IJTASE

International Journal of New Trends in
Arts, Sports & Science Education

IJTASE

INTERNATIONAL JOURNAL OF NEW TRENDS IN ARTS, SPORTS & SCIENCE EDUCATION

OCTOBER 2022

Volume 11 - Issue 4

Message from the Editor

I am very pleased to publish fourth issue in 2022. As an editor of International Journal of New Trends in Arts, Sports & Science Education (IJTASE), this issue is the success of the reviewers, editorial board and the researchers. In this respect, I would like to thank to all reviewers, researchers and the editorial board. The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to International Journal of New Trends in Arts, Sports & Science Education (IJTASE), For any suggestions and comments on IJTASE, please do not hesitate to send mail.

Prof.Dr. Cenk KEŞAN
Editor in Chief

Educational Drama
PhD. Alev Önder, (Marmara University, Turkey)
PhD. Fatoş Giritli, (Near East University, North Cyprus)

Educational Psychology
PhD. Abbas Türnüklü, (Dokuz Eylül University, Turkey)
PhD. Christina Athanasiades, (Aristotle University of Thessaloniki, Greece)
PhD. Muhammad Sabil Farooq, (Nankai University Tianjin, P.R. China)
PhD. Nergüz Bulut Serin, (European University of Lefke, North Cyprus)
PhD. Olena Huzar, (Ternopil National Pedagogical University, Ukraine)
PhD. Partow Izadi, (Lapland University, Finland)
PhD. Rengin Karaca, (Dokuz Eylül University, Turkey)
PhD. Thanos Touloupis, (Aristotle University of Thessaloniki, Greece)

Fine Arts Education
PhD. Ayfer Kocabaş, (Dokuz Eylül University, Turkey)
PhD. Azize Özgüven, (Yeni Yüzyıl University, Turkey)
PhD. Benan Çokokumuş, (Ondokuz Mayıs University, Turkey)
PhD. Esra Gül, (Anadolu University, Turkey)
PhD. Süreyya Çakır, (Okan University, Turkey)
PhD. Bedri Karayağmurlar, (Dokuz Eylül University, Turkey)

Foreign Language Teaching
PhD. Mehmet Ali Yavuz, (Cyprus International University, North Cyprus)
PhD. Nazife Aydınoğlu, (Girne American University, North Cyprus)
PhD. Uğur Altunay, (Dokuz Eylül University, Turkey)
PhD. İzzettin Kök, (Girne American University, North Cyprus)

Guidance and Counselling
PhD. Ahmet Rıfat Kayiş, (Kastamonu University, Turkey)
PhD. Alim Kaya, (Eastern Mediterranean University, North Cyprus)
PhD. Ferda Aysan, (Dokuz Eylül University, Turkey)
PhD. Gürcan Seçim, (Cyprus International University, North Cyprus)
PhD. Mehmet Engin Deniz, (Yıldız Teknik University, Turkey)
PhD. Nalan Kazaz, (AAB University, Kosova)
PhD. Nergüz Bulut Serin, (European University of Lefke, North Cyprus)

Mathematics Education
PhD. Elizabeth Jakubowski, (Florida State University, United States)
PhD. Cenk Keşan, (Dokuz Eylül University, Turkey)
PhD. Elif Beymen Türnüklü, (Dokuz Eylül University, Turkey)
PhD. Joakim Samuelsson, (Linköping University, Sweden)
PhD. Kakoma Luneta, (University of Johannesburg, South Africa)
PhD. Murat Tezer, (Near East University, North Cyprus)
PhD. Moritz Herzog, (University of Wuppertal, Germany)
PhD. Osman Cankoy, (Atatürk Teachers Academy, North Cyprus)
PhD. Sinan Olkun, (Final International University, North Cyprus)
PhD. Süha Yılmaz, (Dokuz Eylül University, Turkey)

Measurement and Evaluation

PhD. Emre Çetin, (Eastern Mediterranean University, North Cyprus)
PhD. Gökhan İskifoğlu, (European University of Lefke, North Cyprus)
PhD. Gürol Zırlıoğlu, (Yüzüncü Yıl University, Turkey)
PhD. Selahattin Gelbal, (Hacettepe University, Turkey)

Music Education

PhD. Burak Basmacıoğlu, (Anadolu University, Turkey)
PhD. Cansevil Tebiş, (Balıkesir University, Turkey)
PhD. Gulsen G. Erdal, (Kocaeli University, Turkey)
PhD. Hale Basmacıoğlu, (Anadolu University, Turkey)
PhD. H. Hakan Okay, (Balıkesir University, Turkey)
PhD. Nezihe Şentürk, (Gazi University, Turkey)
PhD. Şirin Akbulut Demirci, (Uludağ University, Turkey)
PhD. Sezen Özeke, (Uludag University, Turkey)

Pre-School Education

PhD. Alev Önder, (Marmara University, Turkey)
PhD. Eda Kargı, (Cyprus International University, North Cyprus)
PhD. Rengin Zembat, (Marmara University, Turkey)
PhD. Sezai Koçyiğit, (Adnan Menderes University, Turkey)
PhD. Şafak Öztürk Aynal, (Ondokuz Mayıs university, Turkey)

Science

PhD. Abdulkadir Yıldız, (Kilis 7 Aralık University, Turkey)
PhD. Ali Doğan Bozdağ, (Adnan Menderes University, Turkey)
PhD. Fatma Noyan, (Yıldız Technical University, Turkey)
PhD. Gianni Viardo Vercelli, (Genova University, Italy)
PhD. Giovanni Adorni, (Genova University, Italy)
PhD. Gülhayat Gölbaşı Şimşek, (Yıldız Technical University, Turkey)
PhD. Valerio De Rossi, (Safety Management Research Consultant, İtaly)

Science Education

PhD. Baştürk Kaya, (Selcuk University, Turkey)
PhD. Çiğdem Şenyiğit, (Van Yüzüncü Yıl University, Turkey), Turkey
PhD. Gizem Saygılı, (Süleyman Demirel University, Turkey)
PhD. Hakan Kurt, (Selcuk University, Turkey)
PhD. Meryem Nur Aydede, (Niğde University, Turkey)
PhD. Nilgün Seçken, (Hacettepe University, Turkey)
PhD. Nilgün Yenice, Adnan Menderes University, Turkey), Turkey
PhD. Oğuz Serin, (European University of Lefke, North Cyprus)
PhD. Salih Çepni, (Uludağ University, Turkey)
PhD. Şule Aycan, (Muğla University, Turkey)
PhD. Teoman Kesercioğlu, (Dokuz Eykül University, Turkey)

Social Sciences

PhD. Ali Bavik, (Institute for Tourism Studies, Macao)
Ph.D. Erdogan Ekiz, (King Abdulaziz University, Tourism Institute, Saudi Arabia)

Table of Contents

Research Articles

Research Article

ENVIRONMENTAL PROBLEMS ACCORDING TO THE GIFTED AND TALENTED STUDENTS AND THEIR SOLUTION PROPOSALS: A QUALITATIVE RESEARCH

Murat ÖZARSLAN
Dr. Ministry of Education, Kocaeli, Turkey
ORCID: https://orcid.org/0000-0003-2139-4347
muratozarslan14@gmail.com

Abstract

In this study, it was aimed to determine the opinions and solution proposals of gifted and talented students. The study group was comprised of 19 gifted and talented students who were attending the Science and Art Centers (SACs) in the Marmara Region in the fall semester of 2015-2016 education year. These students were attending the 7th to 10th grades in their formal education. In order to determine the study group, the convenience sampling method was used which is among the sampling methods. The qualitative research approach was used in the research. As the data collection tool, the "Environmental Problems Semi-Structured Interview Form" was used, which was developed by the researcher. The data were analyzed though the content analysis and descriptive analysis methods. As the conclusion of the research, it was determined that gifted and talented students mostly emphasized environmental problems in our day such as water and air pollution, and global warming. However, it was also determined that the students emphasized less about the environmental problems such as biodiversity loss, acid rains, the loss of agricultural lands, deforestation, and genetically modified products. Students mostly mentioned that the environmental problems mainly result from lack of education and consciousness in the society, and due to environmental polluting elements. As a solution for the environmental problems, students proposed recycling and treatment of waste, educating individuals about the environment, re-regulating laws, and increasing inspections. Students stated that, in the future, water pollution, global warming, and radiation pollution will emerge as the environmental problems. The majority of the gifted and talented students stated that they will make contributions to solve the environmental problems in the future, but a significant number of students mentioned that they did not want to deal with these issues.

Keywords: Gifted and talented students, environmental education, environmental problems, Science and Art Centers, qualitative research

INTRODUCTION

Today, the environment is being destroyed by factors such as the development of industry and technology, rapid population growth and construction (Li, 2018; Uğulu, 2015). The environment is a natural habitat created through an interaction between living beings and non-living things (Yavetz, Goldman & Pe'er, 2014). The environmental problem is the destruction in nature occurring as a result of uncontrolled and improper use of the resources that constitute the structure of this living environment (Yüksel, 2009). Researchers indicate the problems such as air, water, and soil pollution, global warming, depletion of ozone layer, biodiversity loss, destruction of green spaces, desertification, and erosion as today's environmental problems (Harris, 2012; Li, 2018; Tsekos and Matthopoulos, 2009). Destruction of the environment adversely affects all living things. Therefore, environmental problems are of interest to all human beings, they are the subjects of frequent media coverage, and they are constantly discussed (Marinopoulos & Stavridou, 2002).

Providing environmental education to individuals is of significant importance since the main cause of environmental problems is the human (Kocabaşoğlu & Şahin, 2021; Pınar & Yakışan, 2017). Environmental education includes comprehensive lifelong education in order to become sensitive to changes in the world (Khan, 2018). This training will enable individuals to avoid environmental problems and to gain environmental awareness and sensitivity (Valderrama-Hernández, Alcántara, & Limón, 2017). At this point, another important group that should acquire environmental awareness and sensitivity is the group of gifted and talented individuals.

Gifted and talented individuals can be an important opportunity for environmental protection and solutions to environmental problems of our day. Because it is stated that the gifted and talented individuals are interested in humane problems and they strive to propose solutions (Piechowski, 1997; Sak, 2012; Stuart & Beste, 2011; Şahin, 2015; Önal, 2020). Additionally, Silverman (1993) reported that the strong emotional intensity, justice, and empathy traits of the gifted and talented individuals rendered them particularly sensitive to problems such as the destruction of nature, overfishing, starvation and endangered species (Lovecky, 1993; Piechowski, 1997; Silverman and Ellsworth, 1981). Moreover, gifted and talented individuals perform better in terms of productivity, creativity, analytical thinking, and problem solving compared to their peers (Ataman, 2009; Gubbins, Callahan & Renzulli, 2014; Stenberg, 1986, 1999; Yıldırım Doğru, 2013).

The advanced characteristics of gifted and talented students also differentiate their expectations and requirements from environmental education. Environmental education approaches that do not take into account the characteristics of gifted and talented students are not considered sufficient to meet their needs (Şahin & Levent, 2015). In addition, before organizing activities and trainings to support gifted and talented students to develop positive behaviors and attitudes towards the environment, it is important to determine their thoughts and perceptions of environment and environmental problems (Özarslan, Çetin & Yıldırım, 2017). Because these variables are closely related to awareness levels, attitudes, and approaches of students towards the environment and environmental problems (Roczen, Kaiser, Bogner & Wilson, 2014). However, it is stated that the number of the studies in the literature is insufficient which examine the perceptions, opinions, level of knowledge and similar traits of gifted and talented students concerning environmental problems (Karakaya, Ünal, Çimen & Yılmaz, 2018).

When the literature was examined, a small number of studies were found investigating the thoughts, attitudes, behaviors, etc. of the gifted and talented students concerning the environment and environmental problems. As examples of these studies, Aydın, Coşkun, Kaya, and Erdönmez (2011), Uğulu (2013), and Esen (2011) stated that the attitudes of gifted and talented students towards the environment were at a very high level. Esen (2011) determined that gifted and talented students were able to develop solutions to environmental problems; however, they were not creative ideas. In addition, it was determined that most students suggest penal sanctions as the solutions to environmental problems. Uğulu (2015) stated that the attitudes of gifted and talented students towards recycling are at a very good level. Sontay, Gökdere, and Usta (2014) demonstrated that gifted and talented students are more sensitive in displaying positive attitudes towards the environment than their peers. Concerning the literature, this study can both contribute to the reorganization of environmental education for gifted and talented students according to their characteristics and contribute to revealing different solution proposals of these students concerning the environmental problems.

The aim of the study is to determine the thoughts and solution proposals of gifted and talented students on environmental problems. For this purpose, answers were sought for the following sub-problems:

Sub-Problems

1. What are the thoughts of gifted and talented students about the environmental problems?

2. What are the thoughts of the gifted and talented students about today's most important environmental problems and their causes?

3. What are the solution proposals of gifted and talented students for the environmental problems?

4. What are the thoughts of the gifted and talented students about the future environmental problems?

5. What is the possibility of the gifted and talented students to consider working on environmental issues in the future?

METHOD

The qualitative research method was used in the study (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2011). "Environmental Problems Semi-Structured Interview Form", which was developed by the researchers, was used as the data collection tool.

Study Group

The study group was determined according to the convenience sampling method within a Science and Art Center (SAC) in Marmara Region in the fall semester of the 2015-2016 education year. Convenience sampling method is a sampling method that is widely used among the qualitative research studies (Yıldırım and Şimşek, 2011). The study group was comprised of 19 gifted and talented students who were attending 7th to 10th grades in their formal education. Identification of these students as "gifted and talented individuals" was concluded through the general ability and intelligence tests conducted by the experts of Ministry of National Education. Semi-structured interviews were conducted with these students. The interviews were implemented on a voluntary basis. Necessary permissions were gained from the relevant institutions. The information concerning the study group is given in Table 1.

Table 1. Descriptive statistic values of the students in terms of gender and grade variables

Variable		7th grade	8th grade	9th grade	10th grade	Total
				N		
Gender	Female	1	1	1	-	3
	Male	4	3	6	3	16
	Total	5	4	7	3	19

In our country, the education of the gifted and talented students is provided in the SACs which are functioning under the Ministry of National Education (MNE). In general, during their spare times after the formal education hours and weekends, students participate in certain science and art activities such as harmony, support, recognizing individual skills, developing special skills, and project production, respectively (MNE SAC Directive / BILSEM Yönergesi, 2007).

Data Collection Tool

The data of the study were collected through the "Environmental Problems Semi-Structured Interview Form" that was prepared by the researcher. In preparation of this form, initially, necessary literature review was conducted. The questions of the form were decided in line with the objectives of the research. The views of scholars were obtained in order to determine the content validity of the interview form, its compliance to the language and to the field. Necessary changes were made on the questions in line with the views of two scholars from the environmental education and biology education field and a teacher from the Turkish Language and Literature field. The pilot test of the interview form was conducted on 2 students and the views of students were asked about the clarity and understandability of the questions. The interview form was comprised of seven questions investigating the thoughts and proposals of students about environment problem, current environmental problems, the reasons and solutions of these problems, future environmental problems that humanity will face, etc. The interviews were recorded with a recorder after gaining the consents of the participants. Each interview lasted about 20 minutes.

Data Analysis

The sound recordings of the interviews were transcribed by the researcher. These qualitative data were analyzed through content and descriptive analysis techniques (Yıldırım and Şimşek, 2011). During the content analysis, the data were coded and organized as themes and sub-themes. The coding of the data was separately conducted by the researcher and a doctoral student, who was experienced in content analysis. Using the data obtained from the both coders, the reliability of the study was calculated through the agreement formula of Miles and Huberman (2002). In an attempt to reach a consensus, the coders re-evaluated the points of dissensus. It was determined that the agreement level

of the coders was 90%, which was enough for the reliability (Miles and Huberman, 2002). The multiple answers of the participants for each question were taken into consideration. Therefore, the frequencies of the answers of the participants can sometimes be more than the number of the participants. Additionally, the views of the participants were stated in the findings section, indicating the number of the participant, like (K_1) (Yıldırım & Şimşek, 2011).

RESULTS

The views of the gifted and talented students concerning the environmental problems and their solution proposals are presented in this section. The views of the gifted and talented students concerning the environmental problems are given in Table 2.

Table 2. The views of the gifted and talented students concerning the environmental problems

Theme	Code	f
Environmental problem	Impairment of functioning of nature	7
	Impairment of the harmony of the elements comprising the environment	4
	Contamination of the nature through wastes and garbage	4
	Anything irritating	2
	Misuse of environment	1
	Unplanned construction	1

According to Table 2, concerning the environmental problem concept, the gifted and talented students mainly explained their views as 'Impairment of functioning of nature' (7), 'Impairment of the harmony of the elements comprising the environment' (4), 'Contamination of the nature through wastes and garbage' (4). The example statements concerning the findings are as follows:

K_{15}: *Environmental problem is the impairment of the harmony of the elements comprising the environment.*
K_3: *Environmental problem is destroying the nature through wastes by human beings.*
K_{19}: *Environmental problem is any problem that impedes or disrupts the continuation of the natural process around us.*

The views of the gifted and talented students concerning the environmental problems of today and future are presented in Table 3.

Table 3. Theme and sub-theme distribution of views of the gifted and talented students concerning the environmental problems of today and future

	Sub-theme	Codes	Today	Future
Environmental problem	Human induced	Noise pollution	4	1
		Light pollution	3	-
		Oil spill	3	-
		Traffic problem	3	-
		Deforestation	2	-
		Unplanned construction	2	-
		Genetically modified products	1	1
		Loss of agricultural lands	1	1
		Wastes	1	-
		Overhunting	1	-
		Rapid population growth	-	1
	Industrial and human induced	Air pollution	10	3
		Global warming / Climate change	10	8
		Water pollution	8	13
		Disruption of ecological balance	8	2

ISSN: 2146 - 9466
www.ijtase.net
International Journal of New Trends in Arts, Sports &Science Education   *2022, volume 1, issue 4*

		Soil pollution	8	1
		Nuclear contamination / radiation	7	4
		Depletion of the ozone layer	3	3
		Biodiversity loss	2	3
		Environmental pollution	1	-
		Acid rains	1	1
		Electronic pollution	-	1
		Cancer-causing environmental pollution	-	1
	Natural and human induced	Famine	-	2
		Erosion	1	-
		Volcanic eruptions	-	1
Other		Wars	1	2
		Lack of education	1	-
		Miscommunication	1	-

According to Table 3, the views of gifted and talented students concerning the most important environmental problems were organized under two themes as 'Environmental problems' and 'Others'. The theme 'Environmental problems' was organized under three sub-themes as 'human induced', 'industrial and human induced', and 'natural and human induced'.

Under the 'human induced' sub-theme, students perceived 'noise pollution (today: 4; future: 1)', 'genetically modified products (1;1)', and 'loss of agricultural lands (1;1)' as the most important environmental problems of both today and future. As per the 'Industrial and human induced environmental problems' sub-theme, students perceived 'Global warming/Climate change (10;8)', 'Air pollution (10;3)', 'Water pollution (8;13)', 'Soil pollution (8;1)', 'Disruption of ecological balance (8;2)', 'Nuclear contamination/radiation (7;4)', and 'Biodiversity loss (2;3)' as the most important environmental problems of both today and future. Under the 'Natural and human induced' sub-theme, students mentioned that 'Famine (2)' will be the environmental problem of the future. As per the 'Others' sub-theme, students mentioned that 'Wars (1; 2)' will be among the important problems of both today and future. Students mentioned that 'Rapid population growth (1)', 'Cancer-causing environmental pollution (1)', 'Electronic pollution (1)', and 'Volcanic eruptions (1)' will be among the most important environmental problems of the future. Exemplary statements within the findings are as follows:

K_4: *Among the important environmental problems of today are unplanned urbanization, global warming, air and water pollution.*
K_{11}: *Traffic problem, destroying the nature, and climate change are among the important environmental problems.*
K_2: *Depletion of the ozone layer, animal extinction, and cutting trees…*
K_8: *Electronic pollution will emerge in the future. Because there is no recycling for electronic devices such as telephones and computers.*
K_6: *In the future, global warming will take place and the climates will change.*
K_{14}: *In the future, water shortage and decreasing potable waters will be a problem. Because the drinking waters are being contaminated by the acid rains.*

The views of gifted and talented students concerning the causes of today's environmental problems are presented in Table 4.

Table 4. Theme and sub-theme distribution of views of the gifted and talented students concerning the causes of today's environmental problems

Theme	Sub-theme	Codes	f
Environmental problem	Pollutant factors	Dumping garbage and waste materials into soil and water	15
		Toxic gasses and wastes emitted from factories	8

ISSN: 2146 - 9466
www.ijtase.net
International Journal of New Trends in Arts, Sports &Science Education   *2022, volume 1, issue 4*

		Exhaust fumes of vehicles	7
		Radioactive leaks and waste	6
		Nuclear power plants	3
		Chemical weapons	2
		Unnecessary lighting	2
		Oil spill	2
		Radiation emitted by technological devices like computers and phones	1
		Tobacco smoke	1
	Lack of education and conscience	Lack of respect for the environment	3
		Unconscious water pollution	2
		Unconscious use of pesticides and artificial fertilizers	2
		Lack of education	2
		Unconscious attitudes of people towards environment	1
		Carelessness of people	1
	Misuse	Use of petroleum products as fuel	4
		Traffic congestion	2
		Excessive use of nature resources for energy needs	1
		Unplanned urbanization	1
		Insufficient use of public transport	1
Ecological balance	Biodiversity loss	Unplanned construction	4
		Unconscious fishing and overfishing	3
		Insufficient knowledge about the importance of living things for the nature	1
	Erosion	Insufficient reforestation	1
		Lack of education in farmers for soil processing	1
	Depletion of ozone layer	Unconscious use of hazardous gasses	3
		Excessive sunrays	1
	Global warming	Release of greenhouse gases through human activities	5
		Depletion of the ozone layer	2
		Contamination of air due to excessive use of oil-induced fuels	2
		Using nature unlimitedly for energy requirements	1
		Non-recyclable waste	1
	Genetically Modified products	Yielding more from plants and animals	1
Residence	Unplanned construction	Insufficient urban planning	1
		Building constructions in agricultural areas	1
		Destruction of green spaces	1
		Excessive population growth	1
	Traffic problem	Excessive population growth of cities	2
		Excessive increase in the number of private vehicles	1

According to Table 4, under the 'Pollutant factors' sub-theme of the 'Environmental pollution' theme, the views of the gifted and talented students concerning the causes of today's environmental problems were 'Dumping garbage and waste materials into the soil and water' (15), 'Toxic gases and wastes emitted from factories' (8), 'Exhaust fumes of vehicles' (7), and 'Radioactive leaks and wastes' (6). In the sub-theme of 'Lack of education and consciousness', students expressed their views as 'Lack of

respect for the environment' (3), 'Unconscious water consumption' (2) and 'Unconscious use of pesticides and artificial fertilizers' (2). Under the sub-theme of 'misuse', students expressed their views as 'Use of petroleum products as fuel' (4) and 'Traffic congestion' (2).

Under the 'Biodiversity loss' sub-theme of the 'Ecological balance' theme, students expressed their views as 'Unplanned construction' (4) and 'Unconscious fishing and overfishing' (3) as the results of the biodiversity loss. In the sub-theme of 'global warming', students expressed their thoughts as 'The release of greenhouse gases due to human activities' (5) and 'Polluting the air with overuse of oil-derived fuels' (2). In addition, students stated that 'Depletion of the ozone layer' (2) was one of the causes of global warming. These findings demonstrate the existence of misconceptions in students about the global warming.

Under the 'Unplanned construction' sub-theme of the 'Residence' theme, students stated their views as 'Insufficient urban planning' (1), 'Building constructions in agricultural areas' (1), and 'Destruction of green spaces' (1) as the causes of the environmental problems. The example statements concerning the findings are as follows:

> K_3: *The cause of the air pollution is the exhaust being emitted from the factory chimneys and cars.*
> K_1: *Loss of agricultural lands and deforestation, the bridges were constructed in the forests in our town, over-construction…*
> K_6: *Nuclear contamination, insecure nuclear power plants to be built in our country.*
> K_8: *Unplanned urbanization and water pollution are caused from continuous increasing of the city population and factory wastes being dumped to the seas without treatment.*

The solution proposals of the gifted and talented students concerning today's environmental problems are presented in Table 5.

Table 5. Theme and sub-theme distribution of solution proposals of the gifted and talented students concerning today's environmental problems

Theme	Sub Theme	Code	f
Environmental problems	Treatment and recycle	Installing filters to factory chimneys, vehicle exhausts, etc.	6
		Recycling of waste must be ensured	5
		Factory waste and other kinds of waste should be treated	4
		New filters and treatment systems should be developed	2
		Nuclear waste must be stored and disposed of under appropriate conditions	2
	Alternative implementations	Renewable fuel sources should be used instead of petroleum products	8
		Alternative energy sources should be used instead of nuclear energy	4
		City planning should be done more carefully	4
		Public transport should be encouraged	3
		Trees must be protected	2
		Natural fertilizer should be used instead of artificial fertilizer	1
		Cycling should be encouraged	1

	Agricultural engineers should be assigned in the relevant regions	1
	Developments in industrialization should prioritize conservation of nature	1
	Biological fight should be started against agricultural pests	1
	Sound-baffles should be placed on the roadsides	1
Legislation and sanctions	Regulations should be revised and controls should be increased	9
	Population should be restricted and planned in the cities	3
	Migration to major cities must be prevented	2
	Greedy destruction of nature by human must be prevented	1
	Overfishing must be prevented	1
Education and consciousness-raising	Environmental education should be given and a certain level of awareness should be raised	15
	People should be made aware of energy consumption	3
	Non-governmental organizations should be supported	2
	Unconscious and excessive lighting should be reduced	2
	Generations should be raised with love of nature	1
Negative opinions	It cannot be solved or pollution cannot be eradicated	2

According to Table 5, the solution proposals of the gifted and talented students concerning today's environmental problems were organized under the themes of 'Environmental problems' and 'Negative opinions'. 'Environmental problems' theme were categorized under the sub-themes of 'Treatment and recycling', 'Alternative implementations', 'Legislation and sanctions', and 'Education and consciousness-raising'.

Under the treatment and recycling sub-theme, students stated their views as 'Installing filters to factory chimneys, vehicle exhausts, etc.' (6), 'Recycling of waste must be ensured' (5), 'Factory waste and other kinds of waste should be treated' (4), and 'New filters and treatment systems should be developed' (2). Under the 'Alternative implementations' sub-theme, they mentioned their suggestions as 'Renewable fuel sources should be used instead of petroleum products' (8), and 'Alternative energy sources should be used instead of nuclear energy' (4).

Under the 'Legislation and sanctions' sub-theme, they mentioned their suggestions as 'Regulations should be revised and controls should be increased' (9), and 'Population should be restricted and planned in the cities' (3). As per the 'Education and consciousness-raising' sub-theme, they stated their views as 'Environmental education should be given and a certain level of awareness should be raised' (15), and 'People should be made aware of energy consumption' (3). Under the 'Negative opinions' sub-theme, some students stated the view 'It cannot be solved or pollution cannot be eradicated' (2). The example statements concerning the findings are as follows:

K_{18}: *Air pollution can be solved through alternative fuel sources and using filters in the chimneys.*
K_{10}: *In order to prevent soil pollution, natural fertilizers can be used instead of artificial ones.*
K_9: *Noise pollution and traffic problem can be solved through the use of public transportation.*
K_5: *In order to prevent biodiversity loss, hunting should be forbidden. Significance of living beings should be taught to the people.*

The views of the gifted and talented students concerning their future interests in studying environmental problems are presented in Table 6.

Table 6. The distribution of views of the gifted and talented students concerning their future interests in studying environmental problems

Interest in studying	f	Study field	f
I want	11	I can join/support non-governmental organizations (NGOs) founded for environmental issues.	4
		I can study on environmental law.	2
		I'm going to be a journalist writing on environmental issues.	1
		I want to be useful to people about environmental issues.	1
		I want to be an electrical engineer and work on natural energy sources.	1
		I'm going to study on organic chemistry, I can work on solving water pollution in this field.	1
		I want to work on soil pollution in the future.	1
		I'm going to be an aircraft engineer. I can build planes that don't harm the environment.	1
I don't want	8	No reason	4
		I did not think of studying in these fields.	3
		I am not interested in these fields.	1

According to Table 6, the views of the gifted and talented students concerning their future interests in studying environmental problems were organized under two themes as 'I want' (11) and 'I don't want' (8). Under the 'I want' theme, the students mentioned their views as 'I can join/support non-governmental organizations (NGOs) founded for environmental issues' (4), 'I can study on environmental law' (2), 'I'm going to be a journalist writing on environmental issues' (1), and 'I want to be useful to people about environmental issues' (1). Under the 'I don't want' theme, the students mentioned their views as 'I did not think of studying in these fields' (3), and 'I am not interested in these fields' (1). Examples of the statements in the findings are as follows:

K_{15}: *I will study journalism of law in the future. I can be the statutory advisor of the NGOs functioning in environment field.*
K_4: *I am thinking of being an aircraft engineer. I am planning to produce planes that do not have any threat for the environment.*
K_3: *I will be an electrical engineer, and I am thinking of studying on natural energy resources.*

DISCUSSION and CONCLUSIONS

The aim of the research is to determine the views of gifted and talented students about environmental problems and their solution proposals for these problems. In the results of the research, it was determined that the views of the gifted and talented students concerning the concept of environmental problems were often in line with the functioning of nature, the impairment of the harmony between the elements comprising the environment, and the pollution of nature with waste or garbage. It was also determined that the students explained the environmental problems as the deterioration of the natural functioning and harmony of the living and non-living elements comprising the environment. These results coincide with the explanation of environmental problems defined in the literature as arising from the change of the elements comprising the environment and a change in its functioning, or deterioration of its structure due to negative factors (Torunoğlu, 2013; Yüksel 2009). This conclusion was interpreted as that the majority of students had accurate views about the environmental problem. It was also determined that many students perceived the concept of environmental problems by associating them with environmental pollution. These results were also interpreted as that students perceived environmental problems as environmental pollution in general. In this respect, the environmental education activities of the gifted and talented students can involve certain subjects such as the elements that comprise the environment, and the interaction, functioning, and ecological balance between these elements. In addition, environmental problems other than the environmental pollution can be emphasized more in these trainings. Environmental education can be

enriched by using different teaching methods and techniques such as non-class activities, project studies, and problem-based learning for environmental problems.

As the conclusion of the research, it was determined that the gifted and talented students mostly emphasized air pollution, global warming, water pollution, disruption of ecological balance, soil pollution, nuclear contamination/radiation contamination as the environmental problems of today. However, it was determined that students less emphasized environmental problems such as biodiversity loss/extinction, acid rains, loss of agricultural areas and deforestation, unplanned construction, genetically modified products, and overfishing. Similar to the results of studies conducted on normally developing peers of gifted and talented students in the field, the results of this research are in parallel with those of previous studies, in which the participants emphasized air, water, and soil pollution as the environmental problems (Alerby, 2000; Barraza, 2001, Genç, Genç, Ergenç & Erkuz, 2016; Doğan, Saraç, & Çiçek, 2017; Duan & Fortner, 2005). It was also determined that gifted and talented students emphasized some global environmental problems such as nuclear pollution/radiation problems and global warming. According to this conclusion, it was considered that students were aware of the environmental issues discussed by the society. However, it was determined that the gifted and talented students did not adequately emphasize environmental problems such as biodiversity loss/extinction, acid rains, loss of agricultural areas and deforestation, unplanned construction, genetically modified products, etc. This result demonstrated that gifted and talented students were less aware of the mentioned environmental problems (Nacaroğlu & Bozdağ, 2020). This can be due to the insufficient environmental education in their formal education. Because routine environmental education approaches that do not take into account the characteristics of gifted and talented students do not adequately meet the needs of gifted and talented students (Şahin and Levent, 2015). For this reason, a learning environment can be established where the gifted and talented students can conduct research in the field of environment, think about environmental problems, and discuss their solutions. The subjects of the environmental education can be preferred from among the issues about which students have low levels of awareness.

In the research results, gifted and talented students mentioned that, in the future, mostly the environmental problems such as water pollution, global warming/climate change, and nuclear contamination/radiation contamination will occur. It was determined that water pollution was the most frequently emphasized environmental problem by the students to occur in the future. Additionally, students stated rapid population growth, cancer-causing environmental pollution, electronic pollution, famine, and volcanic eruptions as the important environmental problems of the future. In the literature, it was stated that gifted and talented individuals demonstrate a better performance compared to their peers in terms of creativity, analytical thinking, advanced imagination, etc. (Ataman, 2009; Gubbins et al., 2014; Stenberg, 1986, 1999; Yıldırım Doğru, 2013). The predictions of these students arising from the abovementioned characteristics are considered important. At this point, environmental problems that will affect the environment more in the future such as water pollution, global warming, cancer-causing environmental pollution, electronic pollution, and famine can be addressed in environmental education activities. Projects can be conducted in terms of determining the causes and solutions to these problems. An environment without these problems can be modeled. In this way, the awareness levels of the gifted and talented individuals can be increased in solving future environmental problems.

The research results demonstrated that the gifted and talented students emphasized environmental problems such as miscommunication and lack of education. It was also determined that students stated 'everything disturbing' as an environmental problem, in their perception of environmental problem. These stated ideas were in line with the environmental problems and description reported in Erduran, Avcı, Demirekin, Hare, Özlü & Özkan (2013), Doğan & Simsar (2018), and Özcan & Demirel (2019). Students mentioned the depletion of the ozone layer as one of the causes of the global warming problem. This result was interpreted as that some gifted and talented students have misconceptions about environmental problems. The results of this study is in parallel with the previous studies in the literature emphasizing that normally developing peers of the gifted and talented students have misconceptions about the environmental problems (Boyes, Chambers, & Stanisstreet, 1995; Doğan et

al., 2017; Emli & Afacan, 2017; Khalid, 2003; Kocabaşoğlu & Şahin, 2021; Mutlu & Nacaroğlu, 2019; Rye, Rubba & Wiesenmayer, 1997; Özcan & Demirel, 2019; Wals 1992). According to these results, it was notable that the misconceptions of the gifted and talented students were similar to their normally developing peers. This result may be due to inadequacy of formal education concerning environmental education. Therefore, different teaching methods and techniques such as non-class activities, projects, and problem-based learning method can be included in environmental education in order to eliminate misconceptions. The works and conferences of experts or well-known environmentalists can be followed.

Research results demonstrate that the gifted and talented students mainly emphasized certain factors causing environmental pollution such as dumping waste materials and garbage into soil and water, factory wastes and toxic gases emitted from their chimneys, and exhaust smoke of vehicles. In addition, students particularly emphasized factors such as fossil fuels, lack of public transportation, and unplanned construction. These results are consistent with the results of previous research studies conducted by Genç et al., (2016), Nacaroğlu and Bozdağ (2020) and Doğan et al., (2017) concluding that the factory smoke, liquid waste of factories, and the cutting trees caused environmental pollution. In order to solve these problems, the gifted and talented students proposed filtering factory chimneys and exhausts, and purifying or recycling polluting wastes such as factory and household waste. In addition, students proposed encouraging community to use bicycles and public transport, and suggested using renewable fuel sources instead of fossil fuels. The gifted and talented students addressed the greenhouse gases and overuse of fossil fuels as the main cause of global warming. Based on this result, it was considered that students had a certain level of awareness about global warming. However, it can be accepted as a negativity that some students had misconceptions about global warming. Therefore, in environmental education, the subjects that students' have misconceptions can be particularly emphasized.

Among the factors that pollute the environment, radioactive leaks and waste, nuclear power plants, chemical weapons, and the radiation emitted from technological devices such as computers and telephones have an important place in the minds of the gifted and talented students. As a solution for these problems, students proposed storing or disposal of the nuclear waste under appropriate conditions and using alternative energy sources instead of nuclear energy. It is thought that the gifted and talented students are highly sensitive about radiation/nuclear pollution. It is considered that recent debates concerning nuclear power plant accidents and the safety of newly built plants in our country and around the world have raised awareness among students. Including subjects about radiation/nuclear contamination in environmental education activities can positively affect the interest, curiosity, and motivation levels of students.

In the research results, the students stated that lack of education and unconsciousness are among the most important causes of environmental problems. Students often proposed educating and raising awareness of individuals to solve environmental problems. According to these results, it was determined that students considered deficiencies in environmental education as one of the most important causes of environmental problems. At this point, projects can be developed or discussion environments can be created with gifted and talented students about the content of environmental education for the individuals in our country.

According to the research results, it was determined that only one student emphasized the issue of genetically modified organisms (GMO) that can be considered among environmental problems, and the motive behind this was determined as the intention of people to yield more from plants and animals. In the literature, it was stated that GMO products have some possible negative effects on the environment and nutrients (Hail, 2000; Losey, Rayor and Carter, 1999; Gianessi, Silvers, Sankula and Carpenter, 2002). Based on these results, it is thought that gifted and talented students do not have a sufficient level of awareness concerning the potential damage of GMOs to the environment and human health and about the fact that it is an environmental problem. This can be caused by a lack of knowledge in students concerning biotechnology and GMO (Demir & Düzleyen, 2012; Leslie &

Schibeci, 2003). Therefore, in order to raise awareness, the GMO knowledge levels of the gifted and talented students can be increased by enriched activities in biology and science courses. In this context, biotechnology laboratories of universities and research centers can be visited.

In the research results, it was determined that, as a solution for the environmental problems, the gifted and talented students proposed developing new filter and treatment systems, implementation of biological control of agricultural pests, prioritization of protecting nature in industrial developments, and use of natural fertilizer instead of artificial fertilizer. According to these results, it is noteworthy that different proposals for solving environmental problems are limited to only a few students. However, it was stated that the gifted and talented students strive to develop solutions to problems concerning humanity and nature (Piechowski, 1997; Sak, 2012; Stuart & Beste, 2011; Şahin, 2015). Moreover, it was reported that gifted and talented individuals perform at a higher level than their peers in terms of creativity, productivity, advanced imagination, analytical thinking, etc. (Ataman, 2009; Gubbins et al., 2014). In this respect, the presence of gifted and talented individuals may be an opportunity for new solutions to environmental protection and environmental problems, and creative solutions can be expected from them. However, Esen (2011) demonstrated that gifted and talented students were able to develop solutions to environmental problems, but they were not creative ideas. It is thought that these results are due to the lack of environmental education given to students both in formal education and the in the education of the SAC. Environmental education approaches that do not take into account the characteristics of these students do not adequately meet the needs of gifted and talented students (Şahin & Levent, 2015). Therefore, environmental education to be given to students can be rearranged in accordance with their requirements.

Based on the research results, students stated that regulations should be revised and inspections should be increased in solving environmental problems. In addition, as a solution to the problems arising from the growing population, the students proposed imposing population restrictions on the cities and preventing migration to the major cities. These results are in parallel with those of the Yalçınkaya (2013), and Yılmaz, Morgil, Aktuğ, and Göbekli (2002) reporting that students proposed imposing severe penalties against polluters and adoption of relevant regulations. However, the most effective way of solving environmental problems is to raise the awareness of people concerning the environment (Yalçınkaya, 2013). In line with these results, certain activities can be planned in cooperation with different disciplines such as sociology, geography, and law, brainstorming activities can be implemented and a discussion environment can be created to decide what methods can be more effective in environmental education of the gifted and talented students for solving and preventing environmental problems, what regulations should be adopted to protect the environment particular to our country, and how to plan the population growth of cities.

In the results of the research, the majority of the gifted and talented students stated that they would be involved or provide support for efforts to solve environmental problems in their future lives. Although these students do not think of having a profession that is directly related to environment or environmental problems, they have stated that they will contribute to solving environmental problems. For example, it is a hopeful development that a student to prefer law as a profession in the future mentions that he/she could work on environmental law, and another student planning to be an electrical engineer is considering working on natural energy sources. However, it is also remarkable that a significant number of students stated that environmental issues are not interesting for them and they do not intend to work on these issues. In addition, it was determined that some students thought that air pollution is an unsolvable problem and that the littering problem cannot be solved. Although the gifted and talented students, who will play an important role in the protection of the environment and solving problems in the future, have a certain level of awareness, knowledge, and attitude towards environmental problems, this level should be increased considering their role in society. Therefore, a special emphasis should be placed on environmental education of gifted and talented students. Within the scope of environmental education and in order to see the environmental problems closely, visits can be made by students to the sites that experienced environmental problems. Conferences of experts or representatives of NGOs in the field of environmental issues can be followed.

Within the scope of the research results, the following recommendations can be made to educators and researchers; in order to increase the knowledge and awareness of the gifted and talented students about environmental problems, environmental education can be enriched in accordance with the characteristics of these students. Environmental problems can be discussed in environmental education of these students and creative thinking activities and discussion environments can be planned to solve environmental problems. In environmental education, students' misconceptions, awareness, and knowledge levels can be determined about environmental problems. Certain environmental issues in which students have low levels of awareness such as biodiversity loss, acid rains, and genetically modified products and certain subjects in which the students have misconceptions such as global warming can be addressed in activities. The emotions, opinions, perceptions, and interest levels of the students concerning environmental problems can be determined and activities can be organized to develop them. In this context, certain activities for the students can be organized such as nature trips, industrial area excursions, monitoring recycling and treatment studies, and observation visits to environments where environmental problems exist. The students can participate in activities of representatives of non-governmental organizations, experts, and academicians who are active in the prevention and solution of environmental problems.

This research study has certain limitations concerning the size of the study group, determining the size of the study group, and using the qualitative research method. Therefore, researchers of further studies can include larger study groups using quantitative data collection tools in addition to the qualitative data collection tools. Moreover, in further studies, as a solution to the environmental problems, a comparison can be made between the ideas of gifted and talented students and normally developing students concerning the environmental problems in terms of certain variables such as opinions, interest levels, and perceptions.

Ethics

As the author of this study, I declare that we collected data in accordance with ethical rules during the research process and acted in accordance with all ethical rules.

REFERENCES

Alerby, E. (2000). A way of visualising children's and young people's thoughts about the environment: A study of drawings. *Environmental Education Research*, *6*(3), 205-222. doi:10.1080/13504620050076713.

Ataman, A. (2009). *Special needs children and introduction of special education. Gifted and talented children*. Ankara: Gündüz Education and Publishing.

Aydın, F., Coşkun, M., Kaya, H., & Erdönmez, İ. (2011). Gifted students' attitudes towards environment: A case study from turkey. *African Journal of Agricultural Research*, 6(7), 1876-1883.

Barraza, L. (2001). Perception of social and environmental problems by English and Mexican school children. *Canadian Journal of Environmental Education*, *6*(1), 139-157.

Boyes, E., Chambers, M., & Stanisstreet, M. (1995). Trainee primary teachers' ideas about the ozone layer, *Environmental Education Research*, 1(2), 133-145. doi:10.1080/1350462950010201.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2010). *Bilimsel araştırma yöntemleri [Scientific research methods]*. Ankara: Pegem Akademi.

Clark, B. (1997). Social ideologies and gifted education in today's schools. *Peabody Journal of Education*, *72*(3-4), 81-100. doi:10.1207/s15327930pje7203&4_5.

Cullingford, C. (1996). *Children's attitudes to the environment*. C. Black Well & G. I. Harris (Eds.), Environmental issues in education. Aldershot, VT: Ashgate.

Çetiner, S. (2010). Genetiği değiştirilmiş organizma (GDO) nedir? Sorular ve yanıtlar-2. [What is genetically modified organism (GMO)? Questions and answers]. *Uluslararası Ekonomik Sorunlar Dergisi (Journal of International Economic Issues)*, 10(39), 13-26.

Demir, B., & Düzleyen, E. (2012). İlköğretim 8. sınıf öğrencilerinin GDO bilgi düzeylerinin incelenmesi [Investigation of GMO knowledge levels of primary 8th grade students], X. *Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, Niğde*.

Doğan, Y., Saraç, E. & Çiçek, Ö. (2017). Ortaokul öğrencilerinin çevre sorunları, nedenleri ve çözümlerine yönelik algıları [Perceptions of mıddle school students about environmental problems, and their causes and solutions]. *International Journal of Eurasia Social Sciences,* 8(29), 787-804.

Dogan, Y., & Simsar, A. (2018). Preschool teachers' views on science education, the methods they use, science activities, and the problems they face. *International Journal of Progressive Education*, 14(5), 57-76. doi: 10.29329/ijpe.2018.157.6.

Duan, H., & Fortner, R. W. (2005). Chinese college students' perceptions about global versus local environmental issues. *The Journal of Environmental Education*, 36(4), 23-58. doi: 10.3200/JOEE.36.4.23-58.

Emli, Z., & Afacan, Ö. (2017). Yedinci sınıf öğrencilerinin küresel ısınma konusundaki zihinsel modelleri [The Mental models of secondary school 7th class students about global warming]. *Hasan Ali Yücel Eğitim Fakültesi Dergisi (Journal of Hasan Ali Yücel Faculty of Education)*, 14(1), 183-202.

Erduran Avcı, D., Demirekin, M., Hare, O., Özlü, S., & Özkan, İ. (2013). 8. Sınıf öğrencilerinin çevre sorunları algısının farklı tekniklerle incelenmesi [8th grade student's perception of environmental problems by different techniques]. *Fen Bilimleri Öğretimi Dergisi*, 1(2), 50-66.

Esen, T. (2011). *Üstün yetenekli öğrencilerin çevreye yönelik bilgi ve tutumlarının incelenmesi* [*A research study on gifted student's knowledge and attitudes towards environment*], Master's thesis, Adıyaman Üniversitesi Fen Bilimleri Enstitüsü, Adıyaman.

Genç, M., Genç, T., Ergenc, M., & Erkuz, N. (2016). Environmental problem perception of 6th grade students. *Online Submission*, 6(1), 14-24. doi:10.18844/wjer.v6i1.139.

Gianessi, L. P., Silvers, C. S., Sankula, S., & Carpenter, J. (2002). *Plant biotechnology: Current and potential impact for improving pest management in U.S. agriculture, an analysis of 40 case studies.* Washington, D.C.: National Center for Food and Agricultural Policy.

Gubbins, E. J., Callahan, C. M., & Renzulli, J. S. (2014). Contributions to the impact of the javits act by the national research center on the gifted and the talented. *Journal of Advanced Academics*, 25(4), 422-444. doi:10.1177/1932202X14549355.

Hail, R.S. (2000). Genetically modified plants-The debate continues. *Trend in Ecology and Evolution*, 15 (1), 14-8. doi:10.1016/S0169-5347(99)01751-6.

Harris, F. (2012). *Global environmental issues* (2nd Ed.). Chichester, UK: Wiley-Blackwell.

Huberman, M., & Miles, M. B. (2002). *The qualitative researcher's companion*. California: Sage. doi:10.4135/9781412986274.

Karakaya, F., Ünal, A., Çimen, O., & Yılmaz, M. (2018). Fen bilimleri öğretmenlerinin STEM yaklaşımına yönelik farkındalıkları [STEM awareness levels of science teachers]. *Eğitim ve Toplum Araştırmaları Dergisi (Journal of Research in Education and Society),* 5(1), 124-138.

Khalid, T. (2003). Pre-service high school teachers' perceptions of three environmental phenomena. *Environmental Education Research*, 9(1), 35-50. doi: 10.1080/13504620303466.

Khan, D. (2018). Sustainable learning a new paradigm in environmental education: A study to facilitate awareness among the school children in some selected schools in Nadia district, West Bengal, India. *International Research Journal of Multidisciplinary studies, 4*(3), 1-5. ISSN: 2454-8499.

Kocabaşoğlu, B., & Şahin, E. (2021). Investigation of gifted students' cognitive structures on the concept of innovation. *Journal of Turkish Science Education*, 18(4), 649-673.

Leslie G., & Schibeci, R. (2003). What do science teachers think biotechnology is? Does it matter ? *Australian Science Teachers' Journal*. 49(3), 16–21.

Li, Y. (2018). Study of the effect of environmental education on environmental awareness and environmental attitude based on environmental protection law of the people's republic of China. *Eurasia Journal of Mathematics,Science and Technology Education*, 14(6), 2277-2285. doi:10.29333/ejmste/86214.

Losey, J. E., Rayor, L. S., & Carter, M. E. (1999). Transgenic pollen harms monarch larvae. *Nature*, 399(673), 214. doi:10.1038/20338.

Lovecky, D. V. (1993). *The quest for meaning: Counseling issues with gifted children and adolescents.* L. K. Silverman (Ed.), Counseling the gifted and talented. Denver Colorado: Love Publishing.

Marinopoulos, D.,& Stavridou, H. (2002). The influence of a collaborative learning environment on primary students' conceptions about acid rain, *Journal of Biological Education,* 37(1), 18-25. doi:10.1080/00219266.2002.9655841.

Mutlu, F., & Nacaroğlu, O. (2019). Examination of perceptions of gifted students about climate change and global warming. *Journal of Baltic Science Education*, 18(5), 780-792. doi: 10.33225/jbse/19.18.780.

Nacaroğlu, O., & Bozdağ, T. (2020). Özel yetenekli öğrencilerin çevre sorunlarına yönelik algılarının kelime ilişkilendirme testi kullanılarak incelenmesi [An Investigation into the Perceptions of Gifted Students on Environmental Problems by Using Word Association Test]. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, 40(2), 385-409.

Pınar, E., & Yakışan, M. (2017). İlkokul öğrencilerinin çevre kavramları ile ilgili çizimlerinin analizi [Analyze of the drawings on environmental concepts of the primary school students]. *Trakya Üniversitesi Eğitim Fakültesi Dergisi (Trakya University Journal of Education Faculty)*, 8(1), 97-113. doi: 10.24315/trkefd.366693.

Piechowski, M. M. (1997). *Emotional giftedness: The measure of intrapersonal intelligence*, N. Colangelo & G. A. Davis (Eds.) Handbook of gifted education (2nd ed.), Boston: Allyn & Bacon.

Roczen, N., Kaiser, F.G., Bogner, F.X., &Wilson, M., (2014). A competence model for environmental education. *Environment and Behavior,* 46, 972–992. doi:10.1177/0013916513492416.

Rye, J. A., Rubba, P. A., & Wiesenmayer, R. A. (1997). An investigation of middle school students' alternative conceptions about global warming, *International Journal of Science Education.* 19(5), 527-551. doi:10.1080/0950069970190503.

Önal, N. T. (2020). Investigation of gifted students' environmental awareness. *International Journal of Curriculum and Instruction*, *12*(2), 95-107.

Özarslan, M., G. Çetin, & Yıldırım, O. (2017). Üstün zekâlı ve yetenekli öğrenci ailelerinin bilsem biyoloji proje çalışmaları hakkındaki görüşleri [Parental views of gifted and talented students about biology projects in science and art centre]. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi (Journal of Abant İzzet Baysal University Educational Faculty)*, 17(3), 1411-1436. doi: 10.17240/aibuefd.2017.17.31178-338838.

Özcan, H., & Demirel, R. (2019). Ortaokul öğrencilerinin çevre sorunlarına yönelik bilişsel yapılarının yaptıkları çizimler aracılığıyla incelenmesi [Exploring middle school students' cognitive structures about environmental problems through their drawings]. *Başkent University Journal of Education*, 6(1), 68-83. ISSN 2148-3272.

Sak, U. (2012). *Üstün zekalılar: Özellikleri, tanılanmaları, eğitimleri [The gifted: Characteristics, identifcation and education]*. Ankara: Maya Academy Publishing.

Silverman, L. K. (1993). Counseling the gifted & talented. Denver, Colorado: Love Publishing Company.

Silverman, L. K., & Ellsworth, B. (1981). *The theory of positive disintegration and its implications for giftedness. Theory of positive disintegration: Proceedings of the third international conference,* N. Duda (ed.), Miami, FL: Xerox.

Sontay, G., Gökdere, M., & Usta, E. (2014). A comparative investigation of environmental behaviors of gifted students and their peers. *Türk Üstün Zekâ ve Eğitim Dergisi (Turkish Journal of Giftedness and Education), 4(2), 90.* ISSN:2146-3832.

Stuart, T., & Beste, A. (2011). *Farklı olduğumu biliyordum: Üstün yeteneklileri anlayabilmek [Always knew I was different: Understanding the gifted]*. Ankara: Kök yayıncılık.

Şahin, F. (2015). *Üstün zekalı ve üstün yetenekli öğrencilerin eğitimi [Education of gifted and talented students]*. F. Şahin(ed.), Ankara: Pegem Akademi.

Şahin, F., & Levent, F. (2015). Examining the methods and strategies which classroom teachers use in the education of gifted students. *The Online Journal of New Horizons in Education*, 5(3), 73-82.

Şimşek, H., & Yıldırım, A. (2011). *Sosyal bilimlerde nitel araştırma yöntemleri [Qualitative research methods in the social sciences]*. Ankara: Seçkin Yayıncılık.

Tsekos, C. A., & Matthopoulos D. P. (2009). Ethics, science and the environment: The need for a new environmental worldview. *International Journal of Environmental Studies, 66*(6), 679-687. doi: 10.1080/00207230903028326.

Torunoğlu, E. (2013). *Çevre politikaları [Environmental policies]*, Eskişehir: Anadolu Üniversitesi Yayınları.

Ugulu, I. (2015). A quantitative investigation on recycling attitudes of gifted/talented students. *Biotechnology & Biotechnological equipment*, *29*(1), 20-26. doi:10.1080/13102818.2015.1047168.

Ugulu, I. (2013). Üstün zekalı/yetenekli öğrenciler ile normal gelişim gösteren öğrencilerin çevreye yönelik tutumlarının karşılaştırılması [A comparison of environmental attitudes between gifted and talented students and normaly devolopment students]. *Buca Eğitim Fakültesi Dergisi (The Journal of Buca Faculty of Education)*, 35, 1-14.

Valderrama-Hernández, R., Alcántara, L., & Limón, D. (2017). The complexity of environmental education: Teaching ideas and strategies from teachers. *Procedia - Social and Behavioral Sciences*, 237, 968-974. doi: 10.1016/j.sbspro.2017.02.137.

Wals, A. E. J. (1992). Young adolescents' perceptions of environmental issues: Implications for environmental education in urban settings. *Australian Journal of Environmental Education*, 8, 45-58. doi:10.1017/S081406260000330X.

Yalçınkaya, E. (2013). İlköğretim 8. sınıf öğrencilerine göre çevre sorunları: Nitel bir çalışma (Environmental issues to 8th grades elementary education students: A qualitative study). *Marmara Coğrafya Dergisi (Marmara Geographical Review),* 27, 416-439. ISSN:1303-2429.

Yavetz, B., Goldman, D., & Pe'er, S. (2014). How do preservice teachers perceive 'environment' and its relevance to their area of teaching? *Environmental Education Research, 20*(3), 354-371. doi:10.1080/13504622.2013.803038.

Yıldırım Doğru, S. S. (2013). *Erken çocukluk döneminde özel eğitim [Early childhood special education]* (3. Baskı). Ankara: Maya Akademi.

Yılmaz, A., Morgil, İ., Aktuğ, P., & Göbekli, İ. (2002). Ortaöğretim ve üniversite öğrencilerinin çevre, çevre kavramları ve sorunları konusundaki bilgileri ve öneriler [Knowledge of the secondary school and universıty students on the environment, environmental concepts and problems and suggestions]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi (H. U. Journal of Education)*, 2, 156-162.

Yüksel, Y. (2009). *Klasik okullar ile eko-okullar ve yeşil bayraklı eko-okulların çevre eğitimi açısından karşılaştırılması [Comparing ordinary schools, eco-schools and ecoschools rewarded with green flag in terms of their environmental education].* Unpublished Master Thesis. Gazi Üniversitesi, Ankara.

ÇEMBER BAŞARI TESTİ GEÇERLİK VE GÜVENİRLİK ARAŞTIRMASI[1]

INVESTIGATION OF THE VALIDITY AND RELIABILITY OF CIRCLE SUCCESS TEST

Tuğçe AYDIN
Dokuz Eylül Üniversitesi, Eğitim Bilimleri Enstitüsü, Buca-İzmir, Türkiye
ORCID: https://orcid.org/0000-0002-4078-6728
tugceeaydin95@gmail.com

Şerife FAYDAOĞLU
Doç.Dr., Dokuz Eylül Üniversitesi, Buca Eğitim Fakültesi, Buca-İzmir, Türkiye
ORDIC: https://orcid.org/0000-0002-9690-2409
serife.faydaoglu@deu.edu.tr

Öz

Bu çalışmada test geliştirme basamakları dikkate alınarak ortaokul altıncı sınıf öğrencilerinin çember konusundaki başarılarını ortaya koyan geçerli ve güvenilir bir başarı testi oluşturulması hedeflenmiştir. Çember Başarı Testi'nin kapsam geçerliğini sağlamak için önce madde havuzu oluşturulmuş, ardından uzman görüşleri alınarak belirtke tablosu hazırlanmış ve sorulara son şekli verilmiştir. Nicel araştırma yöntemlerinden tarama deseninin kullanıldığı çalışmada, 20 maddelik 'Çember Başarı Testi' İzmir ili Ödemiş ilçesinde dört devlet okulunda öğrenim gören 220 ortaokul yedinci sınıf öğrencisine uygulanmıştır. Geçerlik ve güvenirlik çalışması ile madde güçlük ve ayırt edicilik indeksleri belirlenerek testin madde analizi sonuçları sunulmuştur. Güvenirliği tahmin etmek için Kuder Richardson yaklaşımı kullanılmıştır. Veriler SPSS.23 programında ve T.A.P. da analiz edilmiş, güvenirlik katsayısı Kuder Richardson-20 (KR-20) (Alfa) 0,786 ve Kuder Richardson-21 (KR-21) 0,759 olarak bulunmuştur. Güvenirlik katsayısı 1.00 değerine ne kadar yaklaşırsa ölçeğin güvenirliğinin o kadar arttığını gösterir. Testin çarpıklık değeri 0.337, basıklık değeri -0.643 dir. Bu değerlerin düşük olması sapmanın önemsiz olduğunu ifade eder. Soruların güçlük indeks ortalaması 0,540 ve ayırt edicilik indeks ortalaması 0,486 elde edilmiştir. Bu sonuçlara göre geçerliği ve güvenirliği saptanan Çember Başarı Testinin bir ölçme aracı olarak yaralanılabileceği görülmektedir. Literatürde altıncı sınıf çember ve daire konusu ile ilgili geliştirilmiş başarı testi bulunmamaktadır. Bu nedenle geliştirilen testin okullarda ve araştırmalarda da kullanılmasına katkı sağlayacağı düşünülmektedir.

Anahtar Terimler: Çember, başarı testi, geçerlik, güvenirlik, test geliştirme.

Abstract

In this work, it was aimed to create a valid and reliable achievement test that reveals the success of the sixth grade students in the circle, taking into account the test development steps. First, an item pool was created, then a table of specifications was prepared by taking expert opinions to ensure the content validity of the Circle Achievement Test, and the questions were finalized. In the work the scanning design from the quantitative research methods was used and the 20-item 'Circle Achievement Test' was applied to 220 secondary school seventh grade students studying in four state secondary schools in Ödemiş, İzmir. With the validity and reliability study, item difficulty and discrimination indexes were determined and the results of the item analysis of the test were presented. The Kuder Richardson approach was used to estimate the reliability. The data were analyzed in the SPSS.23 program and T.A.P., and the reliability coefficient Kuder Richardson-20 (KR-20) (Alpha) was found 0.786 and Kuder Richardson-21 (KR-21) 0.759. The closer the reliability coefficient is to 1.00, the higher the reliability of the scale becomes. The skewness value of the test is 0.337, and the kurtosis value is -0.643. If these values are low, it means that the deviation is insignificant. The difficulty index average of the questions was 0.540 and the distinctiveness index average was 0.486. According to these results, it is seen that the Circle Achievement Test, whose validity and reliability has been determined, can be used as a measurement tool. In the literature, there are no improved

---

achievement tests on the 6th grade circle and circle. Therefore, it is thought that the developed test will make contribution to use in schools and research.

Keywords: Circle, achievementtest, validity, reliability, test development.

GİRİŞ

Bilim tarihinde matematiksel gelişme büyük bir öneme sahiptir. Matematik aynı zamanda şekillerle de ilgilenir. İnsanlık tarihi boyunca geometrik şekiller bir çok yerde görülmektedir. Matematik öğretiminde resim, fotoğraf ve grafik gibi şekillerin önemi yadsınamaz. Şekil bilgisi de denilen geometri matematik öğretiminde büyük bir role sahiptir. Matematik kavramların şekillerle açıklanması anlamayı kolaylaştırdığı bilinmektedir (Karpuz, Koparan ve Güven, 2014). Bu nedenle araştırmacılar matematik öğretiminde aktif öğrenme (Gür ve Seyhan, 2006); oyunlarla matematik öğretimi (Usta ve diğ., 2018); 4MAT öğretim modeli (Uyangör ve Dikkartın, 2009) gibi yöntemler geliştirmişlerdir. Geometrik şekillere ve tanımlara ilişkin kavram yanılgıları ve hataları (Altıparmak ve Gürcan. 2021; Cantimer ve Şengül, 2017; Özerbaş ve Çağla, 2012), zihnin geometrik alışkanlıkları da (Tolga ve Günhan, 2020) çalışılmıştır.

Literatür incelendiğinde geometri dersi konularından çember ve daire konusunun eğitimi için; kavram haritası ve Vee diyagramı kullanımı (Bozkurt ve Oğraş, 2011), problem tabanlı öğrenme modeli (Çakır, 2007), basamaklı öğretim uygulaması (Duman ve Özçelik, 2017), bağlaşık öğrenme modülü (Göktaş, 2019), proje destekli öğretim (Yıldız ve Özdemir, 2013), gösterip yaptırma yöntemi ile öğrenme (Keskinkılıç ve Taşdemir, 2019), geogebra yazılımıyla (Küçük Demir ve Çolakoğlu, 2018; Topuz ve Birgin, 2020; Şeker ve Erdoğan, 2017), bilgisayar destekli (Orçanlı Binnur ve Orçanlı, 2016) ve Orff Yaklaşımıyla öğretim (Erdoğan Kaya, 2014) gibi yöntemlerin önerildiği görülmektedir. Ayrıca Aydın ve Faydaoğlu (2019) tarafından, çember konusunun öğretimi için son yıllarda oldukça ilgi çekici ve güncel olan STEAM eğitim sistemi önerilmiştir.

Matematik ve geometri konularının öğretimi ile ilgili yeni çalışmalar, farklı öğretim yaklaşımları matematiğin anlaşılmasına önemli katkı sağlayacaktır. Araştırmalarda, öğrencilerin matematik derslerindeki başarılarını ölçme ve değerlendirmede geçerli ve güvenilir başarı testleri geliştirilmesine ihtiyaç duyulmaktadır. Bu amaçla matematik ve geometri derslerindeki konular ile ilgili bazı başarı belirleme testlerinin geliştirildiği görülmektedir. Örneğin; matematik genel başarı testleri geliştirme (Akkuş ve Akkaş, 2021; Balcı, 2019), ondalık gösterime ait (Ersoy ve Bayraktar, 2018), cebirsel düşünme becerilerine yönelik (Akarsu Yakar ve Yılmaz, 2021), geometride özyeterlik inançlarını belirleme ölçekleri (Kesici, 2022; Günhan ve Başer, 2007; Baş ve Katrancı, 2020) ve geometri derslerine yönelik (Bulut, 2013; Şahin ve Keşan, 2017; Topuz, 2017) başari belirleme testleri geliştirilmiştir.

Bu araştırmanın amacı ortaokul altıncı sınıf öğrencilerinin matematik dersindeki çember konusundaki akademik başarılarının değerlendirilmesi için geçerli ve güvenilir başarı testi elde etmektir. Başarı testi oluşturma çalışmaları incelendiğinde hazırlık, uygulama ve raporlaştırma aşamaları dikkate alınmaktadır. Bu aşamalarda amacın belirlenmesi, belirtke tablosu hazırlanması, soruların yazılması, belirtke tablosu ve sorular için uzman görüşü alınması, testin oluşturulması ve uygulanması, uygulama sonucunda verilerin analiz edilmesi gibi süreçler yer almaktadır (Gömleksiz ve Erkan, 2010).

Bu süreçte, ilk olarak Milli Eğitim Bakanlığı (MEB) altıncı sınıf matematik yıllık ders planı incelenmiş, programda yer alan çember konusu kazanımları belirlenerek, bu kazanımları ölçmeye yönelik 30 soru hazırlanmıştır. Çoktan seçmeli olan bu sorular hazırlanırken Bloom'un bilişsel öğrenme basamakları göz önünde bulundurulmuştur. Test son halini almadan önce matematik alanında uzman görüşü alınmış ve başarı testinin kapsam geçerliliği sağlanarak belirtke tablosu oluşturulmuştur. Soruların sayısı 20'ye düşürülmüş ve elde edilen 'Çember Başarı Testi' İzmir ilinin Ödemiş ilçesinde bulunan dört devlet ortaokulundaki 220 adet yedinci sınıf öğrencisine uygulanmıştır. Uygulama sonucunda, SPSS.23 programında veriler incelenerek güvenirlik katsayısı Kuder Richardson-20 (KR-20) (Alfa) 0,786 ve Kuder Richardson-21 (KR-21) 0,759 bulunmuştur. Testin madde güçlük indeks ortalaması 0,540 ve ayırt etme indeks ortalaması 0,486 elde edilmiştir.

Böylece testin ortalama güçlükte ve ayırt edici bir test olduğu sonucuna ulaşılmıştır. Bu sonuçlar, geliştirilen Çember Başarı Testi'nin geçerli ve güvenilir olduğunu göstermektedir. Dolayısıyla altıncı sınıf öğrencilerinin matematik dersindeki başarılarını ölçmek için kullanılabilir.

YÖNTEM

Bu çalışmada altıncı sınıf öğrencilerinin 'Çember' konusu kapsamında başarılarını ölçmek amacıyla bir başarı testi geliştirilmiş, testin geçerlik ve güvenirlik analizleri yapılmıştır. Bu başarı testi, yüksek lisans tezinde kullanılmak üzere geliştirilmiştir. Başarı testleri madde analizi yapılarak geliştirilir. Bu analiz süreci cevapların, seçeneklere dağılımı, madde ve test istatistikleri, madde güçlüğü, madde ayırt edicilik indeksleri, varyansı, standart sapması ve güvenirliği dikkate alınarak yürütülür (Gömleksiz Erkan, 2010).

Araştırma Modeli

Çalışmada nicel yaklaşımlarından tarama yöntemi kullanılmıştır. Bu araştırma yöntemi genelleyici bir özelliğe sahiptir. Örneklemden elde edilen bilgilere dayanılarak evren hakkında genelleme yapılır. Evren genelindeki görüşler nicel olarak araştırılarak açıklamak hedeflenir. Dolayısıyla bilimsel yöntem çerçevesinde araştırılan konuyla ilgili iyileştirme yapmak için; planlı bir şekilde veriler toplanacak, sınıflandırılacak, düzenlenecek, çözümlenecek, yorumlanacak ve sonuçlar raporlanacaktır (Creswell ve Plano Clark, 2011; Metin, 2016).

Katılımcılar

Yapılan araştırma, İzmir İli Ödemiş ilçesinde dört devlet okulunun 2019-2020 eğitim öğretim yılındaki 220 adet yedinci sınıf öğrencisi ile gerçekleştirilmiştir. Uygulama için okul seçimini yapılırken kolay ulaşılabilir durum örneklemesi kullanılmıştır. Bu yöntem araştırmanın daha kolay ve hızlı ilerleyebilmesi için seçilmiş bir yöntemdir. İki sınıf arasından deney ve kontrol gruplarının belirlenmesi için işlemler gerçekleştirilecektir. Deneysel yöntemde grupların oluşturulmasındaki en önemli nokta, deney-kontrol gruplarının mümkün olduğunca eşdeğer olmasıdır ve ön test puanlarının birbirine yakın olmasına dikkat edilir (Çepni, 2010). Katılımcılarla çalışabilmek için 3558626-10.06-e.12607291 sayılı araştırma izini alınmıştır.

Testin Geliştirilme Aşamaları ve Verilerin Analizi

Nitelikli bir test hazırlama sürecinde belirli kurallar gözönüne alınır. Bu süreç testin amacının, kapsamının ve konunun belirlenmesi, belirtke tablosunun hazırlanması, madde havuzu oluşturulması, uzman görüşü alınması, kapsam geçerliğinin incelenmesi, testin uygulanması, madde ve güvenirlik analizi yapılarak testin oluşturulmasını kapsamaktadır. Yapılan çalışmada bu basamaklar dikkate alınarak çember konusuna yönelik verimli ve doğru sonuç alınabilecek 'Çember başarı Testi' (EK 1) geliştirilmiştir.

Testin amacının ve kapsamının belirlenmesi

Yapılan literatür taramasında ortaokul altıncı sınıf Çember konusu ile ilgili geliştirilmiş başarı testi çalışması bulunmamaktadır. Dolayısıyla yapılan bu araştırmanın özgün ve literatüre katkı sağlayacağı düşünülerek ortaokul altıncı sınıf 'Çember' konusu ile ilgili başarı testi geliştirmek amaçlanmıştır.

Konunun belirlenmesi

Çember Başarı Testi hazırlanırken MEB müfredatı göz önünde bulundurulmuş, çoktan seçmeli soruların ilgili konunun kazanımlarıyla ilişkili olmasına dikkat edilmiştir. Çember konusunda öğrencilerin; çemberi tanımlayabilme, çizebilme, merkez, çap, yarıçap, çevre uzunluğu, pi (π) sayısını anlayabilmeleri hem geometrik, hem de analitik olarak işlemleri yapabilmeleri amaçlanmaktadır.

Madde havuzu, uzman görüşü alma

Çember Başarı Testi geliştirilirken altıncı sınıf matematik ders planı incelenmiş, Bloom'un bilişsel öğrenme basamakları dikkate alınarak çoktan seçmeli sorular hazırlanmıştır. Sorular Çember konusu

ISSN: 2146 - 9466
www.ijtase.net
International Journal of New Trends in Arts, Sports &Science Education   *2022, volume 1, issue 4*

ile ilgili kazanımlar doğrultusunda geometri ders kitaplarından, sanal ortamlardan araştırılmış ve araştırmanın amacına uygun bir şekilde oluşturulmuştur. Başlangıçta soru havuzu 30 maddeden oluşmaktadır. Çember Başarı Testi'nin kapsam geçerliğini sağlamak amacıyla matematik alanında uzman üç öğretim üyesinin görüşü alınmıştır. Uzman görüşlerine göre gerekli düzenlemeler yapılarak soru sayısı 20'ye indirilmiştir.

Kapsam geçerliği

Başarı testinin kapsam geçerliği için; uygulanmadan önce 'Çember' konusuna ait kavramlar ve kazanımlara ilişkin belirtke tablosu hazırlanmıştır. Bu tablo testteki öğrencilerin hangi özelliklerinin ölçüleceği belirtir. Bir boyutunda kazanımlar ve bilişsel alan ve diğer boyutunda bilişsel alanın hangi basamakta olduğu gösterilir.

Testin uygulanması, madde analizi ve güvenirlik

Çember Başarı Testi'nin uygulaması 2019-2020 eğitim öğretim döneminde, İzmir ili Ödemiş ilçesinde dört farklı devlet okulunun 220 adet yedinci sınıf öğrencisi ile gerçekleştirilmiştir. Madde analizi yapılırken öğrencilerin bu sorulara verdiği yanıtlar dikkate alınarak ayırt edicilik ve güçlük indeksleri bulunmuştur. Veriler SPSS.23 programında incelenmiştir. Toplam 20 puandan değerlendirilen, dört seçenekli başarı testinde cevaplar doğru ise "1", yanlış ve boş ise "0" puan girilmiştir. Çember Başarı Testi'nin madde analizi için uygulama sonrasında Test Analysis Programı (T.A.P.) kullanılmıştır (version 19.1.4).

Başarı testlerinin güvenirliğini hesaplamak için en fazla kullanılan teknikler KR-20, KR-21 ve Cronbach Alfa (α) yöntemlerdir (Metin, 2016). Bu yöntemlerde testlerdeki doğru yanıt "1", yanlış yanıt "0" olarak puanlandırılır. Genellikle KR-20 değerinin 0,70 üzerinde olması hazırlanan başarı testinin güvenilir bir test olduğunu ifade eder. Çember Başarı Testinde KR-20 (Alfa) ve KR-21 yöntemleri kullanılmıştır.

BULGULAR

Araştırmanın bu bölümünde ortaokul altıncı sınıf 'Çember' konusu ile ilgili oluşturulan 'Çember Başarı Testi'nin' geçerlik ve güvenirlik analiz sonuçları verilmiştir.

Başarı Testi Geçerlik ve Güvenirlik Çalışması

Kapsam geçerliği

Başarı testleri geliştirilirken öncelikle kapsam geçerliğine bakılır. Kapsam geçerliği belirtke tablosu hazırlanarak veya uzman görüşüne başvurularak sağlanabilir. Sorular hazırlanırken konunun her hedef alanından soru hazırlanması ile kapsam geçerliği sağlanmış olacaktır. Belirtke tablosu sayesinde hedef alanlarıyla ilgili soru hazırlanmış ve öğrencilerin bilgilerinin düzeyi de anlaşılmış olacaktır. Ayrıca soruların niteliği, sayısı, konuları ve testin türü gibi konularda da bilgi verir. Bu amaçla soruların kapsadığı çember konusu için Tablo 1'de gösterilen belirtke tablosu hazırlanmıştır. Bu tabloda kazanımlar, bilgi, kavrama, uygulama, analiz, sentez, değerlendirme ile ilgili soru dağılımları bulunmaktadır.

Tablo 1. Çember başarı testi belirtke tablosu

Kazanımlar	M.6.3.3.1.	M.6.3.3.2.	M.6.3.3.3.	Toplam Soru	Yüzde
Bilgi	1,2,3	9	-	4	20
Kavrama	4,5	10	12,13,14	6	30
Uygulama	8	11	15,16,17,19	6	30
Analiz	6,7	-	18,20	4	20
Sentez	-	-	-	0	0
Değerlendirme	-	-	-	0	0
Toplam Soru	8	3	9	20	-
Yüzde	40	15	45	-	100

Milli Eğitim Bakanlığı müfredatında ortaokul altıncı sınıf Matematik Dersi Öğretim Programında "Çember" öğrenme alanında yer alan kazanımlar ise şunlardır:

M.6.3.3.1. Çember çizerek merkezini, yarıçapını ve çapını tanır.
M.6.3.3.2. Bir çemberin uzunluğunun çapına oranının sabit bir değer olduğunu ölçme yaparak belirler.
M.6.3.3.3. Çapı veya yarıçapı verilen bir çemberin uzunluğunu hesaplamayı gerektiren problemleri çözer.

Test geliştirilirken altıncı sınıf matematik ders planı incelenmiş, Bloom'un bilişsel öğrenme basamakları doğrultusunda 30 soruluk çoktan seçmeli sorular hazırlanmıştır. Teste son hali verilmeden önce matematik alanında uzman görüşüne başvurularak kapsam geçerliliği sağlanmış ve Tablo 1'de sunulan belirtke tablosu oluşturulmuş, soru sayısı 30'dan 20'ye düşürülmüştür. Çalışma 220 ortaokul öğrencisi ile yürütülmüştür. Öğrencilerin yanıtlarına göre sorular için ayırt edicilik ve güçlük indeksleri bulunmuştur. Veriler SPSS.23 programında incelenmiş toplam puanlandırma 20 alınarak, doğru yanıtlara "1", yanlış ve boş yanıtlar "0" olarak puanlandırılmıştır.

Madde analizi ve güvenirlik çalışması

Bir ölçeğin bireylerin bir konuya veya duruma yönelik tutumlarını doğru bir şekilde belirleyebilmesi için ölçeğin geçerli ve güvenilir olması gerekir. Başarı testinin geçerliğini ölçmek için madde analizi yapılır. Madde analizi için bir çok istatistik yöntem vardır. Ancak en sık kullanılan istatistik madde güçlük ve madde ayırt edicilik indeksidir. Bir testte soru maddelerinin madde güçlük indeksi ortalaması 0,50 ye yakınsa, ayırt edicilik indeksi 0,30 ve daha büyük olursa testteki maddenin ölçülmek istenilen niteliği ölçmeye uygun olduğu yani geçerli bir test maddesi olduğunu ifade eder. Başarı testinin geçerliği sağlandıktan sonra güvenirliğinin de test edilmesi gerekir (Büyüköztürk ve diğ., 2008; Atılgan ve diğ., 2015; Metin, 2016).

İstatistikte farklı güvenirlik belirleme yöntemleri vardır. Kuder-Richardson (KR) formülleri iç tutarlılık ölçüsüdür. KR-20 ve KR-21 olmak üzere iki farklı formülazsayonu vardır. KR-20 ve KR-21 testlerinden elde edilen katsayılar 0,7'den yüksekse testin 'güvenirliği yüksek, sınıf heterojen, sınıftaki bilenlerle bilmeyenler birbirinden ayrılmıştır, sorular homojendir ve uyum içindedirler, güvenirlik yüksek olduğundan test tesadüfi hatalardan arındırılmıştır' gibi yorumlar yapılmaktadır (Metin, 2016).

Test maddeleri arasındaki ikili kolerasyondan hesaplanan iç tutarlılık ölçüsü Cronbach Alfa(α) katsayısı, KR-20 yöntemine dayanmaktadır. Ölçeğin güvenirliği bu katsayıya bağlıdır. Ölçek, güvenilir değil ise $0.00 \le \alpha < 0,40$; güvenirliği düşük ise $0,40 \le \alpha < 0,60$; oldukça güvenilir ise $0,60 \le \alpha < 0,80$ ve yüksek düzeyde güvenilir ise $0,80 \le \alpha < 1,00$'dir (Metin, 2016). Buradan geliştirilen ölçeğin Cronbach Alfa(α) güvenirlik katsayısı 1,00 değerine yaklaştıkça ölçeğin güvenirliğinin arttığı anlaşılmaktadır.

Çember Başarı Testi'nin madde analizini yapmak için uygulama sonrasında Test Analysis Program (T.A.P.) kullanılmıştır (version 19.1.4). Tablo 2'den görüleceği gibi testin aritmetik ortalaması 10,809 ve standart sapma değeri 4,218 bulunmuştur. Standart sapma testin güvenirliğinin hesaplanmasında kullanılır. Bu çalışmada 'Çember' konusu başarı testinin güvenirlik katsayısı, KR-20 yöntemi ile hesaplanmış, KR-20 (Alfa) 0,786 ve KR-21 0,759 olarak elde edilmiştir. Bu sonuçlara bakılarak testin oldukça güvenilir olduğu söylenebilir. Çember Başarı Testi'nin çarpıklık (0.337) ve basıklık değerlerinin (-0.643) düşük olması sapmanın önemsiz olduğunu ortaya koymaktadır. Çember Başarı Testi istatistik sonuçları Tablo 2'de sunulmuştur.

Tablo 2. Çember başarı testi istatistikleri

Soru Sayısı	20
Uygulanan Kişi Sayısı	220
Ortalama	10,809
Standart Sapma	4,218

Çarpıklık	0,337
Basıklık	-0,643
KR-20 (Alfa)	0,786
KR-21	0,759

Testlerde oluşturulan soruların kalitesi madde analizi ile ortaya çıkarılır. Tablo 3'de bu analiz sonuçları listelenmiştir.

Tablo 3. Çember başarı testi maddelerinin madde güçlük ve ayırt etme indeksler

Madde(Soru)	Madde Güçlük	Madde Ayırt Etme
S1	0,69	0,43
S2	0,89	0,31
S3	0,74	0,59
S4	0,6	0,56
S5	0,65	0,62
S6	0,41	0,36
S7	0,42	0,45
S8	0,65	0,56
S9	0,65	0,56
S10	0,37	0,58
S11	0,45	0,62
S12	0,48	0,68
S13	0,59	0,32
S14	0,64	0,45
S15	0,37	0,54
S16	0,66	0,4
S17	0,41	0,46
S18	0,36	0,31
S19	0,46	0,33
S20	0,31	0,58

Madde güçlük indeksi soruların zorluk seviyesini, -1 ile +1 arasında değişen madde ayırt etme indeksi ise maddenin geçerliğini ifade eder. "0"a yakın madde güçlük indeksleri soruların zorluk seviyesinin yüksek olduğunu, "1"e yakın ise düşük olduğunu belirtir. "0"a yakın ayırt edicilik indeksleri için ayırt ediciliğin düşük, "1"e yakın ise yüksek olduğu bilinmektedir. Ortalama güçlüğün 0,50'ye yakın olması ideal kabul edilir.

Bu bilgiler ışığında Tablo 3 incelendiğinde 0,31 ile 0,89 aralığında değişen madde güçlük indekslerinin "0"a yakın olanlar için soruların zorluk düzeyi yüksek, "1"e yakın olanların ise düşük olduğu anlaşılmaktadır. Testin madde güçlük indeksi ortalaması 0,540, ayırt edicilik indeksi ortalaması 0,486'dir. Yapılan analiz sonucunda testteki S10, S15, S18, S20 maddeleri zor; S4, S6, S7, S11, S12, S13, S17, S19 maddeleri orta güçlükte; S1, S2, S3, S5, S8, S9, S14, S16 maddeleri kolay olarak değerlendirilmiştir. Tablo 3'ten de görüldüğü gibi 0,31 ile 0,68 aralığında değişen madde ayırt etme indekslerinin "0"a yakın olan soruların ayırt ediciliği düşük, "1"e yakın olanların ise yüksektir. Ayrıca madde ayırt edicilik indeksi 0,20'den düşük ise bu maddelerin testten çıkarılması gerektiği ve 0,20 - 0,29 aralığında bulunan maddelerin ise düzeltilmesi gerektiği bilinmektedir. Bu yüzden testte düzeltilmesi veya çıkarılması gereken bir madde olmadığı belirlenmiştir. Bu sonuçlara göre test orta güçlükte, geçerli ve güvenilirliği oldukça yüksektir. Geliştirilen 'Çember Başarı Testi' geçerli ve güvenilir bir testtir.

SONUÇ VE ÖNERİLER

Bu makale matematik dersi altıncı sınıf ortaokul öğrencilerinin çember konusundaki başarılarını ölçmek ve değerlendirmek için geçerli ve güvenilir bir 'Çember Başarı Testi' geliştirme çalışmasıdır. Çoktan seçmeli test, 20 sorudan oluşmaktadır. Testin belirtke tablosu Tablo 1, istatistik sonuçları Tablo 2, maddelerinin madde güçlükleri ve ayırt edicilik indeksleri Tablo 3'de sunulmuştur. Soruların güçlük indeksleri 0,31-0,89; ayırt etme indeksleri ise 0,31-0,68 aralığında değişmektedir. Güçlük indeksleri "0"a yakın olan soruların zorluk düzeyi yüksek, "1"e yakın olanların düşük olduğu, ayırt edicilik indeksleri "0"a yakınsa ayırt edicilik düşük, "1"e yakın ise yüksek olduğu bilinmektedir.

Madde güçlüğü ortalamasının 0,50'ye yakın olması ideal kabul edilir. Çember başarı testi sorularının güçlük indeksi ortalaması 0,540 ve ayırt etme indeks ortalaması 0,486 elde edilmiştir. Bu sonuca göre başarı testinin orta güçlükte ve güvenirlik katsayısı yüksek bir test olduğu söylenebilir.

Yapılan analizler sonucunda geçerli ve güvenirliği elde edilen 'Çember Başarı Testinin' çember konusunda başarı belirleme aracı olarak kullanılabilecektir (Ek 1). Bu testin geliştirilmesi ortaokul öğrencileri ve çember konusundaki başarıyı ölçen sorular ile sınırlıdır. Ortaokul öğrencilerinin çember konusundaki başarı düzeylerini belirlemek için bilimsel çalışmalarda kullanılabilir. Aynı zamanda, öğretmenler derslerinde öğrencilerinin çember konusundaki başarılarını belirlemek amacıyla bu testten faydalanabilir. Öğrencilerin düzeylerine göre ders planlarını hazırlayabilirler. Çember başarı testi, ortaokul öğrencileri için hazırlanmıştır. Ancak ilkokul, lise ve yükseköğretim öğrencileri için örneklem sayısı arttırılarak tekrar test edilebilir. Böylece tüm eğitim kademelerinde öğrenim gören öğrencilerin çember konusundaki düzeylerini ölçmek amacıyla ölçme aracı geliştirme araştırmaları yapılabilir. Her seviyedeki öğrenciler için bir ölçme aracı olarak kullanılabileceğinden literatüre katkı sağlayacağı düşünülmektedir.

Etik ve Çıkar Çatışaması

Bu çalışmanın yazarları olarak, araştırma sürecinde verileri etik kurallara uygun olarak topladığımızı ve tüm etik kurallara uygun hareket ettiğimizi beyan ederiz. Ayrıca yazarlar arasında herhangi bir çelişki olmadığını beyan ederiz. Katılımcılarla çalışabilmek için 3558626-10.06-e.12607291 sayılı araştırma izini alınmıştır. Bu makale, 2022 yılında yürütülmekte olan Doç.Dr. Şerife FAYDAOĞLU danışmanlığında Tuğçe AYDIN'ın yüksek lisans tezinden üretilmiştir.

KAYNAKÇA

Altıparmak K. & Gürcan G. (2021). Examination of 4th grade students definitions for square, rectangle and triangle geometric shapes. *Education Quarterly Reviews*, *4*(3). 304-321.

Akarsu Yakar, E. ve Yılmaz, S. (2021). Cebirsel düşünme düzey belirleme testi: Geçerlik ve güvenirlik çalışması. *Ihlara Journal of EducationalResearch*, *6*(1). 138–154.

Akkuş, R ve Akkaş, E . (2021). Ortaokul 5., 6. ve 7. sınıf seviyelerinde matematik genel başarı testleri geliştirme çalışması. *Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi Dergisi*, *51*:180-209.

Atılgan, H., Kan, A., ve Doğan, N. (2015). *Eğitimde ölçme ve değerlendirme*. Hakan Atılgan (Ed.), Ankara: Anı Yayıncılık.

Aydın T. & Faydaoğlu Ş. (2019). The efffect of mandala activities on 6th grade students mathematics achievementand creative thinking in steam (stem+art) training, 4. International Turkish computerand Mathematics Education Symposium, *Proceedings Book*, 289-292.

Büyüköztürk, Ş., Kılıç Çakmak, E., Erkan Akgün, Ö., Karadeniz, Ş. ve Demirel F. (2008). *Bilimsel araştırma yöntemleri*. Pegem Akademi: Ankara.

Balcı, O. (2019). İlkokul 3. ve 4. sınıf öğrencilerine yönelik matematik başarı testi geliştirilmesi (Yüksek Lisans Tezi). Ordu Üniversitesi, Ordu (No: 589759).

Balcı Şeker, H. & Erdoğan, A. (2017). GeoGebra yazılımı ile geometri öğretiminin geometri dersi başarısına ve geometri öz-yeterliğine etkisi. OPUS Uluslararası Toplum Araştırmaları Dergisi, *7*(12) , 82-97. DOI: 10.26466/opus.313072

Baş, F. F. & Katrancı, Y. (2020). Geometri ile ilgili öz-yeterlik ölçeğinin geçerlik ve güvenirlik çalışması. *Asya Studies-Academic Social Studies / Akademik Sosyal Araştırmalar*, *4*(14). 19-29.

Bozkurt, A. & Oğraş, A. (2011). Kavram haritası ve Vee Diyagramı kullanımının ilköğretim 7. sınıf matematik eğitiminde öğrenci başarısına etkisi. *Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi*, *2*(3), http://dergipark.org.tr/tr/pub/gumus/issue/7512/98995.

Bulut, N. (2013). *Çember kavramının dinamik matematik yazılımı ile öğretilmesinin matematik öğretmeni adaylarının başarıları ve düşünme düzeylerine etkisi* (Doktora Tezi). Gazi Üniversitesi, Ankara (No: 349053).

Cantimer, G. & Şengül, S. (2017). Ortaokulu 7. ve 8. sınıf öğrencilerinin çember konusundaki kavram yanılgıları ve hataları. *Gazi Eğitim Bilimleri Dergisi*, *3*(1). 17-27.

Creswell, J. W. & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research*. Los Angeles: Sage.

Çakır, T. (2007). *İlköğretim 7. sınıf matematik dersinde çember ve daire konusunun öğretiminde problem tabanlı öğrenme modelinin başarıya, kalıcılığa ve tutuma Etkisi* (Yüksek Lisans Tezi). Balıkesir Üniversitesi, Balıkesir(No: 177961).

Çepni, S. (2010). *Araştırma ve proje çalışmalarına giriş* (5. Baskı), Trabzon: Celepler Matbaacılık.

Duman, B. & Özçelik, C. (2017). 7. sınıf çember ve daire konusunda basamaklı öğretim uygulamasının öğrencilerin matematik dersine ilişkin akademik başarı ve tutumlarına etkisi. *Bartın Üniversitesi Eğitim Fakültesi Dergisi*, *6*(3). 1293-1308.

Erdoğan Kaya S. (2014). *Ortaokul 8. sınıflarda matematik dersi geometrik cisimler ve yüzey alanları alt öğrenme alanlarının Orff yaklaşımıyla öğretiminin akademik başarı ve tutuma etkisi(Yüksek Lisans Tezi)*. Gazi Üniversitesi, Ankara (No: 381564).

Ersoy, E. & Bayraktar G. (2018). İlkokul 4. sınıf matematik dersi "ondalık Gösterim" alt öğrenme alanına ilişkin başarı testi geliştirilmesi. *Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi Dergisi*, 46:240-266.

Göktaş, S. (2019). *Çember ve Daire Bağlaşık Öğrenme Modülünün Öğrenci Başarısına ve Matematiğe Yönelik Tutuma Etkisi* (Yüksek Lisans Tezi). Ankara Üniversitesi, Ankara(No: 593375).

Gömleksiz, M. & Erkan, S. (2010). *Eğitimde ölçme ve değerlendirme*, Ankara: Nobel Akademik Yayıncılık.

Günhan, B.C. ve Başer, N. (2007). Geometriye yönelik öz-yeterlik ölçeğinin geliştirilmesi. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, *33*:68-76.

Gür, H. & Seyhan, G. (2006). İlköğretim 7.sınıf matematik öğretiminde aktif öğrenmenin öğrenci başarısı üzerine etkisi. *Balıkesir Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, *8*(1). 17-27.

Karpuz, Y., Koparan, T. ve Güven, B. (2014). Geometride öğrencilerin şekil ve kavram bilgisi kullanımı, *Turkish Journal of Computer and Mathematics Education*, *5*(2). 108-118.

Kesici, A. (2022). Lise öğrencilerine yönelik geometri özyeterlik inancı ölçeğinin geliştirilmesi: geçerlik ve güvenirlik çalışması. Milli Eğitim Dergisi , *51*(233), 33-53 .

Keskinkılıç V. & Taşdemir M. (2019). Ortaokul 6. sınıf matematik dersi geometri öğrenme alanında gösterip yaptırma yönteminin öğrenci başarisına ve kaliciliğina etkisi. *Route Education and Social Science Journal, 6*(9). 61-80.

Küçük Demir, B & Çolakoğlu, S. (2018). Çember konusunun GeoGebra yazılımıyla öğretiminin 7. sınıf öğrencilerinin yaratıcı düşünme becerilerine etkisi. *Journal of Gifted Education and Creativity*, *5*(1). 20-44.

Orçanlı, H. B. & Orçanlı, K. (2016). Bilgisayar destekli geometri öğretiminin 7. sınıf öğrencilerinin geometri başarısına ve geometri özyeterlik algısına etkisi . Sosyal Bilimler Araştırma Dergisi, *5*(1), 80-97.

Özerbaş, M. A. & Çağla, K. (2012). Çember alt öğrenme alanına ait kavram yanılgılarının belirlenmesi. *Gazi Üniversitesi Endüstriyel Sanatlar Eğitim Fakültesi Dergisi*, No.28. 78-94.

Metin, M. (2016). *Eğitimde Bilimsel Araştırma Yöntemleri* (3. Baskı), Ankara: Nobel Akademik Yayıncılık.

Şeker, H.B. & Erdogan, A. (2017). Geogebra yazılımı ile geometri öğretiminin geometri ders başarısına ve geometri öz-yeterliğine etkisi. *Uluslararası Toplum Araştırmaları Dergisi*, *7*(12), 82-97.

Şahin, Z. & Keşan, C. (2017). Bir başarı testi geliştirme çalışması: Beşinci sınıf öğrencilerinin geometri kazanımlarını ölçmeye yönelik bir başarı testi geçerlik ve güvenirliğin araştırılması. *International Journal of New Trends in Arts, Sports &ScienceEducation*-2017, *6*(3).

Tolga, A. & Cantürk Günhan, B. (2020). Ortaokul 8. sınıf öğrencilerinin zihnin geometrik alışkanlıklarının incelenmesi. *Buca Eğitim Fakültesi Dergisi*, *49*:1-23.

Topuz, F. (2017). *Çember ve daire konusunun öğretiminde dinamik geometri yazılımı geogebra kullanımının yedinci sınıf öğrencilerinin başarılarına, geometriye yönelik tutumlarına ve öğrenmedeki kalıcılık düzeylerine etkisi* (Yüksek Lisans Tezi). Uşak Üniversitesi, Uşak(No: 467848).

Topuz, F. & Birgin, O. (2020). Yedinci sınıf "çember ve daire" konusunda geliştirilen geogebra destekli öğretim materyaline ve öğrenme ortamına ilişkin öğrenci görüşleri. *Journal of ComputerandEducationResearch*, *8*(15). 1-27. doi:10.18009/jcer.638142.

Usta, N., Işık, A. , Taş, F., Gülay, G., Şahan, G., Genç, S., Diril, F., Demir, Ö. & Küçük, K. (2018). Oyunlarla matematik öğretiminin ortaokul 7. sınıf öğrencilerinin matematik başarısına etkisi. *İlköğretim Online*, *17*(4). 1972-1987. doi: 10.17051/ilkonline.2019.506917.

Uyangör, S.M. & Dikkartın, F.T. (2009). 4MAT öğretim modelinin öğrencilerin erişileri ve öğrenme stillerine etkisi. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi*, *3*(2). 178-194.

Yıldız, Z. & Özdemir, A. (2013). Çember ve daire konularının öğretiminde proje destekli öğretim yönteminin kullanılmasının öğrenci başarısına etkisi. *Marmara Üniversitesi Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi*, 35(35). 175-187.

EXTENDED ABSTRACT

Mathematical development has been of great importance in the history of science. Mathematics also deals with shapes. Geometric shapes are seen in many places throughout human history. The importance of figures such as pictures, photographs and graphics in mathematics teaching is undeniable. Geometry, also called morphology, has a great role in mathematics teaching. It is known that explaining mathematical concepts with figures facilitates understanding (Karpuz, Koparan and Güven, 2014). Misconceptions and errors related to geometric shapes and definitions (Altıparmak and Gürcan, 2021; Cantimer and Şengül, 2017; Özerbaş and Çağla, 2012), geometric habits of mind (Tolga and Günhan, 2020) were also studied. Considering the studies in the literature, it is seen that many approaches are applied in the teaching of the subject of 'Circle and Disc' from the subjects of geometry course (Bozkurt & Oğraş, 2011; Çakır, 2007; Duman & Özçelik, 2017; Erdoğan Kaya, 2014; Göktaş, 2019; Küçük Demir and Çolakoğlu, 2018; Orçanlı Binnur & Orçanlı, 2016; Şeker & Erdoğan, 2017; Topuz & Birgin, 2020; Yıldız & Özdemir, 2013). In addition, the STEAM education system which has attracted a lot of attention recently was suggested for teaching the subject of circle by Aydın and Benefoglu (2019). New studies on the teaching of mathematics and geometry, and different teaching approaches will contribute remarkably to the understanding of mathematics. In researches, there is a need to develop valid and reliable achievement tests to evaluate students' achievement in mathematics and geometry lessons. For this purpose, some achievement determination tests have been developed (Akkuş & Akkaş, 2021; Akarsu Yakar & Yılmaz, 2021; Baş & Katrancı, 2020; Balcı, 2019; Ersoy & Bayraktar, 2018; Günhan & Başer, 2007; Kesici, 2022; Şahin & Keşan, 2017). Also it should be pointed out that an achievement test has not been developed for the sixth grade circle subject in the literature. The goal of this study is to develop a valid and reliable achievement test for the measurement and evaluation of secondary school sixth grade students' success in the circle subject for the mathematics lesson. In this article, it is used the scanning design from the quantitative research approaches (Creswell & Plano Clark, 2011; Metin, 2016). Examining the achievement test development studies in educational research, the test development process consists of preparation, application and reporting stages, and various steps are followed in these stages (Gömleksiz & Erkan, 2010). Considering these steps in this study, the 'Circle Achievement Test' (Appendix 1) was developed for the circle subject. In the process of creating the achievement test, the MEB curriculum was examined, the achievement list in the sixth grade mathematics curriculum and appropriate questions were prepared to measure these achievements. For this purpose, achievements were determined and an item pool consisting of 30 questions suitable for these achievements was formed. Considering Bloom's cognitive learning steps, multiple-choice questions were written to measure related skills. Before the test took its final form, a table of specifications shown in Table 1 was created for the content validity of the achievement test by taking the opinion of experts in the field of mathematics, and the number of questions was decreased to 20. The prepared 'Circle Achievement Test' was impletented to 220 seventh grade students in four state secondary schools in Ödemiş, İzmir. In the multiple-choice achievement test with 4 options, it has been entered "1" points for correct answers and "0" points for incorrect answers, and the evaluation has made over a total of 20 points. Considering the answers of the students, item analysis was made and the discrimination and difficulty indexes of each item were found. As a result of the application, the Test Analysis Program (T.A.P.) was used to perform the item analysis of the test (version 19.1.4). The item difficulty indexes of the questions were between 0.31 and 0.89; item discrimination indices ranged from 0.31 to 0.68. If the difficulty index of the questions approaches "0", the difficulty level is high, if it approaches "1", the difficulty level is low. If the discrimination is close to "0", the discrimination is low, if it is close to "1", the discrimination is high (Çepni, 2010). A mean difficulty level close to 0.50 is ideal. The most preferred techniques for calculating the reliability of achievement tests are Kuder-Richardson (KR-20 and KR-21) and Cronbach Alpha (α) methods (Metin, 2016). Generally, a KR-20 value above 0.70 indicates that the prepared achievement test is a reliable test. These methods were used in the Circle Achievement Test. The data were analyzed in the SPSS.23 program and the reliability coefficient of the test results was found to be KR-20 (Alpha) 0.786 and KR-21 0.759. The mean item difficulty index of the test was 0.540 and the discrimination index was 0.486. The arithmetic mean of the test was 10,809 and the standard deviation was 4,218. The standard deviation is used to calculate

the reliability of the test. The low skewness (0.337) and kurtosis values (-0.643) of the Circle Achievement Test reveal that the deviation is insignificant. These results show that valid and reliable results were obtained with the 'Circle Achievement Test' developed. According to the results of validity and reliability studies, the test was determined as 20 items. Statistical results of the Circle Achievement Test are shown in Table 2, and the difficulty and distinctiveness indices for each item are shown in Table 3. The 'Circle Achievement Test' developed as a result is a valid and reliable measurement tool that can be used in evaluating the mathematics achievement of secondary school students and in the scientific study processes carried out under this title. The test was developed for secondary school students. However, it can be retested by increasing the number of samples for students at primary, high school and higher education levels. Thus, measurement tool development studies can be built to measure the levels of students studying at all education levels on the circle subject. It will contribute to the literature as it can be used as a valid and reliable measurement tool for students at all levels.

IMPROVING STUDENTS' CALCULUS MASTERY USING DRILL METHOD

Sedya SANTOSA
State Islamic University Sunan Kalijaga Yogyakarta, Indonesia
ORCID: https://orcid.org/0000-0003-2148-8984
sedya.santosa@uin-suka.ac.id

Vivin Devi PRAHESTI
State Islamic University Sunan Kalijaga Yogyakarta, Indonesia
ORCID: https://orcid.org/0000-0002-4148-8327
vivin.uinsuka@gmail.com

Abstract

The study aims that describing learning outcomes and students' responses in improving students' calculus mastery using drill method. The study used qualitative research. This study is conducted in Elementary School of Pungging, Indonesia and the population one is grade 3rd students at around 24 students. Students are given a pretest and posttest to examine the understanding of the math lesson, related on calculation task. The data is analyzed as presented by Miles and Huberman which interview data and pre-test data are collected, and the data used observation ways to examine the data. Then, data is selected the rough data and Displaying and is drawn to become conclusions. The data concluded that drill method will be implemented in math problems, improving the rate of practices repeatedly so that students can remember math concepts, resulting in students' creativity. Such students can answer the question without thinking twice in drilling math and learn basic calculation repeatedly, enhancing master in math.

Keywords: Improving students, calculus mastery, drill method.

INTRODUCTION

Education related on learning activities which students are as a main subject, and the learning activities are as an object of learning. The learning activities create human interaction as a teaching process (Siadi et al., 2009). The ones are not only giving the lesson, but also studying students properly, so such learning generates meaningful concepts which change the way student think. The main problem that is found by the educators is the method used so that such people overcome method changing to get effective result based on learning circumstance. The learning quality can guide students in developing skills, attitudes, appreciation and knowledge, creating learning activities and giving meaningful learning (Kamil & Olvatika, 2015).

Education has a function to develop students' skills and need to be prepared a knowledge related on calculation so that learning one is an essential role for students to compute problems in daily life (Mulyani et al., 2020). Calculus learning needs as a basic concept in elementary school to help students in the next lessons (Mulyani et al., 2020). The way to master calculation is through drill method that train students enhance calculus mastery, and the educator should be have interested learning instead. However, the big problems are that students get difficulties to compute numbers so that the ones need more practices or drilling. Such a problem is found almost in every institution because some students consider that such learning is hard to solve before they get drilling. Also, students get bored due to math lesson repeatedly or being not interested in the lesson one. Therefore, learning one has to be arranged becoming enjoyable lesson (Astuti & Istiarini, 2020).

Also, the educators facilitate and pay attention toward students for enhancing learning outcomes through method, utilizing procedures to get studying interaction to achieve learning purpose (Sudiyono, 2006). Sophisticated technology can be able to make balance between learning component

and the institutions attempted using drill method for gaining creativities and accuracy. There is an effort that has an effort to conduct learning processes completely through using variety of methods, and drill method is able to enhance students' calculus mastery.

Math is one of science related on real activities in daily life, improving knowledge. Math has different characteristic in thinking skills, helping to solve daily problems in the social life (Nisa & Karim, 2017). The subject one needs in globalization era that has important role in basic education (Afifah et al., 2015). Math can stimulate thinking skills and train remembering the lesson (Samosir, 2020), and the concept one is taught by connecting the lesson one to others, improving knowing sense about math lesson (Wardhani, 2017).

Mathematical literacy becomes the essential subject in social life that is included education programs to reach math goal in today's life (MATIĆ, 2014). Ministry of education states that 21th century applied creativity, critical thinking, communication and collaboration skills that related on learning processes in era of industry revolution 4.0 (Sartika, 2019). Such processes require online-based learning models to develop educational qualities, exploring their environment (Wewe & Kau, 2019). Also, calculus is one of branch of math that is contained a number of basic materials as a prerequisite in mastering in math, using patterns, reasoning, communicating an idea to solve the problem. Simmons states that there are trigonometry, algebra and geometry being prerequisites for studying calculus. Furthermore, calculus is a core course of math that has two branches namely differential and integral calculus, solving various problems (Latorre et al., 2007).

One of the important learning in math is calculation, giving lesson about number such as mentioning, ordering, subtracting and adding (Malapata & Wijayanigsih, 2019). According to the other studies from Mirawati, math can be implemented in various institution that can be conducted through students' growth and development despite of having mistaken (Misrawati & Suryana, 2021). Math learning related on number and analyzing, so there are classification, number and measurement that can stimulate thinking skills, influencing the students' development. Moreover, math calculation can be implemented in innovative learning to ease students grasp the lesson in calculation, using learning media to help educators delivering the lesson (Jogezai et al., 2021, Neppala et al., 2018). There is a finding research states that learning media can help students' calculation in math, based on students' needs (Sayekti, 2020) and becoming students getting easy to compute (Annisa et al., 2020).

Math is a subject that is in the all education, needed to all categories. However, some students consider that math is hard to get understanding since they have lack of practice, and such a subject has a discrepancy in learning through conventional method, referring to the theoretical behaviorism. Math is utilized to interpret the lesson to the students, and the teachers ask for students to complete calculus lesson by practice about calculations. The math concept is begun by thought approach in the intuitive learning to get easy students' activities, enhancing calculation skills. Basic calculation that is taught covering addition, subtraction, division and multiplication

Students' have to master in five skills to learn math, first, learning that encourage students to communicate (mathematical communication). Secondly, learning to think critically (mathematical reasoning), then learning to solve the problem (mathematical problem solving). Next, learning to connect the ideas (mathematical connection) and learning to represent the ideas (mathematical representation). In addition, math learning requires activities that related on symbols and real circumstances to solve the certain problem (Pendidikan, 2016).

Drill method is teaching method used to make students becomes active in learning processes, and such a method is conducted with the same method repeatedly. Also, drill method is to accomplish skills permanently, gaining practical processes and provide knowledge to produce learning outcomes (Fitriyah & Khaerunisa, 2018). The characteristic of drill method is a repeated the activity in the different circumstances and the skill can be completed to be reached. Drill process requires practice, time and students' responses properly, and the one is necessary to make fun and enjoy learning for changing early activities so that such students feel optimistic to learn. Educators enable to think about essential processes so that study needs and students' skills can be improved.

Giving stimulus with variety techniques is purposed to reach enjoyable learning, and students' can be interested in subject learned. Based on Muhaimin and Abdul Mujib in *"Pemikiran Pendidikan Islam"* explained that there is variety of drill method. Firstly, Inquiry techniques that divide students' in some groups is to solve a certain problem. The one is carried out to do the task that the educators give. Secondly, Discovery techniques involve students in learning activities not only discussion but also giving an opinion. Next, micro teaching is the techniques that is frequently utilized in teaching practices for enhancing the insights and skills. Then, Package learning is to support students' competition completely. Lastly, learning independently that encourages students become independent without any help from educators, but such techniques can be accompanied by educators as observer. Those techniques require choosing the lesson with techniques' combination, and techniques from educators (Maliki, 2017).

Learning method stages that cam be implemented in learning activities that is, First, students is given knowledge based on theory that is implemented in the method. The next is educators giving an example drills before students is explained the real lesson. Then, educators give lesson carried out by students' through educator's guidance. Next, educators correct the answer that is done by students so that the ones can improve their mistaken. Furthermore, students should do practice repeatedly to reach better learning outcomes, and the last session is that there is an evaluation process regarding to the learning outcomes.

Drill method has characteristic that improving skills with strategy that has been learned. Also, Focusing on method and being ready in alternative method are essential. Method can give different understanding, and the math rules give a clear purpose. Furthermore, strengthen in drill method is that improving the skills, having different understanding and the insights that are gained oriented into mathematical theory (Primayanti et al., 2018). However, the weakness method one is making boredom, and practice that is guided by teacher directly will be hard to make improvement. Also, practice that is done repeatedly will be monotonous activities, blocking students' creativity.

Students who has a low capability has to understand instructional learning, teachers have a role to guide students understanding the lesson (Nasution, 2019). Students get a hard understanding toward the lesson, reducing lesson improvement, and the ones have to experience the ability to support the academic schools so that solving mathematical problems can be accomplished precisely. Students have a wrong concept to get the lesson, so they misconception about the mathematical concepts, and the obstacles that happened in the students when such people get failed to learning objectives. Thus, the ones cannot master in mathematical concepts (Wahyuni, 2017). Student should get used to practice every time to make a habit, resulting to them being used to calculate (PRAHESTI, 2019; Prahesti, 2020).

The students in Elementary School of Pungging, Indonesia are hard to calculate in basic math, so some experienced falling behind other to calculate addition, subtraction, division and multiplication. Based on students' outcomes of 2021/2022 academic year that students feel hard to conduct calculation courses, making them cannot follow next lessons since calculus being a core subjects in math.

METHOD

This research is a descriptive research with qualitative approaches to get interview and observation in the area, being conducted in 2021/2022 academic year. Study one focuses on learning outcomes and students responses to handle the lesson one. This study is conducted in Elementary School of Pungging, Indonesia and the population one is grade 3rd students at around 24 students. Students are given a pretest and posttest to examine the understanding of the math lesson, related on calculation task. Interview is carried out randomly for students, and the researcher observes students' outcomes toward the way to do calculus operation.

The data is analyzed as presented by Miles and Huberman which interview data and pre-test data are collected, while the data is reduced that is precise based on the data concepts. Then, data is selected

ISSN: 2146 - 9466
www.ijtase.net
International Journal of New Trends in Arts, Sports &Science Education   *2022, volume 1, issue 4*

the rough data. Displaying of data that have been verified based on the rate of improving students' calculation, and next is the data presentation is drawn, becoming conclusions.

RESULTS and DISCUSSION

The finding of data is students' learning outcomes in the interview and observation, being collected in the different ways. Students are treated calculus lesson and how the way to solve the questions in order to know students' ability, and interview is carried out toward a random students in 3rd grade. Based on the interview was used to measure the student's ability to calculate basic math such as addition, subtraction, division and multiplication. The interview's questions are determined in the how the way they to solve basic math learning and why they feel struggling to master in calculation of math learning. The data that is gained is that almost 50% of random students cannot be able to master basic math since the ones have not been used to practice, becoming to students to hamper in calculus mastery. The ones only know the theory and rare practice so that they feel hard to solve. Also, students forget the way to calculate calculus theory so that they are struggling, and they do not get explanation from their teacher due to restriction of COVID cases. Students is giving stimulus to be more interedted in math, so that they can improve a bit. Due to virtual learning, some students believe that educators do not pay attention about the learning quality. Educators only focus on lesson so that they have not known about learning quality.

Students tend to train themselves by practicing so that they can achieve the lesson goal, and those enable to get drilling by educators who teach them in the class. Improving calculation can be trained to students who are interested in, making them knowing how to solve the math problems. Additionally, students have to know to to arrange their lesson based on their skills. The result based on student's answers that is gained in improving in calculus mastery in giving drill method, repeating to practice calculation gradually so that students are more likely to practice or do drilling in math to get the lesson, remembering the basic concept of math. Due to drilling the math question, such students can answer the question without thinking twice. Additionally, students get used to do drilling to reduce misunderstanding toward the lesson that can be examined comprehensively. They also often learn basic calculation repeatedly, enhancing master in math.

Regarding with the observation, students master in math being able to get the theoretical math precisely, making them to calculate as quick as possible, while for the ones who feel difficult to calculate forget the basic calculation. The writer observes that math lesson in the low class of elementary school related on addition, subtraction, division and multiplication in basic. However, there is a different result based on in the field showing students who have not accept the teachers' explanation being able to do the lesson so that they can do the task, while the others in the interview results need to more explanation and drill the math skills. Basically, students have the way to solve math problem although the ones have different ways, and they have different skills to improve math skills in calculation.

Based on the data students in the low level is not used to do drilling, making them forget about the concepts, while in the middle class, students need more practices more due to forget. For low level, educators or teachers have strategy to make students reducing problems in calculation. The high class, they master in math since they do practice or drill more and more, remembering the concept. Students are more likely to do drilling more when they can achieve their goal, but they need more practices. The differences between low, middle and high level are in their skills in calculation so that they are categorized becoming 3 different levels. Students who are in low level are more likely to forget the lesson so that they need for drilling processes, and some students master in calculation, but almost a half of students master in calculation so that they can solve math problem. Others need more practices to be mastery in calculation in some areas, and students are more likely to get difficulties in subtraction and multiplication, making them to do drilling. For students in the low level have to do drilling more to reduce misunderstanding for the learning process. When it comes to the math lesson, there are variety targeted learning that students in 3rd grade have to achieve the competency. To remember the concept, 3rd students need more time to practice repeatedly, achieving the targets being determined.
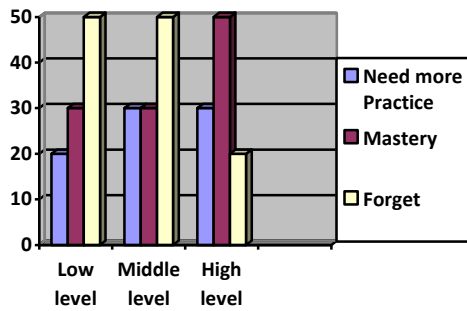
Diagram 1. Observation results improving calculus

A half of students need more practices in the middle level, showing the same as students master in calculation, while many students forget the lesson, making them get failed in calculation. Educators or teachers can master to compute lesson related on numbers through drilling process. Calculus mastery can be gained when students are used to train repeatedly, making them in higher level than others. Also, less students forget in certain lesson, having variety obstacles like less drillings In the interview processes, students have a lack of mastery in math due to many matters, alleviating the speed of calculating in calculation. Based on the interview, 10 of students chosen have a different matter to master in math before using drill method

Table 1. Observation results improving calculus

No.	The constraint found	*Information
1.	Students experienced confused to do math's questions	A
2.	Students do not accept the lesson, making them to feel hard	B
3.	Students have a different level to master calculation	B
4.	Students are less interested in the math	A
5.	Students do not know the way or strategy to calculate	A

*Information:
A: 50-90% of students = often
B: 10-50% of students= sometimes

Almost all students frequently get confused to solve math problem, and the ones do not get the lesson, making them feeling hard to accomplish the math's task. However, less than a half of students rarely do not learn the lesson before practicing the math, forcing them to think twice and will decrease the students' calculation. The data reveal that students experience different condition in term of calculus mastery since they have a different skill to solve math's problem so that they need more practices using drill. The researcher assumes that drill method will be implemented in math problems, improving the rate of practices repeatedly so that students can remember math concepts, resulting in students' creativity.

The study states that students have different skills to grasp the lesson so that they have different way to master calculation, making them to more struggle to achieve high score in math. Some have difficulties to accomplish the math's task, so they cannot complete them. Nevertheless, some have experiences to solve math problem based on the lesson, making them understand the way to do, and such questions are set based on formula that is given such as fraction, adding, multiplication, subtraction, wide and volume. Those lessons are implemented in the story question related on students' life so that students analyze the lesson more, while the basic calculation only finding the answer. The question one train the way students think so that they have different ways to solve the question. Some make confused due to similarity story that students should classify the lesson. They have to understand the question about, and they have to know which formula that is related on the question, resulting to them having correct answer. Students who experienced confusion can do math question. Hence, they require practice repeatedly.

Students have bad feeling that make them cannot concentrate to study. Some do not understand, resulting to them hard to answer due to the level of lesson. The higher the lesson, the harder the way to solve, such lessons make students struggling to answer, and such students do not want to accept the lesson due to harder lesson. Moreover, increasing concentration give an impact to accomplish the task, but they feel hard to concentrate due to feeling, tired and emotion. Students need practice more and more so that they can control their emotion and feeling since drilling processes enable to reduce those obstacles. 3rd grade students get used to practice calculation in their daily life, but they have difficulties if they deal with higher lesson, feeling obstacles or getting stuck to solve the problem.

Due to different students, 3rd grade students have different level of calculus mastery. Some only understand how to solve multiplication, while others know the answer without compute the number since they memorize the answer. Students who memorize the answer they can answer without any time to calculate more. Although students have the same lesson, they have different the way to get the lesson. Students have variety to grasp the lesson due to some factors is that 1) less doing drill in calculation; 2) they do not have any time to practice; 3) they get lazy to calculate, making them hard to achieve other levels.

Strategy to compute the math needs for students who learn basic math in elementary school so that they need more time to solve math calculation. When it comes to the math lesson that does not need any analyzing skills, the skill one enables to solve due to being used to do drilling. Some need more time, and they do not know the strategy to solve, becoming them to get difficulties. Based on the table states, there two categories are that A and B. Almost 50- 90% students who get point A are not interested in, do not have strategy and getting confused to do math problems, while students who get point B do not accept the lesson and having different level of math lesson. Those problems can be solved through drill method in which students train repeatedly.

Conclusion

This study concludes that students are more likely to improve their skills through drill method. Such students can think twice in drilling time in calculation. Students in 3rd who practice math repeatedly addressed to master in math skills. Almost a half of students in their stage rely on understand in math because of drilling time. However, students need more practice and forget about the math's formula. The more students practice in calculation, the more they are easier to understand.

REFERENCES

Afifah, A., Parta, I. N., & Chandra, T. D. (2015). Penerapan Metode Penemuan Terbimbing untuk Meningkatkan Penalaran Matematika Siswa. *Tahun III, Nomor 1, Januari 2016*, *69*, 22.

Annisa, E. N., Supriyati, Y., & Nurani, Y. (2020). Peningkatan Pemahaman Berhitung dan Kardinalitas melalui Penggunaan Media Rangkasbitung. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *4*(2), 665–675.

Astuti, R. F., & Istiarini, R. (2020). Upaya Meningkatkan Kemampuan Membaca Permulaan AnakUsia 5-6 Tahun Melalui Media Puzzle di PAUD Flamboyan Sukasari Kota Tangerang. *Ceria: Jurnal Program Studi Pendidikan Anak Usia Dini*, *8*(2), 31–43.

Fitriyah, A., & Khaerunisa, I. (2018). Pengaruh penggunaan metode drill berbantuan permainan engklek termodifikasi terhadap kemampuan pemecahan masalah siswa kelas VII. *Journal of Medives: Journal of Mathematics Education IKIP Veteran Semarang*, *2*(2), 267–277.

Jogezai, N. A., Baloch, F. A., Jaffar, M., Shah, T., Khilji, G. K., & Bashir, S. (2021). Teachers' attitudes towards social media (SM) use in online learning amid the COVID-19 pandemic: the effects of SM use by teachers and religious scholars during physical distancing. *Heliyon*, *7*(4), e06781.

Kamil, B., & Olvatika, Y. P. (2015). Konseling Behavioral dalam Meningkatkan Konsentrasi Belajar Peserta Didik Sekolah Menegah Pertama Negeri 1 Hulu Sungkai Kabupaten Lampung Utara. *KONSELI: Jurnal Bimbingan Dan Konseling (E-Journal)*, *2*(1), 29–36.

Latorre, D. R., Kenelly, J. W., Reed, I. B., Carpenter, L. R., & Harris, C. R. (2007). *Calculus Concepts: An Applied Approach to the Mathematics of Change*. Cengage Learning.

Malapata, E., & Wijayanigsih, L. (2019). Meningkatkan Kemampuan Berhitung Anak Usia 4-5 Tahun melalui Media Lumbung Hitung. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *3*(1), 283–293.

Maliki, M. (2017). *Analisis nilai-nilai pendidikan Islam dalam novel Api Tauhid karya Habiburrahman El shirazy*. UIN Sunan Ampel Surabaya.

MATIĆ, L. J. (2014). Non-mathematics students'reasoning in non-routine calculus tasks. *The Eurasia Proceedings of Educational and Social Sciences*, *1*, 124–134.

Misrawati, M., & Suryana, D. (2021). Bahan Ajar Matematika Berbasis Model Pembelajaran Tematik terhadap Kemampuan Berhitung Anak Usia Dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *6*(1), 298–306.

Mulyani, D., Cahyati, N., & Rahma, A. (2020). Pengembangan Media Permainan Dakon Untuk Kemampuan Berhitung Anak. *Al-Athfaal: Jurnal Ilmiah Pendidikan Anak Usia Dini*, *3*(2), 161–173.

Nasution, S. P. (2019). Analisis Kesulitan Belajar dalam Memahami Kecemasan Peserta Didik pada Pembelajaran Matematika. *Desimal: Jurnal Matematika*, *2*(1), 49–57.

Neppala, P., Sherer, M. V, Larson, G., Bryant, A. K., Panjwani, N., Murphy, J. D., & Gillespie, E. F. (2018). An interactive contouring module improves engagement and interest in radiation oncology among preclinical medical students: Results of a randomized trial. *Practical Radiation Oncology*, *8*(4), e190–e198.

Nisa, T. F., & Karim, M. B. (2017). Profil Kemampuan Matematika Anak Usia Dini Melalui Learning to Think Different. *Jurnal PG-PAUD Trunojoyo: Jurnal Pendidikan Dan Pembelajaran Anak Usia Dini*, *4*(2), 143–152.

Pendidikan, M. (2016). Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 21 Tahun 2016 tentang Standar Isi Pendidikan Dasar dan Menengah. *Jakarta: Menteri Pendidikan Dan Kebudayaan Republik Indonesia*.

Prahesti, V. D. (2020). The use of drill method to enhace curiosity pupils in speaking skill. *oxford: Journal of English Language Studies*, *1*(1), 1–6.

PRAHESTI, V. D. (2019). *Implementasi metode drill dalam pembelajaran matematika kelas v sekolah dasar islam bayanul azhar tulungagung*.

Primayanti, G., Suwu, S. E., & Appulembang, O. D. (2018). Penerapan metode drill untuk meningkatkan kemampuan komunikasi matematis siswa kelas VIII SMP Lentera Way Pengubuan pada topik persamaan garis lurus [The implementation of the drill method to increase mathematical communication skills of grade 8 students . *JOHME: Journal of Holistic Mathematics Education*, *1*(2), 135–149.

Samosir, D. (2020). Penerapan model contextual teaching and learning (ctl) untuk meningkatkan kemampuan berpikir kritis matematis siswa berbantuan aplikasi geometry calculator. *cartesius: Jurnal Pendidikan Matematika*, *3*(1), 58–70.

Sartika, D. (2019). Pentingnya pendidikan berbasis STEM dalam kurikulum 2013. *JISIP (Jurnal Ilmu Sosial Dan Pendidikan)*, *3*(3).

Sayekti, T. (2020). Peningkatan keterampilan berhitung siswa melalui media kotak ajaib berbasis stem pada materi konsep penjumlahan. *Jurnal Pendidikan Dasar*, *11*(1), 10–19.

Siadi, K., Mursiti, S., & Laelly, I. N. (2009). Komparasi hasil belajar kimia antara siswa yang diberi metode drill dengan resitasi. *Jurnal Inovasi Pendidikan Kimia*, *3*(1).

Sudiyono, S. (2006). *Strategi pembelajaran partisipatori di perguruan tinggi*. UIN-Maliki Press.

Wahyuni, A. (2017). Analisis hambatan belajar mahasiswa pada mata kuliah kalkulus dasar. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *1*(1), 10–23.

Wardhani, D. K. (2017). Peran guru dalam menerapkan pembelajaran matematika yang menyenangkan bagi anak usia dini. *Jurnal Paud Agapedia*, *1*(2), 153–159.

Wewe, M., & Kau, H. (2019). Etnomatika bajawa: kajian simbol budaya bajawa dalam pembelajaran matematika. *Jurnal Ilmiah Pendidikan Citra Bakti*, *6*(2), 121–133.

DETERMINING THE ANALYTICAL THINKING LEVELS OF PROSPECTIVE TEACHERS

Duygu BEDİR
Dokuz Eylül Üniversitesi, Eğitim Bilimleri Enstitüsü, İzmir, Türkiye
ORCID: https://orcid.org/0000-0001-5809-2161
duygumat35@gmail.com

Süha YILMAZ
Prof. Dr., Dokuz Eylül Üniversitesi, Buca Eğitim Fakültesi, Matematik ve Fen Bilimleri Eğitim Bölümü
Matematik Eğitimi Anabilim Dalı, İzmir, Türkiye
ORCID: https://orcid.org/0000-0001-5948-0588
suha.yilmaz@deu.edu.tr

Cenk KEŞAN
Prof. Dr., Dokuz Eylül Üniversitesi, Buca Eğitim Fakültesi, Matematik ve Fen Bilimleri Eğitim Bölümü
Matematik Eğitimi Anabilim Dalı, İzmir, Türkiye
ORCID: https://orcid.org/0000-0003-2629-8119
cenk.kesan@deu.edu.tr

Abstract

The most important feature of the human being is the ability of thinking. Human should be able to develop their own thinking skills based on their experiences and ideas. It is aimed to provide the individual's thinking development by taking into account the individual characteristics during the education in our schools. When an individual encounters a problem, he reaches a solution with different ways of thinking. The individual with analytical thinking skills will be able to define the parts of the problem and the steps in the process of solving. It is expected that prospective teachers who will raise individuals of the future will have analytical thinking skills by dealing with individual differences. Therefore, in order to determine the level of thinking styles used by prospective teachers in solving problems, it is aimed to investigate the level of analytical thinking of prospective teachers. The research was carried out on the prospective teachers of mathematics teaching of a public university education faculty. In order to determine the level of analytical thinking of prospective teachers, quantitative research method was preferred and Holistic and Analytical Thinking Scale was applied. Descriptive analysis of data obtained from prospective teachers was evaluated.

Keywords: Prospective teachers, analytical thinking, holistic and analytical thinking scale.

INTRODUCTION

One of the most distinguishing characteristics of humans from other living is the ability of thinking. When a person encounters a problem, he should be able to develop the solution of the problem by using his own thinking skills based on his experiences and ideas The aim of the education in our schools is to provide the knowledge and skills that will prepare the individual for the future. One of the most important of these skills is to develop a person's thinking skills. One of the most basic tasks of our teachers is to develop the individual's thinking skills by taking into account the individual characteristics during the education.

Before defining thinking skills, it is important to make some definitions related to the subject. According to Türk Dil Kurumu (1992), thinking is defined as examining information, comparing and producing thoughts by using the interests between them in order to come to a conclusion. According to Ariol (2009) from Sigel (1991), thinking is defined as the conditioning of many mental processes to work to solve problems. It is emphasized that the individual should be able to use his mental processes to find a solution to a problem situation he has not encountered before. As another

definition, Style is defined as the way an individual prefers using their skills and processing information. From this point of view, style can be considered as a choice made by the individual in using skills, not a skill or talent on its own fining style as a preference indicates that it differs from skills. Because while skills are about a person's ability to do something, styles are about what a person prefers to do and how.Therefore, various styles are not good or bad, they are just different (İnci, Erten & Çitil, 2012).

Thinking styles, on the other hand, are the approaches and tendencies that individuals exhibit at the end of their mental processes against the problems, events, facts and variables they encounter. Each individual has many thinking styles towards a problem. However, the individual mainly uses some of them according to their special circumstancesSünbül 2004, Dinç Artut ve Bal 2008). The fact that an individual's thinking styles can change according to his knowledge and experience causes different thinking styles. When the literature is examined, analytical thinking and holistic thinking are among the thinking styles individuals use while solving problems. Analytical and holistic thinking includes the difference between the ways of processing and gathering information. (Hammouri 2003, Konyalıhatipoğlu, 2016).

Various definitions are made about analytical thinking. According to Güneş (2012), analytical thinking includes the processes of disassembling the whole, redefining and classifying them. It is a way of thinking based on analysisBloom Taxonomy defined the Analytical thinking in the words as follows : analyze, arrange, connect, divide, separate, classify, compare, contrast, explain, select, order, breakdown, correlate, diagram, discriminate, focus, discriminate, illustrate, infer, outline, prioritize, subdivide and points out. (Larry & Annette, 2010; Montaku, 2011). Analytical thinkers prefer different ways to solve problems compared to other people. According to Dewey (2007), individuals with analytical thinking focusing on details solve problems sequentially. They can divide the problem into sub-problems, describe the steps in the process, and describe each step that they assume to do (Dewey, 2007, Bolça 2015). By their nature, their break down concrete problems into small pieces and collects information (logical, functional, etc.) based on the properties of the pieces, trying to reach the whole. They establish a link between knowledge and events and define the basic relationships between them and examines the complex relationships. Another style of thinking, holistic thinking, can also be expressed as the ability to come to mind small details that are not immediately noticeable in complex problems. Individuals with a holistic thinking style prefer to use the answers they obtain in similar activities as a source and go to the right result instead of going step by step in the solution of a problem or going from the controls to the result (Dewey 2007, Umay & Arıol, 2017). Holistic thinkers like to deal with big paintings, generalizations and abstract things (Dinç Artut, & Bal 2008). Çubukçu (2004) stated that since thinking skills can be taught to the individual, the abilities of an individual can be developed by using effective thinking tools.

Developing the individual's high-level thinking skills in formal education in our schools is one of the most important responsibilities of teachers. In order for teachers to develop the thinking of the individual effectively, it is expected that they must have and be able to use different ways of thinking effectively. For this reason, prospective teachers who will train future individuals are expected to have different thinking styles in addition to their professional knowledge. For this reason, prospective teachers trained in universities are required to have analytical and holistic thinking skills by considering their individual differences. For this reason, determining the thinking styles that prospective teachers use while solving problems has an important place in teacher education.

One of the most important stages of dissemination thinking skills in education is teacher training. First of all, teachers need to acquire thinking skills and apply this to their real life. After teachers gain these skills, they can make their own students do developmental work. For this reason, providing teachers with different thinking skills is an important step in educational studies (Tok & Sevinç, 2010). It is expected that prospective teachers, who will train individuals of the future, will have high level thinking skills by handling their individual differences. For this reason, it is aimed to investigate the analytical thinking levels of prospective teachers in order to determine the thinking styles used by prospective teachers while solving problems.

In this study, answers were sought for the sub-problems
- ✓ What are the distributions of prospective teachers according to their analytical and holistic thinking levels? "
- ✓ "Do the thinking styles scores of the prospective teachers differ significantly according to the gender variable?
- ✓ Is there a significant difference between grades between the analytical and holistic thinking styles of prospective teachers?
- ✓ Do prospective teachers thinking styles scores differ significantly according to the variable of the school they graduated from?

METHOD

In this study, the descriptive approach was used, as the main goal was to thoroughly define, explain the situation studied, make assessments in accordance with standards, and identify possible relationships between events (Çepni, 2007). In our study, the "holistic and analytical thinking scale in Problem solving" consisting of 10 items whose validity and reliability were calculated prepared by Ariol (2009) was used to determine the holistic and analytical thinking styles of prospective teachers. Each item on the scale contains two different expressions that explain analytical and holistic thinking styles. The "No Idea" option was used for those who remained unstable between these two substances. In the scoring of the scale, the option expressing analytical thinking was rated as 1 point, the option "I have no idea" was rated as 2 points, and the option expressing holistic thinking was rated as 3 points. The lowest score to be taken from the scale was calculated as 5 and the highest score was calculated as 15. It is mentioned that as the score from the scale approaches 5, it is prone to analytical thinking, and as it approaches 15, it is prone to holistic thinking. The SPSS-23 package program was used in the analysis of the data in the study. In order to test sub-problems in the study, it was first tested whether the data provided the assumption of normality and homogeneity. The Kolmogorov-Smirnov test was applied to find out if it was normal distribution or not. The value obtained from this test (p<.05) it was found that the data did not show a normal distribution in the working universe. For this reason, it was decided to apply the Mann–Whitney U test from nonparametric analysis methods.

RESULTS, DISCUSSION, and CONCLUSION

In this study, answers were sought for the sub-problems
1. What are the distributions of prospective teachers according to their analytical and holistic thinking levels? "
2. "Do the thinking styles scores of the prospective teachers differ significantly according to the gender variable?
3. Is there a significant difference between grades between the analytical and holistic thinking styles of prospective teachers?
4. Do prospective teachers thinking styles scores differ significantly according to the variable of the school they graduated from?

Findings of the sub-problems of our study are given below.

1. "What is the distribution of prospective teachers according to their analytical and holistic thinking levels? " the answer to the question was sought. The results obtained are shown in Table 1.

Table1. Distribution of ProspectiveTeachers According to their Thinking Styles

Thinking	N	Min.	Max.	$\bar{X}$	Ss	Thinking Styles Analytical		Holistic	
Styles	97	5.00	15.00	8,88	2,3	f	%	f	%
						40	41,2	10	10,3

The lowest score that can be obtained from the Holistic and Analytical Thinking Scale in Problem Solving was calculated as 5 and the highest score as 15. In the study, it was determined that the analytical thinking style of the prospective teachers who got 5, 6, 7 and 8 points was dominant, and

the holistic thinking style of the prospective teachers who got 15, 14, 13 and 12 points was determined as dominant. It was found that 41.2% of prospective teachers prefered analytical thinking predominantly and 10.3% prefered holistic thinking predominantly.

2. "Do the thinking styles scores of the prospective teachers differ according to the gender variable?" the answer to the question was sought. The results obtained are shown in Table 2.

Table 2. Mann Whitney U Test Results of Thinking Styles Scores by Gender Variable

Gender	N	$\overline{X}$	Average of Rank	Sum of Rank	U	P
Female	66	8,6	45,33	2991,50	780,50	.056
Male	31	9,5	56,82	1761,50		

According to the table, it is seen that the thinking styles of the prospective teachers do not differ significantly according to the gender variable (p> .05).

3. "Is there a significant difference between prospective teachers analytical and holistic thinking styles between grades?" the answer to the question was sought. The results obtained are shown in Table 3.

Table 3. Kruskal-Wallis Test Results of Prospective Teachers Thinking Styles Scores According to Grades

Grade Level	N	Average of Rank	Sd	X^2	p
1.Grade	21	52,64	2	,779	.678
2. Grade	9	52,83			
3. Grade	67	47,34			
Total	97				

When the table is examined, it is seen that the thinking styles scores of the prospective teachers do not show a significant difference (p=.678; p>.05) according to the grade level variable.

4. "Do thinking styles scores of prospective teachers differ significantly according to the variable of the type of school they graduated from?" the answer to the question was sought. In order to determine whether the thinking styles scores of the prospective teachers differ significantly according to the graduates school type, Kruskal Wallis test was conducted and the results obtained are given in Table 4.

Table 4. Kruskal Wallis Test Results for Thinking Styles Scores of ProspectiveTeachers to the Graduated School Type Variable

Graduated School	N	Average of rank	Sd	X^2	p
Anatolian High School	52	48,13	3	2,014	.570
Anatolian Teacher High School	30	53,62			
Science High School	9	46,28			
Basic / private High School	6	37,50			
Total	97				

When the table is examined, it is seen that the thinking styles scores of the prospective teacher do not show a significant difference p=.570 (p> .05) according to the school variable they graduated from.

It is expected that prospective teacher, who will train individuals of the future, will have high-level thinking skills by handling individual differences. For this reason, in our study to determine the level of thinking styles used by prospective teacher while solving problems, the mean score according to the Analytical and Holistic Thinking scale we applied to prospective teacher was $\overline{X}$=8,88.According to this result, we can say that the prospective teacher are a little closer to analytical thinking.

In our study, which examined the thinking styles that prospective teacher preferred while solving problems, 41.2% of prospective teacher preferred analytical thinking predominantly and 10.3% preferred holistic thinking predominantly . We can say that 48.5% of the remaining prospective

teacher prefer both analytical and holistic thinking without being dominant. In general, in our study, it is seen that the prospective teacher prefer analytical thinking style predominantly. Similarly, in the studies of Arıol (2009) and Kabaran, Altıntaş, Kabaran and Sidekli (2016), it coincides with the result that prospective teacher prefer analytical thinking predominantly.

According to the other sub-problem we examined, the thinking styles of prospective teacher did not differ significantly according to gender, variable p=.056 (p>.05). Dinçer and Saracaloğlu (2011) concluded that the thinking styles of prospective teacher differ according to the gender variable, while Özbaş and Sağır (2014) and Çubukçu (2004) concluded that the thinking styles of teachers do not change according to gender, although individual differences are involved.

As a result, we can say that the thinking styles of the prospective teacher do not differ according to the gender variable. In other words, we can state that thinking styles of prospective teacher'are not effective according to gender. Finally, in our study, it is seen that the thinking styles of prospective teacher did not change significantly at grade level p = .678 (p> .05) and p = .570 (p> .05) according to the type of school they graduated from. In other words, we can say that there is no difference between thinking styles of prospective teacher according to grade level and school types.

Suggestions

- It should not be forgotten that each individual will have a unique thinking style. It should be remembered that no one thinking style is superior to another, and that thinking style is the individual's own preference.
- Although the solution steps are divided into pieces and the result is reached as in analytical thinking in problem solving due to its nature in mathematics, it is also important to reach the result by evaluating the whole without focusing on the details as in the holistic thinking approach.
- In Umay and Ariol (2011), they noted that different thinking styles did not cause the problem-solving performance of prospective teacher to differ. For this reason, no matter what style of thinking the individual has, thinking and problem-solving efforts should be supported.
- Considering individual differences in educational environments, the development of individual thinking should be given importance in the education.
- Prospective teacher should be given the opportunity to recognize their own thinking styles in education and to develop themselves.
- Nisbett et al. (2001), in their study comparing analytical and holistic thinking culturally, stated that the most popular game was "Go" in Eastern culture and "Chess" in Western culture, and that "Go" game is a more holistic, complex and analytical game than "Chess". For this reason, we can say that the development of both holistic and analytical thinking can be achieved by supporting education with games.

REFERENCES

Arıol, Ş. (2009).*Matematik öğretmen adaylarının bütüncül (holisitik) ve analitik düşünme stillerinin matematiksel problem çözme becerilerine etkisi*, Yayınlanmamış Yüksek Lisans Tezi, Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü, Ankara .

Bolça, M. (2015). *Probleme dayalı öğrenme yönteminin öğrencilerin analitik düşünme becerileri, kavramsal anlamaları ve fene yönelik tutumları üzerine etkileri,* Yayınlamamış Yüksek Lisans Tezi, Dokuz Eylül Üniversitesi İzmir .

Çepni, S. (2007). *Araştırma ve proje çalışmalarına giriş.* Celepler Matbacılık, Trabzon

Çubukçu, Z. (2004). Öğretmen adaylarının düşünme stillerinin öğrenme biçimlerini tercih etmelerindeki etkisi, 12. Ulusal Eğitim Bilimleri Kurultayı İnönü Üniversitesi, Malatya.

Dinç Artut, P., & Bal, A. P. (2008). Lise öğrencilerin geometrik başarısı ve düşünme stilllerinin karşılaştırılması. *Çanakkale Üniveristesi, Sosyal Bilimler Enstitüsü Dergisi, 17*(1), 1-10.

Dinçer, B., & Saracaloğlu, A. S. (2011). Öğretmen adaylarının düşünme stilleri profillerinin çeşitli değişkenler açısından incelenmesi. *Türk Eğitim Bilimleri Dergisi, 9*(4), 701-744.

Güneş, F. (2012). Öğrencilerin düşünme becerilerini geliştirme, *Türklük Bilimi Araştırmaları TÜBAR* Sayı:32.

İnci ,N., & Erten, H., Çitil, N. (2012) Fen bilgisi öğretmen adalarının düşünme stilleri. *E-Journal Of New World Sciences Academy* Sayı:3.

Kabaran Gökçen, G., Altıntaş, S., Kabaran, H., & Sidekli, S.(2016). Analitik ve holistik düşünen sınıf öğretmeni adaylarının kullandıkları okuduğunu anlama stratejileri, *Trakya Üniversitesi Sosyal Bilimler Dergisi, 18*(1), 37-57.

Konyalıhatipoğlu, M.E. (2016). *Ortaokul 7.sınıf öğrencilerin analitik ve bütüncül düşünme stillerinin solo taksonomisine ile incelenmesi.* Yayınlanmamış Yüksek Lisans Tezi, Recep Tayyip Erdoğan Üniversitesi Sosyal Bilimler Enstitüsü, Rize.

Montaku, S. (2011). Results of analytical thinking skills training through students ın system analysis and design course. Proceedings Of The IETEC'11 Conference, 2011, Kuala Lumpur, Malaysia

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: holistic versus analytic cognition. Psychological review, 108(2), 291.

Özbaş, N., & Sağır, Ş. U. (2014). Sınıf öğretmenlerinin düşünme stilleri ve kullandıkları ölçme-değerlendirme yöntemleri arasındaki ilişkinin incelenmesi. *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi, 33*(1), 305-321.

Tok, E., & Sevinç, M. (2010). Düşünme becerileri eğitiminin eleştirel düşünme ve problem çözme becerilerine etkisi, *Pamukkale Üniversitesi Eğimi Fakültesi Dergisi, 27*, 67-82

Türk Dil Kurumu (1992). Atatürk kültür dil ve tarih yüksek kurumu,*Türk Dil Kurumu Sözlüğü*, İstanbul.

Umay, A., & Arıol, Ş. (2011). Baskın olarak bütüncül stilde düşünenlerle baskın olarak analitik stilde düşünenlerin problem çözme davranışlarının karşılaştırılması, *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 30*, 27-37.