples t-test for parents' levels of guidance their children toward science based on children's grade level

Variable	Class	N	x̄	s	Sd	t	p
Orientation	Primary School	177	67.81	10.19	0.74	0.218	.680
of Families to Science	Middle school	101	68.52	10.93	1.15	0.213	

Upon examining Table 5, it can be concluded that the level of SAC parents' guidance their children toward science does not show a significant difference based on the grade levels of their children (p > .05).

Educational level of the parents

Table 6 presents the results of the ANOVA (Tukey) test analyses to examine whether the level of SAC parents' guidance children toward science shows a significant difference based on the parents' educational level.

Table 6. ANOVA-Tukey test results of parents' levels of guidance their children toward science based on the level of education variable

Groups	Education status	Average difference	sd	p	Effect size
1	Associate degree Undergraduate and postgraduate	-2.53	2.00	.417	0,65
		-5.85	1.52	.000	
2	High School Undergraduate and postgraduate	2.53	2.00	.417	
		-3.32	1.70	.126	
3	High School Associate degree	5.85	1.52	.000	
		3.32	1.70	.126	

Upon examining Table 6, it is observed that the level of SAC parents' guidance children toward science varies significantly according to their educational level. Parents with undergraduate and postgraduate education levels showed a significant difference compared to high school graduates (p < .05), with the former group exhibiting a higher level of guidance their children toward science (+5.85). The effect size value between those with high school education and those with undergraduate and graduate degrees is 0.65. This value indicates an effect size above the medium level.

Number of children

Table 7 presents the results of the ANOVA (Tukey) test analyses to examine whether the level of SAC parents' guidance their children toward science shows a significant difference based on the number of children they have.

Table 7. The results of the ANOVA (Tukey) test for SAC parents' levels of guidance their children toward science based on the number of children they have.

Groups	Number of children	Average difference	sd	p	Effect size
1	Two	5.53	1.99	.017	0,65
	Three and above	7.17	2.19	.004	0,68
2	One	-5.53	1.99	.017	
	Three and above	1.64	1.43	.484	
3	One	-7.17	2.19	.004	
	Two	-1.64	1.43	.484	

Upon examining Table 7, it is observed that the levels of SAC parents' guidance their children toward science differ significantly based on the number of children they have. A significant difference ($p < .05$) is found between parents with one child and those with two children, as well as between parents with one child and those with three or more children. Parents with one child exhibit higher levels of guiding their children toward science than parents with two children (+5.53) and parents with three or more children (+7.17). There was a significant difference between parents with one child and parents with 2 children and the effect size value of this difference was 0.65. This value is above average. In addition, the difference between parents with one child and parents with 3 or more children was also significant and the effect size of this difference was 0.68. This value shows that there is an effect size value above the average.

Conclusion and Discussion

In this study, SAC parents' levels of guidance their children toward science are examined based on various variables and the results are summarized below: SAC parents' level of guidance their children toward science was found to be high. Similarly, Çavuşoğlu and Semerci (2015) conducted a research study on SAC parents using the survey model. Consequently, it was concluded that SAC parents are motivated to support their children throughout the SAC education process. Çetin and Çetin (2024) conducted a qualitative research study with SAC parents using semi-structured interview forms. Şimşek and Şahin (2023) observed in their study that parents with gifted children argued that it would be important for their children to be supported by science and art centers and for their children to conduct research in laboratory environments in order to develop their existing potential. In the study we conducted, it is seen that similar results were obtained with this study. The study revealed that parents aim for their children to utilize SAC resources effectively and foster scientific development. SAC parents demonstrated a high level of commitment to creating a scientific foundation for their children. De Souza Fleith (2024) et al. conducted a study with parents of gifted children and concluded that parents were willing and voluntary to contribute to their children's development in scientific learning strategies. This study is similar to the results obtained in our study. Köksal et al. (2017) conducted a study involving parents and teachers to explore how students could benefit from SAC. The study revealed that parents expressed satisfaction with the idea of SAC providing content designed to enhance students' scientific studies and foster a metacognitive sense. This included areas such as scientific research, practical applications, and space science. In their research study, Büyüktokatlı and Kurnaz (2021) show that SAC parents find SAC useful in terms of their children's ability to conduct research and project development practices. The fact that SAC has an educational content that forms the basis for scientific studies in the eyes of parents shows that parents consider SAC as a useful place in creating a scientific basis for their children. SAC parents' level of introducing their children to science was high. Özdemir and Bozkurt (2020), in their study with SAC parents, concluded that parents want their children to develop in sciences such as mathematics and science and in areas such as thinking skills and space. Alkhawaldeh et al. (2023) concluded that parents of gifted students feel responsible for introducing their children to science, preparing them for scientific activities and guiding them, and are willing to fulfill this responsibility. Önal (2021) conducted a study with parents and teachers of gifted students. He concluded that supporting students' parents and teachers with practices such as experiments, observations, and laboratory studies would improve them in science. Ünsal et al. (2019) conducted a study with SAC parents using a survey model. The study concluded that SAC parents have high expectations regarding the education their children receive from SACs. These expectations also include elements related to guiding their children toward science. In this respect, similar results were obtained with this study. Esen et al. (2019), in their study including SAC parents, concluded that parents are willing to develop their children in science, mathematics, engineering and 21st century developments and that they support the effective implementation of these subjects in SACs. SAC parents had a high level of practicing scientific practices with their children. In their research study, Köksal et al. (2017) stated that parents want to conduct experiments, projects, etc. with their children. Atılgan et al. (2021) concluded in their study that supporting gifted students in learning styles improves their attention and focus and that the application of learning styles by doing-living motivates them. In our study, the results of Atılgan et al. (2021) and the finding that the parents of gifted students had high levels of having their children practice scientific practices support each other.Tanık Önal (2017), in his research in which SAC parents were also included in the study group, stated that in SAC, students are engaged in activities such as conducting experiments, dealing with science, and doing project-based studies, so parents find it important for their children to benefit from SAC. There was no noticeable difference in SAC parents' levels of guiding their children toward science based on gender. Çavuşoğlu and Semerci (2015) reported that both mothers and fathers exhibit similar behaviors in supporting their children. Yerli (2022) explored SAC parents' perceptions of SAC and found no gender-based differences in these perceptions. Similarly, Altun and Yazıcı (2018) determined that parents showed no significant gender-related differences in addressing the PDR needs of gifted students. Yılmaz et al. (2023), in their research on the digital literacy and communication levels of SAC parents, concluded that these levels did not vary by gender. There was no meaningful difference in SAC parents' levels of science orientation based on their children's grade levels (primary or intermediate). Büyüktokatlı and Kurnaz (2021) conducted a research study with SAC parents using the survey model. In the study, which was attended by parents at primary and secondary school level, parents evaluated that they found SAC useful in terms of having dynamics where their children can develop scientifically. Özgen (2019) concluded in his study with SAC parents that the overall family environment score showed no variation based on the children's grade level. There was no notable difference in SAC parents' levels of guiding their children toward science based on their age. Similarly, Özgen (2019) found no variation in the total family environment scores of SAC parents based on to age. There was a notable variation in the levels of SAC parents' guidance their children toward science based on their educational level. A significant difference was observed between parents with higher education (undergraduate and graduate degrees) and those with high school diplomas. Parents holding undergraduate and graduate degrees exhibited higher levels of guiding their children toward science compared to parents with high school diplomas. However, no meaningful difference was found between parents with an associate's degree and those with high school or higher education degrees. Yerli (2022) observed that SAC parents' perceptions of SAC differed based on their education level, and stated that higher levels of education among parents were associated with a better understanding of SAC. Altun and Yazıcı (2018) aimed to determine the Pychological Counseling needs of students according to the parents in their study with parents with gifted children. In line with this objective, a significant difference was found in the parents' expectations based on their level of education. The average scores of university graduates were notably higher than those of non-university graduates. There was a noticeable difference in SAC parents' levels of guiding their children toward science based on the number of children they have. A significant difference was observed between the levels of guidance for parents with one child and those with two or more children. However, no meaningful difference was found between the levels of guidance for parents with two children and those with three or more children. Eren (2022) states that the number of children in a family impacts students' academic achievement and knowledge levels. Yılmaz et al. (2018), through their research with parents of gifted students, found that parents with multiple children encountered challenges in offering a suitable environment for their children.

Recommendations

Based on the results obtained from the study, the following recommendations can be made: Informative seminars about the importance of scientific research can be organized at schools for parents of SAC students. SAC parents can be informed about studies such as TUBITAK, AIRCRAFT, TEKNOFEST etc. SAC parents can be informed about guidance their children to studies such as TÜBİTAK, AIRCRAFT, TEKNOFEST, etc. Studies can be conducted on SAC students' interest in science and parents' expectations in this sense. Practical activities related to science can be organized for SAC parents with 2 or more children. Informative studies can be conducted to inform parents about scientific orientation and practices to guide their children to developmental studies. SAC parents with lower socioeconomic level can be informed about the importance of scientific studies.

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Interview Article

An interview with Johannes Addido: NASA-Commissioned NWAY and scientists of the future

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Abstract

This interview with Johannes Addido highlights his role as Co-Investigator of the NASA-sponsored NWAY-II project, coordinated by the WEX Foundation in collaboration with Eastern New Mexico University (ENMU). Although not directly employed by NASA, Addido contributes by preparing pre-service teachers to deliver hands-on, NASA-themed STEM activities to middle school students in out-of-school programs. The NWAY (New Worlds Await You) initiative provides curriculum and resources to underserved communities, aiming to enhance STEM education and inspire future scientists. Addido emphasizes the evolving role of educators, particularly in equipping students with critical thinking, collaboration, and technological skills. He also stresses the importance of project-based learning and real-world applications in both elementary and high school settings. Despite financial limitations in academia, he notes successful partnerships with organizations like NASA. Addido concludes by expressing optimism about empowering young, diverse space scientists and the continuing importance of STEM collaboration.

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Michael F. Shaughnessy

I understand that you are involved with NASA. How did this come about?

Johannes Addido

So, I'm not directly involved with NASA. I'm the Co-Investigator of the NASA-sponsored Space-themed Out of School/After-School Project. The project is being led by the WEX Foundation which reached out to Eastern New Mexico University (ENMU) to be a partner in submitting the NASA Teams II grant proposal. As the elementary science and math methods instructor at the College of Education and Technology at ENMU, I was tasked with working on the grant proposal with the WEX Foundation. The Proposal was submitted in August 2023 and in April 2024 NASA awarded WEX Foundation and its partners $800,000 to start the NWAY-II program.

Michael F. Shaughnessy

You are involved with training pre-service teachers in an OST (Out of School Program) what is involved?

Johannes Addido

WEX foundation personnel will train teacher candidates (TCs) and provide them with experience implementing NASA-themed hands-on activities focused on the NWAY curriculum and related NASA resources. Trained TCs will be placed in local OST venues, such as after-school programs and clubs, to implement the curriculum with middle school-aged students. As University partners, ENMU personnel will be involved in the recruitment of pre-service

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teachers, assist with the training of pre-service teachers, and manage and support pre-service teachers in the implementation of the NWAY program.

Michael F. Shaughnessy

What exactly is NWAY?

Johannes Addido

New Worlds Await You (NWAY) is a high-quality Space-STEM program featuring unique partnerships with local, regional, and national networks of in-school and out-of-school time (OST) education providers. Designated by NASA as an Informal Education Community Anchor, the NWAY program provides curricula, multimedia resources, and activities focused on space exploration and architecture for middle school students. One of the aims of NWAY is to empower pre-service teachers and OST providers to implement quality Space-STEM programming accessible to students who are underserved and typically underrepresented in STEM fields.

Michael F. Shaughnessy

Will this be in person or online?

Johannes Addido

The project will be implemented in person at the sites provided by the participating middle schools in the out-of-school/after-school program.

Michael F. Shaughnessy

What do teachers of the future need to do to prepare future scientists and astronauts?

Johannes Addido

In preparing scientists and astronauts, future teachers need to think about ways to provide opportunities for hands-on experiences, such as building model rockets, and conducting experiments. These experiences not only make learning fun but also help students develop practical skills.

Future teachers must also teach students how to think critically, encourage students to ask questions, analyze data, and come up with innovative solutions. Thirdly, future teachers must foster collaboration and teamwork skills, as scientists and astronauts often work in multidisciplinary teams, and equipping students with collaborative skills will go a long way in adequately preparing them for group projects.

Michael F. Shaughnessy

The science teacher of the future will undoubtedly need different skills than 10 years ago- Are the schools keeping up with the demands?

Johannes Addido

The science teacher of the future will require a diverse range of skills to effectively prepare students for the challenges and opportunities of the future. I think the schools are doing their best to equip science teacher candidates with the knowledge to design and deliver engaging lessons that cater to different learning styles and abilities by creating hands-on activities, demonstrations, and experiments to make science come alive in the classroom. Moreover, pre-service teachers are being taught how to integrate technology into their teaching, including the use of multimedia resources, interactive simulations, and educational software to enhance students' learning experiences.

The teacher preparation programs are also focused on training future teachers to adapt their teaching methods and strategies to meet the needs of diverse learners and to accommodate changes in curriculum or technology. These programs aim to create a cohort of professionals who are equipped with the skills necessary to deliver quality education to their students.

Despite the challenges that arise, educational institutions are doing their best with the available resources to ensure that science teachers are prepared to meet the demands of the future. Through their efforts, science teachers are equipped with the knowledge, skills, and tools to deliver engaging, effective, and innovative instruction to their students.

Michael F. Shaughnessy

What do elementary teachers need to be doing differently to prepare young scientists for the next decade?

Johannes Addido

In the coming decade of education, I believe that elementary school teachers will need to adopt the role of facilitators of learning rather than simply providing information in the classroom. They will be required to link scientific concepts with practical, real-world contexts that are significant and relevant to young students. For instance, they could teach about water properties by focusing on water conservation or discuss animal adaptations by highlighting local wildlife. In addition to that, they should integrate educational technology tools and resources that enhance learning experiences like interactive simulations, educational apps, and multimedia resources that engage young learners.

Michael F. Shaughnessy

What do high school teachers need to be doing to prepare their students for the next 10 years?

Johannes Addido

In my opinion, what high school teachers need to do is not much different from what elementary teachers need to do. They should empower students to take charge of their own learning by implementing project-based learning approaches. This way, students will work on real-world, interdisciplinary projects that require critical thinking, problem-solving, and collaboration. This will prepare them for the complex challenges they may face in the future. It's also important to introduce students to Career and Technical Education programs that provide hands-on training. These programs can prepare students for immediate entry into the workforce or post-secondary education.

Michael F. Shaughnessy

Colleges and universities should be at the cutting edge of STEM- but are they?

Johannes Addido

I think that academic institutions find it difficult keeping up with the latest developments in STEM. This is primarily due to the prohibitive costs associated with cutting-edge STEM, which most colleges and universities cannot afford. The private sector and state agencies such as NASA often have a significant advantage over academic institutions in this regard. Nevertheless, there are some silver linings to this situation. Notably, there have been several successful collaborations between the private sector and organizations like NASA that have resulted in meaningful initiatives. One such example is the recent NASA grant awarded to the WEX Foundation and ENMU to implement the NWAY program. This program seeks to empower students in rural and underserved communities by providing them with access to STEM resources and opportunities that they would ordinarily lack.

Michael F. Shaughnessy

Young space scientists—what do they look like and what skills will they have and what skills do they need?

Johannes Addido

The young space scientists are a diverse group, hailing from various cultural, ethnic, and socioeconomic backgrounds. Their eyes are filled with enthusiasm and curiosity, fueled by their passion for space exploration and discovery. They are Innovative thinkers who always come up with new ideas and solutions, they are open to sharing ideas and adapting to changing circumstances and new challenges. They need skills to keep up with technological advancements, including robotics, and AI.

Michael F. Shaughnessy

What have I neglected to ask about this program and your involvement in it?

Johannes Addido

At the moment, I don't have anything in mind. However, please don't hesitate to contact me if you think of anything.

Biodata of Author

Prof.Dr. **Michael F. Shaughnessy** is currently Professor of Educational Studies at Eastern New Mexico University in Portales, New Mexico USA. He has served as Editor in Chief of Gifted Education International and can be reached electronically at Michael.Shaughnessy@enmu.edu. His orcid i.d. is 0000 0002 1877 1319. His current research interests include talent development and intellectual assessment as well as the role of personality in giftedness, talent and creativity.

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