Mathematically Giftedness from the Perspectives of Preservice Mathematics Teachers

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Abstract
In this research it is aimed is to examine the views of preservice mathematics teachers (PMTs) on mathematically giftedness. Case study, one of the qualitative research design, was used and the study involved 25 sophomore mathematics teaching undergraduate students from Turkey. Data was collected with a semi-structured interview form with open-ended questions and analyzed with content analysis method. As a result of the analysis of the data three themes comprising of definitions of giftedness, characteristics of gifted students including sub-themes of cognitive, affective and social traits, and mathematically gifted students including sub-themes of cognitive and affective traits were emerged. As a result of the study it was determined that the majority of the participants thought that the gifted students have exceptional performance in intelligence or creativity in a spesific area. The cognitive traits of gifted students were favorably listed as being curious or asking questions, strong verbal skills, high performance compared to the peers, fast thinking and learning, creativity and abstract thinking. The affective traits mainly included sensitivity, sense of justice, impatience, sense of humour, intense interest/concentration, diligence and patience, responsibility, curiosity, perfectionism and motivation. The social characteristics of gifted were emerged as preference to communicate with adults, enhanced social relationship (resulting in leadership), rarity in society and valued by society. On the other hand, characteristics of mathematically gifted students have been classified as cognitive and affective traits according to the views of PMTs. Cognitive traits of mathematically gifted students mostly composed of quick, unusual and multiple solutions to problems, analytical thinking, proficiency in mathematics, interest in numbers at an early age, and questioning. Affective characteristics of mathematically gifted students have been found to be introversion, peer disapproval, self-confidence, responding maturely, good sense of self-expression, sense of wonderment, and willingness to learn. As a result, most of the views of PMTs were found to be similar to the literature. Considering that the participants took elective course "Teaching Mathematics to Gifted Students", it can be stated that it is important to give lectures on giftedness to prospective teachers in their undergraduate education.
Keywords: Mathematically Giftedness, Preservice Mathematics Teachers, Views.

Introduction

Gifted individuals are undoubtedly one of the most important resources for emergence of creative ideas, which can be used to achieve targeted revolutions and the development of countries (Arabacı, 2022). Due to this, gifted individuals have been the subject of numerous studies from the past to the present. The definition of giftedness is one of the most important topics in studies of gifted individuals. Even though there are many definitions of giftedness, it is impossible to talk about one that has been agreed upon (Education and Training Committee, 2012). However, one of the prominent definitions belongs to Renzulli (1978), who claims that giftedness emerges in the interaction of the 3 rings which are above average ability, task commitment and creativity.

Renzulli (1978) further argues that gifted children possess these composite characteristics and can apply them to any potential field of human performance they are proficient in. Gifted students are defined as those who perform or have the capacity to perform at a higher level in one or more areas than other students of the same age, experience and environment, according to the National Association for Gifted Children [NAGC] (2023). It is considered gifted for Turkish students who are able to learn faster than their peers, are creative, artistic and leadership-oriented, have special academic abilities, comprehend abstract ideas, like to behave independently in their interests, and perform well (Ministry of National Education [MoNE], 2019). Research has defined giftedness in various ways, but it usually consists of high IQ scores (general giftedness), high performance in a particular area (special giftedness), above-average abilities (usually associated with the first two criteria), task surrender (commitment to a task) and creativity (Leikin & Lev, 2007). All gifted student groups possess general abilities, but some specific groups or individuals display unique domain-specific abilities, called special abilities (Song & Porath, 2006). In this situation, field-specific superior talent becomes a concept worth examining separately since it is relevant to a specific field. In fact, VanTassel-Baska (2005) emphasizes that giftedness must take into account talents in specific fields such as verbal, mathematical, scientific, artistic and social abilities. Mathematical giftedness is therefore a concept that should be treated and examined separately from general giftedness.

Mathematical giftedness is considered a special type of giftedness in the field of gifted education (Leikin, 2018). Nonetheless, mathematics giftedness lacks a commonly accepted definition (Pitta-Pantazi et al., 2011). Generally speaking, giftedness in mathematics is defined as having different intellectual abilities in mathematics (Leikin & Lev, 2007). Krutetskii (1976) defined gifted individuals in mathematics as individuals who possess mathematical thinking, a term used to describe the tendency to perceive the world and non-mathematical phenomena from a mathematical perspective. The potential of students with this distinct mental organization can only be fully utilized if all aspects of their abilities are supported. According to Leikin (2018), mathematical giftedness is a dynamic personality trait associated with high mathematical potential that must be nurtured, supported, and encouraged. It is therefore essential to carefully develop mathematical giftedness in order to promote both individual and social well-being, self-esteem, and technological, scientific, and social progress (Leikin, 2021). Hence, it is undoubtedly the teachers who will teach them who have the most important task. The role of teachers in gifted education is widely acknowledged as being integral (Krijan et al., 2015; Reighley, 2013).

A discussion among gifted educators has focused on how beginning teachers can improve their awareness and education of gifted students (Chamberlin & Chamberlin, 2010). The attitude of teachers towards gifted students affects how they behave and act toward gifted students (Chamberlin & Chamberlin, 2010; Freitag, 2020; Krijan et al., 2015) and teachers' perceptions of students are crucial to meeting gifted students' needs (Chamberlin and Chamberlin, 2010). Furthermore, it is stated that pre-service teachers may have prejudiced emotions and behaviors about gifted students due to their lack of knowledge about the nature and needs of gifted students (Troxclair, 2013). Gifted students are not adequately supported in normal classrooms due to negative teacher attitudes and false beliefs about these students (Tortop & Ersoy, 2015). This can result in teachers not meeting the needs of gifted students (Reighley, 2013). For gifted students to develop their potential, teachers and thus pre-service teachers must be knowledgeable about students' cognitive, emotional, and social needs (Krijan et al., 2015) in order to help them reach their full potential. Teachers will also be able to understand gifted children's differences if they are knowledgeable about their characteristics and approach them positively (Çapan, 2010). As a result, teachers and future teachers who will teach gifted students need to have the right attitudes and beliefs about gifted students (Troxclair, 2013). For the future of gifted education, it is considered very important to train teachers who can view society through the lens of multiculturalism and view the classroom as a mini society (Tortop & Ersoy, 2015).

The literature indicates that pre-service teachers have low awareness of gifted students (Akar & Şengil Akar, 2012; Berman et al., 2012; Chamberlin & Chamberlin, 2010) and some negative or incomplete beliefs and attitudes (Aytekin et al., 2019; Krijan et al., 2015; Reighley, 2013; Troxclair, 2013). Consequently, teacher education programs should include topics and experiences related to giftedness and their needs (Berman et al., 2012; Chamberlin & Chamberlin, 2010; Reighley, 2013; Troxclair, 2013). In order to effectively teach these students, pre-service teachers must first understand their current beliefs about them (Reighley, 2013).

Science and Art Centers (SACs) in Turkey provide five stages of educational programs for gifted students. Specifically, this program addresses adaptation, support training, recognition of individual abilities, development of special abilities, and project production and management (MoNE, 2019). This training program carried out by SACs exposes the importance of identifying talent in a specific field and developing it through educational activities. The Ministry of National Education provides special tools and educational materials to enable gifted students to take advantage of education services offered in schools affiliated with it, where they continue their formal education apart from SACs (MoNE, 2019). Consequently, perception and awareness of teachers who work in public schools affiliated to SACs and MoNE regarding gifted students in mathematics influences the quality of the education they can provide. Battal Karaduman (2010) pointed out that one of the most important points for teachers is to recognize different aspects of gifted students in mathematics in order to develop them. Thus, an education program prepared by taking into account the characteristics of gifted students in mathematics can be beneficial for them. Accordingly, it is important to note that pre-service mathematics teachers' [PMT] perceptions of gifted students in mathematical and general ability play a key role in shaping their ability to develop an educational environment tailored to the needs of gifted students. Identifying the perceptions of PMTs regarding gifted students in mathematics can be used to determine the current situation and make the necessary corrections. It is well documented in the literature that pre-service teachers have positive attitudes towards gifted students, but no studies have examined the views of pre-service teachers towards gifted mathematics students. A major deficiency can be seen in this situation given the increasing importance of field-specific talent. Examining the views of PMTs regarding gifted students in mathematics will reveal clues about their teaching experiences. It is considered important to evaluate the current situation in order to identify the necessary issues and to make the necessary arrangements and interventions in that direction. Indeed, gifted students can develop their potential in mathematics if they have supportive mathematics teachers. In this respect, the aim of the research is to examine the views of PMTs on the concept of gifted students in mathematics.

Method

Research Design

Case studies, one of the qualitative research designs, allow us to examine the cases in detail as well as the participants' perspectives on the emerging environment (Gall et al., 2003). As this study aims to examine perceptions of giftedness in general and in mathematics in PMTs' views, it adopts a case study design in the process.

Participants

This study involved 25 sophomore mathematics teaching undergraduate students from a state university located in the Western Black Sea Region of Turkey in the spring semester of the 2019-2020 academic year. Purposive sampling method was used to select the participants of the study from the PMTs taking the elective course "Teaching Mathematics to Gifted Students". When working with special cases fulfilling certain criteria or possessing certain characteristics, purposeful sampling enables in-depth analysis by selecting situations rich in information (Creswell & Plano Clark, 2017).

Data Collection Tools

Data were collected at the end of the elective course. A semi-structured interview form with open-ended questions was used to collect data for the study. Researchers created a semi-structured

interview form that included nine open-ended questions to determine PMTs' views on giftedness and mathematical giftedness. The questions were finalized after consulting with an expert in mathematics education before applying the semi-structured interview form to PMTs. In addition to removing repetitive questions, some questions were added, and wording of some sentences were revised taking the suggestions into consideration. Approximately 20-30 minutes were spent on each interview. Table 2 shows the questions in the semi-structured interview form as well as information about their purposes.

Table 2 Semi-Structured Interview Questions and their Purposes

Purpose	Interview questions
Definitions of giftedness	Describe talent in your own words.
	What do you think about the development of talent? Why?
	If you think of giftedness, what comes to your mind first? Please explain.
Characteristics of gifted students	If you were asked to describe a gifted child with five adjectives, what would you say? Please explain.
	What do you think is the most distinctive feature/s that distinguish gifted children from their peers? Why?
	Did you have a classmate who you thought was gifted when you were back in school? Can you tell me what field you thought they were gifted in? Provide reasons why you believed that.
Characteristics of mathematically gifted students	How do you define giftedness in mathematics?
	In what ways can you identify a child who is gifted in math? Can you explain the differences between a gifted child and a child with a normal development in mathematics?
	Did you have a classmate who you thought was gifted in mathematics when you were back in school? Provide reasons why you believed that.

Data Analysis

Content analysis was performed on the collected data. In content analysis, the codes emerge during the analyzing process, and then they are divided into categories, and these categories come together to form themes (Kleinheksel et al., 2020).The raw data were coded according to the content and the related codes were brought together to form the categories, i.e. sub-themes. Themes were created by combining these sub-themes. Tables are used to present these themes, sub-themes and codes as well as their frequencies.

In order to ensure internal reliability, direct quotes from pre-service mathematics teachers' answers were directly presented without interpretation. The data were also coded independently by two researchers, and each code was checked for consistency. A coefficient of .87 was found for inter-coder consistency suggested by Miles and Huberman (1994). This ensures the internal reliability as it exceeds the threhold value of .80. Pseudonyms were assigned to each participant to protect their privacy.

Findings

Analyzation of PMTs' views regarding the gifted students' characteristics yielded three main themes as shown in Figure 1.

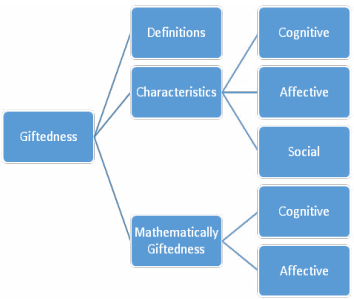

Figure 1 Giftedness in PMTs' views

Figure 1 presents that the views resulted in three themes as definitions, characteristics of gifted students including sub-themes of cognitive, affective and social traits, and mathematically gifted students including sub-themes of cognitive and affective traits.

Findings Regarding the Definition of Giftedness by PMTs

The participants were asked what they associate with and think of giftedness and talent. Table 1 describes how PMTs defined giftedness.

Table 1 Definitions of Giftedness by PMTs

Definitions	Frequency
Exceptional performance in intelligence, creativity, artistry, leadership, or specific academic fields relative to their peers	25
Superiority proven by tests by experts	6
Trait inherited from birth or acquired	6
Capacity to perform a task	1
Outperforming previous performances	1

The majority of PMTs define giftedness scientifically as Table 1 presents. The following quote shows P2's statements regarding this code.

> They are determined to outperform their peers in intelligence, creativity, art, leadership ability, and academic specialization. Students are talented if they differ from their peers in any field and perform a great deal better than expected.

A gifted person is defined by P21 as having both the first code and the second code of being proven to be superior through expert testing. She emphasizes the superiority in a field compared to the peers and states that these individuals should be identified through the use of special reliable tests by experts. It is evident from Table 1 that PMTs also define giftedness as an innate or an acquired talent, an ability to perform a task, or performing better than ever before. Vast majority of PMTs highlighted outperforming their peers for the giftedness. For example, P11 defined giftedness as "the skills possessed by people who are noticeably advanced in a field/skill compared to their peers". A similar statement was made by P18, who described gifted individuals as "people with a high level of performance compared to their peers", and P19 further stated that "people who possess higher levels of intelligence, creativity, and artistry than their peers have". According to P16, a comprehensive definition is as follows:

> As compared with peers, they have a high level of performance in any field. They have a fast-paced development process. Gifted students are those who consistently perform at an IQ of 130 or higher on reliable and accepted intelligence performance tests accepted by experts.

Findings Regarding the Characteristics of Gifted Students

As a means of revealing their views on gifted students, PMTs were asked to define a gifted child with five adjectives and to mention the most distinctive characteristic that distinguishes a gifted student from his peers. PMTs express their views on giftedness in terms of cognitive, affective, and social characteristics as shown below. A majority of PMTs expressed views on the cognitive characteristics of gifted students, followed by views on their affective and social characteristics. Table 2 summarizes the findings related to cognitive characteristics of gifted students.

Table 2 Views by PMTS for the Cognitive Characteristics of Gifted Students

Codes	Frequency
Being curious/asking questions constantly	25
Strong verbal skills/Rich word-hoard	13
Comparatively high performance	11
Fast/easy thinking/learning	11
Creativity	11
Generalizing, having strong intuition, thinking abstractly	9
Superior mind	9
Productive and different solutions	8
Deep and broad interests	6
Unusual memory	6
Fast transition from one step to the next	5
Getting bored quickly, always looking for something to do	4
Interest in experiments	4
Self-learning	4
Enjoying complex and difficult problems	3
Seeing things from a different viewpoint	3
Stubborn, determined, goal-oriented	2
Reasoning ability	1
Special talents in various fields	1
Analytical thinking ability	1
Enjoying messing with numbers	1
Hunger for learning and knowledge	1

Table 2 shows that gifted students have a strong sense of curiosity and are constantly asking questions. Other characteristics that PMTs express most about gifted students are superior performance compared to their peers, quick/easy thinking, creativity, abstract thinking, and giftedness. In P16's opinion, besides being curious about everything, the gifted students are inquisitive because they frequently ask why and how questions, and they are attentive and focused because they can focus for a long time. Practicality comes from their versatility and ability to produce a wide range of solutions. Creativity stems from their openness to new ideas and productivity. Additionally, P6 states that gifted students are able to have imaginary friends because they have developed their imaginations. According to P27, gifted children have the qualities of "inquiring, abstract thinking, high memory, rapid learning, high curiosity" and the reason for thinking that way is that "The gifted children are always on the lookout for information and have a characteristic that questions everything. Since they have a high memory capacity, they never forget and can easily use the information when needed." T8 listed the most prominent features that distinguish the gifted children from their peers as follows:

> "It may be that they are more curious. They may surprise you with the questions they ask. However, these questions are more difficult to answer, and about abstract ideas and concepts. While peers learn step by step, a gifted child can jump from Step 2 to Step 10 and guess the result himself. A preschooler can learn to read and write, unlike his peers. They like to solve difficult and complex problems. Their imaginations are stronger. They enjoy experimenting, tinkering with numbers and solving puzzles."

PMTs tend to express opinions regarding the gifted students' affective characteristics, following the cognitive ones. Table 3 presents the codes regardin the affective characteristics of gifted students in PMTs' views. Table 3 shows that, as for the most expressed affective characteristics, gifted people are said to be sensitive, have a developed sense of justice and impatience, a keen sense of humor and intense interest/concentration. Moreover, PMTs express that gifted children are characterized by intense emotions, determination, patience, and a sense of responsibility, they are also characterized by enjoying complexity, being perfectionists, being highly motivated, and being either introverted or extroverted. For examaple, i It has been shown that gifted children have an intense sense of justice for their emotional characteristics, have a sensitive nature, are impatient and experience their emotions intensely, according to P3. Additionally, P24 asserts that gifted children are characterised by extreme sensitiveness, determination, patience, responsibility, and that these children have developed humor and developed sense of justice. According to P23, these children have a strong sense of perfection and strive to achieve perfection in everything they do. Meanwhile, P17 stated they have introvert/extrovert characteristics and are interested in social events.

Table 3 Views by PMTS for the Affective Characteristics of Gifted Students

Codes	Frequency
An innate sensitivity	11
Enhanced sense of justice	9
Impatience	8
Remarkable sense of humor	6
Intense interest/concentration	5
Emotionally intense	4
Diligence and patience	4
Enhanced sense of responsibility	2
Great interest in the unknown and the mysterious	1
Perfectionist	1
A high level of motivation	1
Introvert/extrovert	1

In addition to these affective characteristics, Table 4 illustrates the social characteristics of gifted students in PMTs' opinions.

As Table 4 summarizes the social characteristics of gifted students, this theme focuses on their social relationships or society's point of view for them. Specifically, this theme focused on the preference of these students to communicate more with their elders, the development of their social relationships, being rare in the society, being valued by society and the characteristics associated with leadership and

individuality. According to P24, gifted children are more likely to communicate with their elders and they are also likely to develop their interpersonal skills earlier in life compared to other children. P3 states that since gifted students have such high intelligence, they tend to talk with adults rather than their peers, so they tend to engage in adult conversation. P26's statement gets at the fact that gifted individuals rarely exist in society and are highly valued by society due to their rarity.

Findings Regarding the Characteristics of Mathematically Gifted Students

This study also aims to uncover what PMTs think about mathematically gifted students. The PMTs were asked to describe what a mathematically gifted child is, how to identify a gifted mathematics child, how a gifted mathematics child differs from a child with a normal development, and if they were aware of anyone they thought was gifted in mathematics in the past. Table 5 summarizes the results obtained from the answers given by PMTs.

Table 4 Views by PMTS for the Social Characteristics of Gifted Students

Codes	Frequency
Preference for communicating with adults	5
Enhanced social relationship, leadership	3
Rarity in the society	3
Valued by society	2
The tendency to be alone (individualism)	1

Table 5 Views by PMTS for the Characteristics of Mathematically Gifted Students

Sub-themes	Definitions	Frequency
Cognitive	Problem-solving in a quick and intelligent manner	19
	Analytical thinking about events and situations	17
	Solving problems in an unusual way	14
	Mathematically proficiency	14
	A keen interest in numbers from an early age	11
	Creating multiple solutions to problems	11
	Asking/Questioning	10
	Generalization ability from solution to problems	9
	Aspiring to solve complex/ difficult problems	8
	Original mathematical thinking	8
	Advanced reasoning ability	7
	Abstract thinking ability	6
	Solving difficult problems with patience	5
	Finding classroom problems boring	4
	Performing better than their peers at learning	4
	A high level of mathematical productivity	3
	Transferability of learning	3
	Creativity	2
	Understanding advanced topics	1
	Enhanced memory	1
Affective	Introversion	1
	Peer disapproval	1
	Self-confidence	1
	Responding maturely	1
Affective	Good sense of self-expression	1
	Sense of wonderment	1
	Willingness to learn	1

Upon examination of Table 5, it becomes apparent that the views of PMTs on the characteristics of gifted students in mathematics are grouped into two categories: cognitive and affective. PMTs seemed to hold the view of gifted mathematics students are largely based on their cognitive characteristics, which is reflected in their views towards gifted students in mathematics. Codes that emphasize the affective characteristics of gifted students in mathematics are fewer in number than code sets emphasizing intellectual traits. Below are explanations of each of the categories in more detail.

Basically, it can be said that among gifted students in mathematics, there are a number of cognitive characteristics that they have, which include analytical thinking, developing quick, extraordinary, and multiple solutions to problems, early awareness of numbers, and being extremely interested in them. Further, it was noted that PMTs also expressed proficiency in the following skills and characteristics: asking/questioning, reaching generalizations, aspiring to solve complex problems, thinking mathematically, reasoning, and abstract thinking. It is shown in the following quote that P1's views on how to understand gifted mathematics children as well as the differences between gifted mathematics children and children with normal development are reflected in his understanding.

> In addition to their interest in numbers, mathematically gifted individuals are analytically capable, eager to solve even difficult problems, patient and determined even if they make mistakes while solving problems, and they use multiple and unprecedented methods for solving problems. A gifted child is more likely to exhibit these characteristics than a child with a normal developmental level.

In P1's view, gifted mathematics students differ from children with normal development in terms of their analytical capabilities, interest in numbers, patience, willingness to solve difficult problems, and ability to come up with multiple solutions that are original and different. Alternatively, P3 defined mathematically giftedness as a higher level of knowledge in mathematics and being able to view the world mathematically, emphasizing that these people can think analytically. P21 stated mathematically gifted students' interest in mathematics and intelligence games and listed the differences of a gifted child in mathematics compared to a child with normal development as follows:

> Besides their ability to calculate faster, learn faster, comprehend more quickly than their peers, they are able to solve problems in a variety of ways, produce different solutions to problems, and find and prove formulas more quickly. What is more, they enjoy solving mathematics puzzles, playing chess, and having an interest in computer programs.

Similarly, P24 listed the characteristics of a gifted child in mathematics as follows:

> Compared to their peers, they demonstrate an early awareness of numbers. They possess advanced reasoning skills. Gifted children are patient and energetic when solving difficult problems, unlike their peers who lose patience quickly. They analyze previous problems and make connections between them.

According to P20, if a child shows intense interest in numbers, enjoys playing games such as puzzles, produces and explains multiple points of view when solving problems within a lesson, he will consider the child gifted in mathematics. P20 also states that these children exhibit analytical thinking, produce alternative solutions, establish analogical relationships, make generalizations, and deal with numbers.

Among the participants of the research, P11 shared some characteristics of gifted mathematics students that were similar to general characteristics of gifted students. Self-confidence, maturity, expressing themselves well, thinking quickly, self-confidence, and open-mindedness are some of these qualities. According to P11, "If the student gets bored easily and if the problems are easy, this could indicate that he or she is gifted. I can also focus on the questions asked by the students to judge their giftedness."

P28, however, states that gifted students in mathematics might be quiet, shy, and introverted, and they might not be liked by their peers. In addition, he points out that gifted individuals may possess characteristics such as being hyperctive and speaking a lot.

Conclusion

The views of PMTs regarding the giftedness have been classified in three categories as definitions, characteristics of gifted students and mathematically gifted students. The majority of the participants thought that the gifted students have exceptional performance in intelligence or creativity in a spesific area. Accordingly, Elmenoufy (2007) also emphasized that gifted students performing better than their peers in special academic fields. In fact, the common point in the definitions of giftedness

in literature appears to be IQ scores in determining and measuring the giftedness (Sarouphim, 1999). However, after the criticisms for IQ related giftedness, Sternberg (2004) proposed a three-faceted theory for giftedness as analytical, synthetic and practical ones. Although the pre-service teachers' definitions of giftedness corresponds more or less to this classification, they mainly focus on the analytical giftedness as other views included superiority proven by tests, capacity to perform a task, or outperforming previous performances. Carman (2013) also concluded that the participants mostly believed that the gifted individuals are identified through the abiltiy tests. This kind of view can be understandable as the giftedness mostly associated with the intelligence (Pezzuti et al., 2022). On the other hand, Sak (2013) put forth that definitions of giftedness are mostly based on cultural inventions as cultural aspect shapes the definition. Hence, there may be differences on the giftedness definitions across countries.

PMTs' views related to the characteristics of gifted students included cognitive, affective and social traits. The cognitive traits favorably listed as being curious or asking questions, strong verbal skills, high performance compared to the peers, fast thinking and learning, creativity and abstract thinking. Manning (2006) also concluded that the gifted individuals retain much information, have comprehensive understanding, high levels of verbal skills, flexible thought processes, an intense desire to learn, think abstractly and learn better than peers among other characteristics. Moon and Brighton (2008) pointed out that teachers perceive gifted students as having strong language skills and wide range of information, powerful reasoning and logical-mathematical skills. According to Bishofberger's (2012) study, teachers see gifted students as being able to provide solutions when others cannot and applying knowledge in new contexts. Examination of the literature shows that the findings of the current study related to the cognitive traits of gifteds coincide with the findings of other studies, even inclusively. The affective traits mainly include sensitivity, sense of justice, impatience, sense of humour, intense interest/concentration, diligence and patience, responsibiltiy, curiosity, perfectionism and motivation. Franks and Dolan (1982) mainly focused on the persistence, independence and self-concept of the gifteds. Garwan (2004) pointed out that gifteds have curiosity and interest in mystery and complex things, perseverance and emotional stability as found in the current study. Smith (2007) focused on the extreme sensitivity of gifteds. As gifted students learn faster because of their advanced cognitive skills than their peers (Cross & Coleman, 2005), it is difficult for them to stick to routines and repeat assignments (Park & Oliver, 2009; Samardzija & Peterson, 2015). This may explain why PMTs thought that gifteds are impatient. In their study about gifted students, Delisle and Galbraith (2002) note that gifted students often demonstrate persistent intellectual curiosity, ask probing questions, and display a special interest in humankind and nature. Manning's (2006) classification of affective characteristics of gifteds predominantly overlaps with the current findings as she highlights the emotion, humour, sensitivity, self-awareness, sense of justice, inner control, high expectations, consistency and moral judgement. As Manning (2006) made the list of gifteds' these affective characteristics studying the previous researches, the findings of this study seemingly add to that list. The current study also brings out the social characteristics of gifteds as preference to communicate with adults, enhanced social relationship (resulting in leadership), rarity in society and valued by society. In line with the findings of the study, Gross (2001) put forth that children who were highly gifted had a greater tendency to prefer playing alone and to have older friends than those in other groups. Gross (2003) concluded that the students with high IQ have poor social skills, which contradict with the findings of this study. However, Ishak et al., (2014) and Bakar et al., (2014) pointed out that gifted students have a wide range of social skills as a result of empathetic understanding. What is more, the correlation between leadership skills and empathy has been proven to be positive for gifted students (Bakar et al., 2014). Lee (2006) concluded that teachers think of gifted students as being rare in the society. This may stem from the fact that the gifted individuals are at the top in terms of intellectual capabilities. This may also result in society's valuing for them. Likewise Ivarsson (2023) found that the principals believe in

gifted people's social usefulness in society, as they constitute a valuable resource for society, which eventually may lead them to the top of society.

Characteristics of mathematically gifted students have been classified as cognitive and affective traits according to the views of PMTs. Cognitive traits of mathematically gifted students according to the PMTs' views mostly compose of quick, unusual and multiple solutions to problems, analytical thinking, proficiency in mathematics, interest in numbers at an early age, and questioning. Krutetski (1976) suggests that gifted students have a unique ability to see the world mathematically. There is evidence in the literature indicating that these students possess characteristic qualities such as a profound understanding of numbers and symbols, an ability to associate these symbols with real life, as well as a developed ability to solve mathematical problems quickly and differently (Fıcıcı & Siegle, 2008; Sriraman et al., 2013). Moreover, an appreciation of these students' needs from the first years of schooling is important because unusual aptitude for mathematics can be evident even before they begin school (McAlpine, 2004). The other codes for the cognitive characteristics of mathematically gifted students comprise of generalization ability, aspiring to solve challenging problems, advanced reasoning and thinking ability, mathematical productivity, transferability of learning, enhanced memory and creativity. Mathematically gifted students are described by Bicknell (2009) as those who possess "special mathematical abilities" or perform qualitatively different mathematical reasoning. According to Leikin et al., (2017) gifted students generally exhibit strong problem-solving abilities, metacognitive abilities, and creative math thinking abilities. These support the PMTs' views of mathemayically gifted students.

Affective characteristics of mathematically gifted students have been found to be introversion, peer disapproval, self-confidence, responding maturely, good sense of self-expression, sense of wonderment, and willingness to learn. Gifted individuals have a higher incidence of introversion than the average population (Silverman, 1988). Boredom, which is often mentioned in relation to gifted students in school, is defined as an affective state characterized by weak feelings, low psychological arousal, and a lack of stimulation (Preckel et al., 2010). The traditional instruction with routine problems and exercises may negatively affect the gifted students yielding boredom and resulting in introversion and peer disapproval for them because of their interrupting behaviors. Literature also suggests that the appropriate cognitive challenges are not provided to gifted students (Diezmann, 2005). Salari and Jenaabadi (2015) reveal high self-confidence of gifted students compared to non-gifted students. Wellisch and Brown (2013) pointed out gifted students have unusual interests, self-expressiveness and strong motivation. According to Freiman (2003) mathematically gifted students have a desire to learn more about mathematics as they are curious, highly motivated and persistent. It is important for gifted students to be passionate about specific subjects and keep learning until they are happy with what they have accomplished (Krofnik-Gottlieb & Idrgor, 2012).

Rather than being a single characteristic, talent is a qualitative combination of different abilities that is unique to each person (Krutetskii, 1976). It is unlikely that every gifted or mathematically gifted student will possess every attribute listed above. Hence, taking the general attributes of gifted and mathematically gifted students into consideration teachers should organize a supporting learning environment for these featured students. A study by Hoth et al., (2017) suggests that learning opportunities are crucial to nurturing mathematically gifted students. In traditional classrooms, the activities are typically intended for students at the general level (Rotigel & Fello, 2004) and gifted students are not provided with the appropriate cognitive challenges (Diezmann, 2005). Studies suggest that teachers should facilitate their students in exploring ideas, making hypotheses, refuting and adapting heuristic strategies, reasoning, justifying conclusions, and reflecting on them at a metacognitive level (Hoth et al., 2017; Nadjafikhah et al., 2012). In educational settings, gifted students display unique learning characteristics, as well as additional aspects beyond those observed in regular learners. For example, learning at a different pace, using advanced materials, performing an analysis more in-depth and meeting

higher academic requirements (Dori & Zohar, 2008). Furthermore, the attitudes of teachers affect gifted students more than those of other students (Sak, 2013). Studies have shown that teachers of gifted students should be qualified in knowledge, skills, and competencies (Davis, 2006; VanTassel-Baska & Johnsen, 2007). Teachers who work with gifted students should possess certain qualities such as empathic understanding, enhanced leadership capabilities, influence skills, communication skills, and collaboration skills. Training teachers with these qualifications is only possible by structuring undergraduate programs in this direction. Teachers's attitudes and emotional states are said to be influential on their performance (Jimenez, 2020). Additionally, teachers' continuous professional develeopments supporting these qualities should be encouraged (Tadesse & Derza, 2020). As a matter of fact, the obtained results revealed that the opinions of preservice teachers who received training on giftedness during their undergraduate education were parallel to the literature. Based on this, it is recommended that courses related to gifted students should be offered to teacher candidates during the undergraduate process and that different learning opportunities should be offered within the scope of these courses. On the other hand, this study did not examine the views of preservice teachers about giftedness in mathematics before the elective course. In future experimental studies, the opinions of pre-service teachers who have not received any training can be examined and how the training shapes these opinions can be examined. In future studies, the opinions of teachers working at SACs towards gifted students in mathematics and the factors affecting these opinions can be examined. In fact, it can be discussed whether the practices of teachers with different views towards gifted students differ and how this differentiation occurs. In this way, the factors affecting the education of gifted students in mathematics can be revealed more clearly and necessary steps can be taken accordingly.

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