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The Needs of Gifted Middle School Students for Developing an Effective Mathematics Program

Firdevs İclal Karataş Aydın

Giresun University, Giresun, Turkey

ABSTRACT

This study aims to determine the needs of gifted middle school students for developing an effective mathematics program. In particular, this needs assessment study was conducted to reveal the gap between practice and expected situation in the implementation of the Turkish middle school mathematics program. The data were gathered from 60 gifted students and two mathematics teachers. Mixed methods research was used in this study. According to the results, the primary needs were determined as developing an enriched mathematics program. This program should include a more comprehensive and deep knowledge of content, interesting topics, and mastery of arithmetic skills. Also, the effective use of information and communication technologies should be supported by the program. Instead of the direct teaching method, inquiry-based learning should be applied in the classrooms. In addition, real-life applications outside the classroom should be embedded in the program. Mathematical tools and materials should be provided to create a mathematics laboratory environment. On the other hand, mathematically gifted students should be identified and some workshops should be prepared for supporting their special needs. The accelerated mathematics program can be used for mathematically gifted students. Basic proof methods and abstract thinking skills can be included in the program designed for mathematically gifted students.

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1. Introduction

Education plays an essential role in the development of society. If people are educated according to their own interests and abilities from childhood, they can be self-realized individuals and they can form a strong society (Davidson, Davidson & Vanderkam, 2007). Today, despite the equal implementation of curriculum for everyone, the aim of the education system is not standardized for individuals. Riley (2011) stated that each individual is different from the other and students coming to the classroom with their own cultures, talents, religions, socio-economic levels, experiences, backgrounds, learning styles, and expectations. Hence, the new regulations in the education system in Turkey consider individual differences and try to discover the talent and interest of the students (MoNE, 2018). Gifted students also constitute one of these special groups of students.

The study conducted by Terman (1925) on intelligence measurement has been regarded as a pioneer of the studies on giftedness. However, there has been no commonly accepted definition and conception of giftedness by researchers (Pfeiffer, Shaunessy-Dedrick & Foley-Nicpon, 2018). While

[1] Corresponding author's address: Giresun University, Giresun, Turkey
e-mail: iclal.karatas@giresun.edu.tr
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some researchers accept that gifted children should be determined based on their intelligence test scores (Jensen, 1980), others claim that there are a number of characteristics that cannot be determined by these tests (Gagné, 2015; Renzulli, 2016; Sternberg, 2018). As a result, there is no universally agreed definition of giftedness among researchers, and definitions of giftedness have expanded beyond intelligence-based conceptions. As a comprehensive definition, gifted children are those who demonstrate outstanding ability in one or more domain, such as, intellectual, artistic, creative, leadership, and/or in specialized subject areas such as literature, science and mathematics when compared to their same-age peers (MoNE, 2012; National Association for Gifted Children, 2005).

Considering the common points of giftedness definitions, when preparing instruction and curriculum, different learning characteristics of gifted students than their peers need to be considered (Tomlinson, 2014). For instance, they usually have a deeper and broader body of knowledge than their peers of the same age (Gross, MacLeod, Drummond & Merrick, 2001). In addition, they generally learn faster and absorb a greater amount of information than their classmates (Hébert & Neumeister, 2000). They are intellectually more curious, and they usually pose more questions than a teacher has time to answer throughout a school day's lesson (Heacox & Cash, 2020).

However, gifted children are more neglected group in special education and they do not adequately benefit from educational opportunities. Although there is a consensus on the opinion that providing education for disabled people is a prerequisite to being a developed society, this consensus is not built when gifted children are the subject (Ataman, 2004). Also, the failure of gifted children is seen as a surprising, incredible, and even unacceptable situation. However, research has shown that many gifted children perform below their intellectual potential (Levine, 2003). The common idea that a bright mind will go its own way causes this situation (Sternberg, 2020). Intellectual and creative talent cannot overcome the ignorance and irrelevance given to education. If gifted children can be identified and educated as early as elementary school, these children can make extraordinary contributions to society in the fields of art, politics, business and science in the future life (Renzulli, 2012).

Due to society's rising technology focus and the growing demand for leadership in mathematics and science, the education of gifted children is an extremely important issue in many countries. Especially in developed countries such as Canada, Germany, Russia, and the USA, the education policy of gifted children has become a government policy (National Association for Gifted Children, 2010). Although practices related to gifted education have a long history in Turkey, there has been a significant quantitative and qualitative deficiency in this issue (Sak, 2011). There have been some attempts to consider the economic, social, educational, and technological developments of Turkey in order to reach more gifted children. Science and art centers (BILSEM) have been established by the Ministry of National Education. BILSEM conducts educational activities after school hours to address the needs of gifted students. Furthermore, some private schools have recently provided opportunities to gifted students in separate and homogeneous schools or classrooms. Part-time educational programs at the Children's University and resource rooms have also been among the opportunities offered to gifted students by some private foundations.

According to the National Association for Gifted Children (2014), gifted students constitute nearly 6% of the overall student population and have special skills and needs that necessitate curricular modifications (Assouline & Lupkowski-Shoplik, 2011; Ozdemir & Isiksal-Bostan, 2021; Winebrenner & Brulles, 2012). Many countries in the world have shown mixed attitudes towards gifted students and their education throughout the years. The preference for excellence or equity has created tension. So, governments have followed different policies for the education of talented and gifted students (McCoach & Siegle, 2007). Since different education systems bring different perspectives to giftedness, a variety of approaches and applications are developed and applied in the field of gifted education (Akarsu, 2004). According to some studies, the most effective model is the separate schools for gifted students (McCoach, Rambo & Welsh, 2013; Rogers, 2002).

In this light, special education programs (formal and informal) have been prepared for gifted students. Some gifted education specialists believe that gifted students should be removed from regular students and placed in full-time formal education institutions with other gifted students (Fiedler, Lange & Winebrenner, 2002). On the contrary, some experts believe that separating gifted students from regular students can create an elite group and this contradicts with democratic educational process (Gamoran, 1992; Maker & Nielson, 1996; McDaniel, 2002). They hold the opinion that all students should be in regular classrooms as a heterogeneous group. The common belief is that gifted students would develop their extraordinary abilities and lead societies, even if they did not get the necessary training. Although there are various perspectives on whether gifted students receive training in the same class as their regular peers or in a separate class, the opinion that these students need a qualitatively distinct program outside of the standard curriculum to satisfy their unique learning demands is widely accepted (Chan, 2001; Ozdemir & Isiksal-Bostan, 2021; VanTassel-Baska & Stambaugh, 2005).

Furthermore, Van Tassel-Baska and Brown (2007) examined existing gifted education programs and curriculum frameworks to see whether there was any evidence of their effectiveness when used with gifted students. Among 20 models, only 11 of them matched the requirements for being considered a curriculum model, and only five of these models were determined to show some evidence of effectiveness with gifted students. Similarly, Ozden (2015) emphasized the necessity of education programs for gifted students to address the shortcomings which were not determined by intelligence quotient (IQ) tests. In addition, the positive effect of the differentiated mathematics program on the success, creativity, attitude, and academic self-concept of 5^{th}-grade students is stated in the literature (Deringol Karatas, 2013). In this respect, there is room to conduct some research studies on the determination of the needs of gifted students for developing mathematics programs (Aygun, 2010). Hence, the current study may contribute to the literature and educational settings by providing some evidence of what shoud be the characteristics of an effective mathematics program for gifted students.

Although some countries had a long history of gifted and talented education, Turkey fell behind the other countries about gifted education. Since the Turkish national curriculum has been developed and adapted considering the abilities and learning capacities of regular students, it has not been meeting the educational needs of gifted learners (Levent & Bakioglu, 2013). Gifted students differ significantly from their peers in terms of their characteristics and needs due to the fact that they need different educational programs than regular educational programs (Akgul, 2021; Tomlinson, 2014). The educational programs enable students to make sense of and use the knowledge and skills they have acquired (Tanner &Tanner, 1980).

Accordingly, determining the needs of gifted students and developing an effective program to meet their needs is essential in today's society. In particular, in mathematics education, such a need arose for gifted students who required additional support in the classroom (Karaduman, 2010; Dimitriadis, 2011). Following the curriculum for regular students make them bored in mathematics classrooms (Ozdemir & Isıksal-Bostan, 2021). They need differentiated educational programs that reveal and develop their potential, creativity, and skills (Baykoc, 2010; Ozyaprak, 2016). Hence, the aim of this study is to determine the needs of gifted students for developing an effective mathematics program for homogeneous classrooms in order to meet their needs.

1.1. Problem Statement

The problem is that the needs of gifted students are often not met in the regular mathematics curriculum and classroom (VanTassel-Baska, Hubbard & Robbins, 2021). Gifted students often receive the exact same assignments as their peers, not being challenged in the way that they should. Why their needs in mathematics are not being met and what can be done about this problem is an important issue to consider. The intent of this study is to find out the needs of gifted students in the mathematics classroom and to provide recommendations for resolving this problem that gifted

students should receive an education that caters to their learning styles and learning needs (Ysseldyke, Tardrew, Betts, Thill & Hannigan, 2004).

1.2. Rationale

In recent years, there have been some attempts to reach many gifted students in Turkey. BILSEM operates under the Ministry of National Education and some private schools have been established which only gifted students can attend. However, there are no specific educational programs applied in those schools and centers for the education of gifted students. Especially in mathematics education, identifying the needs of those students is an important task worth doing. If they do not meet their needs in mathematics, they may be bored and lose interest in a classroom setting. Otherwise, they may begin to perceive mathematics as a subject in which they do not have to struggle to succeed (Ozdemir & Isıksal-Bostan, 2021). Without appropriate opportunities, mathematically gifted students may never develop the skills, motivation, and perseverance they need to reach their potential. Hence, the necessity to develop a mathematics program that meets the needs of gifted students prompted the idea to conduct this study.

2. Methods and Procedures

2.1. Design of the Study

A convergent mixed method was used in this study. In this method, qualitative and quantitative methodologies are mixed within or across stages of the research process (Creswell, Plano Clark, Gutmann & Hanson, 2003). The purpose of this form of research is to provide a better understanding of both qualitative and quantitative research together than either research approach alone. Also, the purposive sampling method was applied because this study aims to determine the needs of gifted students in a private school which only gifted students attend.

2.2. Participants of the Study

There were two different information sources in the current study. The first information source was 60 gifted students (17 girls and 43 boys), who attended private middle school for only gifted students. The study was conducted with (30) 5th, (10) 6th, (9) 7^{th}, and (11) 8^{th}-grade students. Identification of those gifted students was done by WISC-R Intelligent Test score of students and aptitude tests. In this school, mathematics program which is prepared by MoNE is followed.

The other source of information was two experienced mathematics teachers who retired from public school. They took in-service training in gifted education because this was their first time working with gifted students in homogeneous classrooms. Both teachers were male. They have been working at this school for two years.

2.3. Data Collection Instruments

The data were collected through survey and interview in this study. 'An Evaluation of Mathematics Program' survey was designed by the researcher to identify the needs of gifted students for developing an effective mathematics program. It involves three parts. In the first part, some demographic information such as gender, age, and grade level were asked. The second part contains one yes/ no question and 21 Likert-type items. The participants were asked to score their agreement level on certain statements (from 1- strongly disagree to 3 strongly agree). In the last part, they ticked up to their preferences for given statements. Also, two open-ended questions were asked to allow more freedom. Hence, this survey includes many types of questions. Open-ended questions provide more freedom; they give respondents a chance to say what they want, even if the answers are less precise.

Individual interviews with mathematics teachers were conducted. The interview questions focused on the opinions about the current mathematics program, the situations which they experience and expect because of teaching mathematics for gifted students. In particular, seven questions were asked in the interview. The sample questions from the interview were as follows: Is mathematics lesson hours

enough for you? Why? What do you think about the current mathematics program? What do you think about acceleration, enrichment and the MoNE mathematics program for gifted students? Which problems do you face frequently to teach mathematics for that specific group of students? and If you had a chance to change the program, how would you do this? Which characteristics should be included in the program?

2.4. Data Collection and Analysis Procedures

First of all, the problem was identified and the aim of the study was determined. Then, six gifted students who are interested in mathematics were selected. The opinions of these students and their parents about the mathematics program were taken through reflection papers. The parents from different professşions such as an academician in education faculty, self-employment, housewife, and mathematics teacher and also their degree of education were considered. The reason for such a selection was the determination of the needs of gifted students from different perspectives. The students and their parents write their reflections on what they think about the current mathematics program and what they expect from the mathematics program. After reflection papers were examined, survey questions were formed based on the results from the data and related literature. Then, survey questions were revised by an expert in needs assessment, a mathematics teacher, and nine gifted students. The final version of the survey was applied to students in a mathematics lesson. In the final version of the survey, there were seven main questions.

In addition to the survey mentioned above, a structured interview was conducted with mathematics teachers individually. The purpose of the interview was to collect data about teachers' current experiences and expected situations related to the mathematics program. In this way, more detailed information was gathered from teachers to support the findings.

In quantitative data analysis, both descriptive and inferential statistics were applied. All statistical analysis were carried out by SPSS 20 software program. The demographic characteristics of the participants were organized and demonstrated using mean, standard deviation, frequency distribution in terms of descriptive statistics. Also, inferential statistics were used to interpret the results from the survey. First of all, each item of the questions was considered by itself in this part of the section. In order to determine the needs of gifted students for the mathematics program, descriptive analysis including mean, standard deviation,and frequency were calculated. The results of the data were reported based on the range interval of (3-1)/ 3. In other words, three dimensions as low, moderate and high determined to interpret the findings. If mean scores of items are between 1 and 1.66, the needs are considered as 'low'. If mean scores of items are between 1.67 and 2.33, the needs are considered as 'moderate'. If mean scores of items are between 2.34 and 3.00, the needs are considered as 'high'.

Moreover, the researcher recorded the interview and took notes at the same time. Then, the transcripts and notes were reviewed, occasionally wrote down direct quotes that were deemed especially relevant. While analyzing the data, the answers of each teacher were separately examined. Both obtained data from teacher interviews and open-ended questions in the student survey were analyzed using content analysis (Yıldırım & Simsek, 2006). Initially, the data were categorized based on the responses. During the analysis of the categories, sub-categories were formed to cover all data. Some of the categories they would have covered the codes merged together. For the current study, participants were mentioned as Student 1,2, etc. to ensure ethical procedures.

3. Results

In the first survey question, students answer whether mathematics lesson hour is enough for them or not. According to the results, 53.3 % of the students replied to the question as "no ", the others replied to the question as "yes". The results from question 1 showed that mathematics lesson hour is not enough for nearly half of the students. This may be due to mathematics lesson hour in this school is less than the mathematics lesson hours suggested by MoNE. Student 27 commented: "*I believe that the*

number of hours for mathematics lessons is not enough. Instead of four lesson hours, it may be six or eight. We are not able to do much in four lesson hours. In my opinion, some new topics should be included and instructional methods that encourage more critical thinking should be used". Also, mathematics teachers took some extra lessons from other teachers in order to complete the curriculum. Hence, students who say yes may be included extra lessons as their regular mathematics lessons. Moreover, mathematics teachers reported in the interview that mathematics lesson hour is not enough for them to finish off the curriculum.

Furthermore, the mean scores related to gifted students' opinions about the current mathematics program which they apply were shown in Table 1. The results revealed that the lowest mean score for question 2 is related to application of the MoNE mathematics program. . It can be inferred that MoNE mathematics curriculum is not suitable for gifted students. In open-ended questions, student 1 said: "*In my opinion, the current mathematics program is too boring. I do not say the mathematics program is removed. However, it may be enriched for us*". Also, mathematics teachers' opinions about current program support the student's reflection. Mathematics teachers reported that a new mathematics program should be prepared according to the needs of gifted students. The highest mean score (M= 2.72, SD= .6) for item related to enriched mathematics program supports the teachers' opinions. The opinions of student 21 were also supported the idea as in the following: "*I do not support the current mathematics curriculum because gifted students have the ability to perform better. If the student is in the 5th grade, they can understand the 6th-grade mathematics topics, and if they are in the 4th grade, they can understand the 5th-grade mathematics topics. However, we can sometimes take lessons that are lower and simpler than our level because we are placed in the same category as typical children. As we progress to easier lessons, mathematics becomes a boring subject for us*". This verbatim could be accepted as evidence that enriched mathematics program and accelerated mathematics program are the preferences of gifted students because of their ability to perform better than their peers.

Table 1. Mean scores for question 2

Your opinions about current mathematics program which you apply:	n	M	SD
I think that mathematics program applied in my school is adequate.	60	2.40	.72
I want to apply mathematics program prepared by MoNE in my school.	60	1.60	.69
I want to apply accelerated mathematics program prepared for upper class in my school.	60	2.12	.76
I want to apply enriched mathematics program with a variety of topic in my school.	60	2.72	.56
I want to apply revised mathematics program (adding or removing some topics) in my school.	60	2.17	.72

In addition, the mean scores related to gifted students' opinions about which characteristics should be included in mathematics lessons were shown in Table 2. According to the results, the lowest mean scores for items related to using the direct teaching method. Also, they mentioned that they do not like the lessons when they were passive learners. Characteristics of gifted students were considered, the direct teaching method does not allow students to be creative, think abstractly, and have a reflective attitude. Hence, the direct teaching method may not be a suitable method for gifted students. Also, the highest mean score (M=2.87, SD=. 4) for item related to inquiry-based learning supports this claim. Compared to learning by inquiry and direct teaching methods, gifted students prefer learning by inquiry (Ozgur &Yılmaz, 2017). The studies showed that gifted children prefer open-ended activities (Kanevsky, 2011) and studying independently (Sekowski, Siekanska & Klinkosz, 2009). Mathematics laboratory environment equipped with mathematical tools and materials, high school exam preparation, organization of workshops and inclusion of higher-level mathematics program for

mathematically gifted students, solving more question and providing comprehension of the topic and also evaluation system based on the projects, assignments, class participation and performance were determined as the characteristics of the mathematics lesson for gifted students based on the results of this study. To illustrate this, student 12 said: " *Mathematics lessons should be categorized into students' ability of mathematics. Hence, gifted students can be encouraged to pursue a career in the field of mathematics. In mathematics lessons, formulas should not be given directly, and students should be provided to find the formulas. As a result, gifted students will be able to solve problems by exploring and thinking more*". In addition, student 9 mentioned their opinions: "*If there are topics which we are responsible for the high school entrance exam, we should examine the questions in enriched content and do homework on similar questions*".

Table 2. Mean scores for question 3

In your opinion, which of the following characteristics should be included in mathematics lessons?	n	M	SD
I think that high school entrance exam preparation should be made.	60	2.68	.54
I think that more questions should be solved and fully provided comprehension of the topic.	60	2.50	.65
I think that workshops should be organized for students who are interested in mathematics and highest level mathematics topics should be included in their programs.	60	2.60	.62
I think that mathematically gifted students should be prepared specifically for Mathematics Olympics.	60	2.40	.74
I think that mathematics lesson should always be based on project-based learning.	60	1.72	.72
I think that mathematically gifted students should be determined and they should attend university level mathematics courses.	60	1.97	.82
I think that mathematics lesson should be based on only direct-teaching method.	60	1.42	.72
I think that mathematics lesson should be a lesson in which students actively participate and make a presentation and an activity.	60	2.87	.39
I think that there should be no exam in mathematics lesson.	60	2.15	.86
I think that mathematics lesson should be evaluated according to projects, assignments, class participation and performance.	60	2.35	.73
I think that mathematics text books and materials are sufficient.	60	2.02	.79
I think that mathematics lesson should be made in mathematic laboratory equipped with mathematical tools and materials.	60	2.70	.56

Moreover, the mean scores for their desired mathematics curriculum were shown in Table 3. When the preferences of gifted students were considered, helping them in their social and future educational life was reported mostly. On the other hand, learning many mathematical concepts, ideas and skills are not important as the applicability of real life. It can be concluded that the application of mathematics in real settings is more important for gifted students than learning many mathematical concepts.

Table 3 Mean Scores for Question 4

Mathematics program will be implemented in our school;	n	M	SD
should teach many mathematical concepts, ideas and skills	60	2.53	.62
should prepare me to be interested in mathematics, creative and independent thinker	60	2.77	.53
should help me in my future studies	60	2.78	.52
should be applied in real-life.	60	2.73	.48

Besides, in question five, choices were made a list of possible options to determine the characteristics of the expected mathematics curriculum. The frequency table as shown in Table 4 was formed according to the results of the data. Student 49 commented: "*Some unnecessary topics should be removed and topics that will be useful in our future life should be added in mathematics program*".

Table 4 Frequency of the Expected Mathematics Program Characteristics

Characteristics of the program	F
Higher level of complexity combined with abstract concepts	9
Focusing on problem solving	28
Interdisciplinary connections	17
In-deep content	20
Focusing on operational skills	32
Focusing on interested topics	35
Effective use of information and communication technologies	34
The use of information on the development of mathematics	28
Using robotics skills with mathematics and other disciplines	27

According to Table 4, focusing on interested topics and effective use of information and communication technologies are the most desired characteristics of mathematic program should have. On the other hand, a higher level of complexity combined with abstract concepts is the least frequent answer among gifted students. It may be due to the fact that mathematically gifted students are more interested in abstract mathematics concepts.

Moreover, open-ended questions what they would do if they had a chance to change program themed around the following statements in order according to repetition frequency: more comprehensive and deep content, real-life applications outside the classroom, activity-based lessons with more material, technology integration, games and videos to support the learning, interdisciplinary connection, and problem solving. These are some examples from the students' answers.

> Student 42: "*I believe the program will be more effective if the subject is better understood through the use of more instructional games*".
>
> Student 23: "*For me, the knowledge I have gained is insufficient; high-level information should be incorporated into the curriculum*".
>
> Student 19: "*I would add robotics skills to math class*".
>
> Student 28: "*I would have made it more understandable with more material*".
>
> Student 30: "*Apart from notebooks and books, more visuals should be included and different sources should be used* ".
>
> Student 57: "*A program that is more concrete and associated with events from daily life should be made*".

Finally, interview results from mathematics teachers were themed around the following statements: an accelerated program for mathematically gifted students, projects should be determined according to students' needs and the nature of the topic, real-life applications is necessary and measurement and evaluation was inadequate. Mathematical tools and materials should be provided to create a mathematics laboratory environment. The findings from the interviews of mathematics teachers were similar to the opinions of gifted students. Some excerpts from the interviews were as follows.

> Teacher A: *Gifted students should be encouraged to recognize the importance of mathematics…It is important to use technology and robotic skills in order to catch up with the era. Integrating mathematics with daily life and other disciplines will increase their creativity and reasoning skills. The individual abilities of the students should be determined and they should be supported on the subjects of interest*.

4. Discussion and Conclusions

This study investigated the gap between practice and expected situation in the implementation of the Turkish middle school mathematics program to determine the needs of gifted students who attended middle school. According to the results, the lesson hour of mathematics is not enough for both the majority of gifted students and their teachers. Similar to the findings of the studies (Abu, Akkanat & Gokdere, 2017; Kaya, 2015), the results of the present study revealed that the current middle school mathematics program does not address gifted students' diverse needs. The results of this needs assessment study indicated that enriched mathematics programs should be applied for gifted students. This program should include more comprehensive and deep knowledge, interesting topics. It should promote the development of operational and problem-solving skills. The results are consistent with the studies (Boran & Karakus, 2021;Karatas Aydın& Isıksal Bostan, 2021; Miedijensky & Tal, 2016; Sen, Ay & Kiray, 2021) that enriched mathematics program to develop problem solving and operational skills are recommended for gifted students.

In addition, the results from this study revealed that mathematically gifted students should be identified and special workshop programs should be prepared for them. A possible explanation for this might be that mathematically gifted students have not been challenged in the regular classroom when following the regular program (Ozdemir & Işıksal-Bostan, 2021). Based upon the results from the current study, the accelerated mathematics program should be used for mathematically gifted students. Basic proof methods and abstract thinking skills might be included in that program. The results of the present study also supported the idea that gifted students should be able to develop higher-order thinking skills through a differentiated program. The activities for this special group of learners should primarily focus on conceptual learning and maintain a high degree of student interest. The finding of this study is consistent with the study of Tomlinson and colleagues (2003) that the differentiated program for all ability levels should be based on the students' interest, learning profiles, and readiness. Consistent with the findings of the study (Campbell & Walberg, 2011) suggested that mathematically gifted students should be prepared for Olympiad studies.

Furthermore, the results of the present study revealed that the use of information and communication technologies should be integrated into the mathematics program for gifted students. In recent years, information and communication technology has become a prevalent instructional tool for developing and replacing conventional delivery methods, as well as improving education for gifted students (Wallace, 2005). The effect of technological tools on students' learning in the areas of critical thinking and adjusting curriculum to make it more challenging has been the focus of recent studies on the use of technology in gifted education (Dixon, Cassady, Cross & Williams, 2005). Similar to the results from this study, gifted students stated their positive opinions related to the use of technology for their learning (Duda, Ogolnoksztalcacych & Poland, 2010; Gadanidis, Hughes & Cordy, 2011). On the other hand, it is one of the most common trends that teachers design their learning-teaching environments according to the central examination systems that students will enter and determine the purpose and content in the focus of these exams (Cetin & Unsal, 2018). The findings of this study support the idea that central exam preparation is also important for gifted students and their teachers.

Another result of this study indicated that inquiry-based, discovery learning methods that promote open-ended problems with alternative solutions or paths should be provided in the mathematics programs. It should enable students to develop their own strategies for obtaining results to challenging questions. The previous literature supported the result of the present study is that the creative-thinking ability of gifted students should be considered for developing a new program (Sen et al., 2021). Gifted children's ability to come up with multiple solutions to the same problem, have original perspectives and willing to take risks is higher than their same age peers (Sekowski et al., 2009). Also, Kanevsky (2011) stated gifted students have creative problem- solving skills especially in challenging problems. Inquiry learning enables gifted students to state hypotheses and explains outcomes, and creative thinking helps the students in doing so (VanTassel-Baska et al., 2021).

On the other hand, learning material for gifted students should satisfy a number of requirements to provide the best learning opportunities (VanTassel-Baska & Brown, 2007). The implementation of an advanced curriculum at an accelerated rate contributes to faster and better acquisition of knowledge and problem-solving abilities of gifted students. (Robinson & Clinkenbeard, 2008). Also, multiple higher-level thinking skills should be embedded (VanTassel-Baska & Brown, 2007) and learning material should call upon the metacognitive skills of students (Bronkhorst, Drent, Hulsbeek, Steenbergen-Penternman & van der Veer, 2001), like inquiry learning does (VanTassel-Baska et al., 2021). Therefore, mathematics textbooks should provide more enriched opportunities. Unfortunately, the topics in mathematics textbooks have been repeated year by year in the grades (Johnson, 2000). Since most textbooks are written considering the general population, they may not be suitable for gifted students. Hence, mathematics tools and materials should be prepared according to the needs of gifted students.

The other suggestion based on the result of this study is that real-life applications outside the classroom. Students reported in open-ended questions that they were bored in the classroom and wanted to go outside in order to apply their learning. At least two lesson hours should be allowed for real-life applications. For example, gifted students go to factories after they learn the length measures and learn by doing.

Recently, STEM (Science, Technology, Engineering and Mathematics) education gains more importance. It has been widely used when discussing education policy and curriculum decisions in schools in order to increase scientific and technology development competitiveness. Also, this interdisciplinary approach should be used to support gifted students (Sen et al., 2021). In addition, using robotics skills with mathematics and other disciplines is recommended for gifted students based on the results of this study.

5. Future Works

This study was limited to only middle school gifted students and their mathematics teachers. Also, developing the curriculum the views of not only students and teachers but also parents and administrators is important. In future studies, parents and administrators may also be involved in the research. Moreover, primary students and their classroom teachers may be included in further studies. Hence, the comparison can be made between primary school and middle school mathematics classrooms in terms of meeting the needs of gifted students. Another limitation of the current study is the research setting which is a homogeneous school and homogeneous classroom environment. The needs of gifted students in different research settings such as heterogeneous mathematics classrooms, separate rooms, and Science and Art Centers can be investigated and their needs can be comparable in further studies.

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