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I HAVE A LETTER TO MY MATH TEACHERS: A QUALITATIVE STUDY WITH GIFTED STUDENTS

Research article

Çiğdem Çalışkan Toraman (0000-0002-5862-628X) (Corresponding Author)
Ministry of National Education, Balıkesir Edremit Science and Art Center
cigdemcaliskantoraman@gmail.com

Çetin Toraman (0000-0001-5319-0731)
Çanakkale Onsekiz Mart University, Faculty of Medicine
toramanacademic@gmail.com

Biodatas:

Çiğdem Çalışkan Toraman is a researcher with a PhD in mathematics education. She received her BA in Primary Mathematics Teaching from Gazi University, and her MA and PhD in mathematics education from Uludağ University.

Çetin Toraman is an educational expert. He received undergraduate education in the field of guidance and psychological counseling. He has a master's degree in Educational Assessment. and Curriculum & Instruction. He has a PhD in Educational Research Methods and Statistics. and a PhD in Curriculum & Instruction.

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Çiğdem Çalışkan Toraman
cigdemcaliskantoraman@gmail.com

Çetin Toraman
toramanacademic@gmail.com

Abstract

This research aimed to explore the experiences and phenomenological aspects of gifted students' participation in mathematics classes at a science and arts center (a gifted education center in Turkey). This phenomenological study involved 47 students aged 8-15. Data were collected through letters written by the students to their mathematics teachers and analyzed using phenomenological and inductive content analysis. The findings revealed the overarching theme: "My Mathematical Course". Under this theme, students' perceptions of mathematics as a space of freedom/place of self-discovery and, conversely, as a source of boredom were identified. Furthermore, the students expressed expectations and desires regarding the mathematics class, the science and arts center, the system, and their teachers. The findings are discussed within the broader context of the literature.

Keywords: mathematics education, gifted students, phenomenology

1. Introduction

Mathematics functions as a descriptive and explanatory framework, enhancing human understanding and action. Its high level of abstraction and powerful generalizations render it a universally applicable tool, significantly contributing to human progress and well-being. While operating within a realm of abstract entities, mathematics provides models for effectively navigating the complexities of the physical world and human experience. This inherent utility explains its indispensable role in human endeavors (Sfard, 2014). The correlation between widespread mathematical application and national development is well-established; nations and individuals integrating mathematics into their daily lives tend to experience greater success (Göker, 1993). Defined as the scientific discipline employing logical methods to investigate the properties and interrelationships of abstract entities such as numbers, quantities, geometric forms, and operations (Tuncer, 1995), mathematics facilitates the conceptual abstraction of objective reality to achieve a more profound comprehension and manipulation thereof. Mathematical formulas and symbols function as tools and a specialized language within this abstract systematization of logical reasoning, applicable to diverse fields including art and law (Tepedelenlioğlu, 1995). In essence, mathematics cultivates critical thinking skills, fostering problem-solving abilities, and enabling the construction of meaningful interpretations of the world and human existence through logical analysis, evidence-based reasoning, and the generation of novel insights. Its abstract nature is therefore integral to its function.

Mathematics plays a crucial role in education, fostering critical thinking, inquiry, and problem-solving skills essential for navigating complex situations. The complexities of mathematical thinking are well-documented in the literature, with problem-solving identified as a primary, albeit challenging, pedagogical objective (Halmos, 1980). The ideal outcome of mathematics instruction is the cultivation of independent mathematical inquiry and the ability to apply learned concepts to real-world contexts. While progress has been made, particularly in the education of gifted students, a significant gap remains in fostering a deeper understanding of mathematical thinking and its practical applications across various life domains. The economic and technological significance of mathematical literacy is increasingly recognized by governments globally. The Programme for International Student Assessment (PISA, 2006) highlights the strong correlation between national prosperity and high levels of mathematical literacy, defined as the ability to utilize mathematical skills in everyday life, professional settings, and further education. PISA's emphasis on real-world problem-solving underscores the multifaceted nature of mathematical literacy, encompassing critical reasoning, modeling, and conceptual integration. Consequently, the development of robust mathematical thinking skills represents a paramount educational objective, equipping students with the essential ability to effectively apply mathematics across diverse contexts.

Gifted students exhibit exceptional mathematical abilities, characterized by a deeper understanding and engagement with complex concepts than their peers. This aptitude presents a valuable resource for advancing the field of mathematics. Mathematically gifted students demonstrate exceptional problem-solving skills, a profound understanding of mathematical principles, and a keen ability to identify patterns and relationships. Rather than rote memorization, they strive for conceptual understanding, applying creativity and innovative approaches to develop novel solutions and alternative methodologies. The literature describes gifted students in mathematics as possessing the ability to perceive the world through a mathematical lens (Krutetskii, 1976), demonstrating relational understanding of numbers and symbols, readily connecting this understanding to everyday life, and solving mathematical concepts and problems in diverse ways, rapidly and with high accuracy (Fıçıcı & Siegle, 2008; Sriraman, Haavold, & Lee, 2013).

The cultivation of creativity is paramount in the education of mathematically gifted students. Failing to nurture this aspect deprives students, particularly the gifted, of the opportunity to fully appreciate the beauty of mathematics and develop their potential (Mann, 2006). Educators must therefore prioritize and facilitate access to challenging and enriching mathematical experiences that foster creative exploration. Moreover, mathematically gifted students often demonstrate a strong appreciation for the elegance and aesthetic qualities inherent in mathematics, drawn to the inherent beauty, symmetry, and logical structure of the discipline. Cultivating this appreciation fosters a lifelong engagement with mathematics and encourages continued exploration and contribution to the field. The unique learning needs of mathematically gifted students necessitate specialized instructional approaches. Accelerated learning, facilitated through exposure to advanced content, is a key strategy (Ysseldyke et al., 2004). This can involve differentiated instruction incorporating more challenging problems, enrichment activities, and exploration of advanced mathematical concepts.

While a considerable amount of research exists on gifted individuals in general, without specific domain distinctions, the majority of studies focusing on mathematically gifted individuals have concentrated on identifying their characteristic traits, diagnosing individuals, and exploring differentiated educational approaches for them (Diezmann & Watters, 2001; Dimitriadis, 2011; Fıçıcı & Siegle, 2008; Mogensen, 2011; Rotigel & Fello, 2004; Sriraman, et al., 2013). In Turkey, a limited number of studies have investigated the perceptions and opinions of gifted students regarding mathematics instruction in their schools (Özdemir, 2018).

Gifted individuals represent a significant segment of a nation's human capital and can become productive members of society, contributing to both their personal and national advancement, through access to appropriate education. Mathematics is a crucial subject within this education. The aim of this research is to determine the meanings constructed by gifted students attending science and arts centers regarding their experiences in mathematics class, as revealed through letters they write to their mathematics teachers.

2. Method

Individuals experience various applications, situations, and thoughts throughout their lives. It is natural that each person constructs a different meaning from these experiences. This is because each individual's upbringing, cultural background, values, and personal experiences differ, resulting in variations in their interpretations and conclusions drawn from these applications, situations, or thoughts. This research focuses on the experiences of students attending science and arts centers in their mathematics classes. Naturally, these experiences lead to the formation of unique meanings held by the students. This qualitative phenomenological study aims to uncover these meanings.

Phenomenology is a process that seeks reality within the narratives of individuals' lived experiences of phenomena (Moustakas, 1994). Phenomenological research attempts to determine the shared meaning of individuals' experiences related to a concept or phenomenon (Creswell, 2013). This study was conducted with the understanding that phenomenological research involves the study of human experiences, that these experiences are examinable and conscious (van Manen, 2016), and that it requires explication not only of the descriptions of experiences, but also of the essential underlying meanings (essences) of these experiences (Miles, Huberman & Saldaña, 2014; Moustakas, 1994).

2.1. Participants

The participants in this research comprised 47 students, aged 8-15, diagnosed as mathematically gifted, who were enrolled in a science and arts center in Turkey. The sample consisted of 47 students who volunteered to participate and agreed to write letters. Student selection was based on the following criteria: (a) diagnosis of giftedness, (b) enrollment in a science and arts center with a focus on mathematical abilities and participation in mathematics classes, and (c) consent to participate in the research. This represents criterion sampling, an approach where individuals possessing pre-defined characteristics are selected for the sample (Miles et al., 2014).

2.2. Data Collection Tool

Research data were collected through letters written by the participants to their mathematics teachers. Participants were asked to write a letter to their mathematics teacher at the science and arts center, reflecting on the following questions: "Were these classes suitable for you and your expectations?", "How did you feel in these classes?", "What did you expect and imagine these classes to be like?", "What did you encounter in the classes in relation to your expectations?", and "What changes or improvements would you suggest for mathematics classes given to gifted students like yourselves in the future?". However, participants were not provided with a structured list of topics to include. This was to minimize constraints and allow for free expression in their writing. No specific length was prescribed for the letters; participants were encouraged to write as much as they felt comfortable with, and to write on paper or digitally, when they felt ready. Data were collected in December 2024. All 47 students submitted their letters in writing to their teacher.

2.3. Process

The following steps were followed in conducting this research:

- Ethical approval was obtained from the relevant ethics committee.
- Permission was obtained from the Ministry of National Education (MoNE) under the "Research Application Permits Circular (2024/41)".
- The research data collection process commenced.
- Participants were informed about the research. Informed consent was obtained from both parents/guardians and participating students.
- Student letters were analyzed using content analysis.
- The data analyzed were submitted to expert review as part of an external evaluation process.
- The research findings were reported.

2.4. The Role of Researchers

This research was conducted by two researchers. One researcher is a mathematics teacher at a science and arts center affiliated with the Turkish Ministry of National Education (MoNE), holding a bachelor's, master's, and doctoral degree in elementary mathematics education. The other researcher is an educational scientist and a faculty member at a state university, holding a bachelor's, master's, and doctoral degree in educational sciences.

In qualitative research, it is acknowledged that researchers possess inherent assumptions, beliefs, biases, and prior experiences that can influence the research process. These characteristics can affect the research from its planning and execution to its analysis and reporting. In qualitative research, it is beneficial for researchers to disclose these characteristics in the research report, enabling readers to understand the potential influence of the researchers' perspectives (Creswell, 2013; Marshall & Rossman, 2016). Researchers possess expertise in mathematics education and educational sciences. Consequently, they may perceive the education provided to students at the science and arts center as adequate, diverse, aligned with student interests, and conducive to developing their capabilities. Readers are encouraged to consider the potential impact of these perspectives when evaluating the research.

2.5. Data Analysis

The data were analyzed through content analysis. The literature highlights two strategies for conducting content analysis: inductive and deductive (Mayring, 2015; Merriam & Tisdell, 2016). In the inductive strategy, themes and categories are derived directly from the data set. This research utilized an inductive content analysis approach.

Furthermore, the content analysis adhered to the data analysis procedures of phenomenological qualitative research. Moustakas (1994, 121-122) adapted and modified the analytical methods proposed by Stevick, Colaizzi, and Keen to develop a phenomenological analysis method. The steps of this method are as follows (Creswell, 2013; Moustakas, 1994):

- Researchers developed their own definition of the phenomenon of interest.
- All statements related to the phenomenon were recorded and transcribed.
- Each statement was evaluated considering its significance for understanding the experiences.
- Irrelevant, repetitive, and unrelated statements were removed from the data set.
- The data set was grouped and clustered into meaning units or themes.
- Themes were exemplified using textural descriptions (textural descriptions represent participants' narrative accounts of their perceptions of a phenomenon).
- Textural descriptions were combined to arrive at composite textural descriptions, ultimately reaching the "essences of these experiences".

An inter-rater reliability calculation was performed on the data analyzed by the researchers, incorporating expert opinions as part of an external evaluation. This calculation assessed the reliability of the expert opinions obtained. The reliability coefficient was calculated using Krippendorff's Alpha, resulting in a value of .812, indicating a high level of consistency (Krippendorff, 2004).

2.6. Trustworthiness, Credibility and Transferability

Lincoln and Guba proposed the concepts of credibility, dependability, confirmability, and transferability for qualitative research. Merriam and Tisdell (2016, 242-260) use the terms "internal validity or credibility", "reliability or consistency" and "external validity or transferability" for qualitative research standards.

Ensuring voluntary participation is a primary measure for enhancing data trustworthiness (Shenton, 2004). Prior to the letter-writing phase, the researchers provided participants with detailed information about the research, emphasizing voluntary participation and letter writing. Only those who volunteered contributed to the study. To ensure reliable data analysis, it is recommended that each researcher's coding be reviewed by other researchers (Creswell, 2012). In this research, the researchers made their coding available for review by other researchers. To enhance credibility, participant verification was employed (Creswell & Miller, 2000; Creswell, 2013; Merriam & Tisdell, 2016). As the data were analyzed and findings emerged, five of the 47 participating students were recontacted to confirm whether the findings reflected their experiences. Furthermore, three external experts not involved in the research reviewed and evaluated the data and findings. One expert is an educational scientist and associate professor with expertise in educational administration and experience in qualitative research. The second is a mathematics educator and associate professor. The third is an associate professor in an education faculty specializing in gifted education with extensive experience in qualitative research. The researchers' data analysis was submitted to these experts for review, ensuring external auditability (Christensen, Johnson, & Turner, 2015; Creswell, 2013). The experts reviewed the data analysis, offered suggestions regarding certain codes, and the analysis was revised accordingly. Finally, direct quotes from the participants were included to enhance trustworthiness through the use of direct quotation strategies (Christensen et al., 2015).

2.7. Ethical Approval and Institutional Permission

This research was conducted with the approval of Çanakkale Onsekiz Mart University's Scientific Research and Publication Ethics Committee, granted on October 3, 2024, under number 14/28. Additionally, application number MEB.TT.2024.002997 was submitted to the Ministry of National Education (MEB) to obtain permission for the study, which was granted on November 21, 2024.

3. Findings

Students' letters were analyzed using phenomenological and inductive content analysis. The overarching theme that emerged was My Mathematics Course. Under this theme, the following categories were identified: " Space of Freedom/Place of Self-Discovery", "Boredom" and "My Expectations and Wishes".

3.1. Space of Freedom/Place of Self-Discovery

For mathematically gifted students, the mathematics classroom serves as a space of freedom. It is a place where they can unleash their talent, freely engage with mathematics, and grapple with challenging problems that, upon successful resolution, provide a sense of accomplishment and satisfaction. Some students expressed their thoughts as follows:

- Teacher, you sometimes give us really difficult problems. I struggle a lot to solve them, but honestly, struggling doesn't bother me at all. In fact, I kind of like it. I know it's a weird feeling but it makes me even more determined to figure things out.
- Sometimes in my life, it feels like no one really understands me… Life feels boring. But whenever I work on math, I feel I do something that actually matters. Math is the place where I find meaning and feel free.
- When I see a math problem, I can instantly visualize it in so many different ways in my head. I twist and turn it around in my mind, and when I share what I've done, my friends are amazed. They're shocked at how I think, and I love that.
- I've developed a huge curiosity about math recently.

For mathematically gifted students, grounding mathematics in real-world problems and learning meaningful concepts through instruction facilitates the development of their abilities. Seeing the practical application of mathematics in their lives is encouraging. Some students expressed their thoughts as follows:

- I want to become an engineer in the future. But I was really scared of losing my connection with math. The problems you give us and the activities we do are amazing. I can actually see how math applies to real life now. I've realized how closely engineering and maths are related, and that gives me hope. Because I never want to drift away from math.
- I already spend my days at school, and then I come here (to the science and arts center). It's extra work for me. If the math you teach here wasn't the way I wanted, I wouldn't bother coming… I'd definitely quit this place. What keeps me from leaving is seeing how math connects to life and how it challenges my brain

3.2. Boredom

Students reported that the class did not engage them and that they were experiencing burnout from attending the science and arts center. They suggested that more creative activities should be incorporated to make mathematics more relevant to their lives. Some students expressed their thoughts as follows:

- I spend extra time coming to this place. I already have my school during the day, and I came here hoping there would be something interesting for me. But the stuff we do in class is boring. I wish we had activities to boost our creativity more. I imagined there would be much richer math games here...
- The school isn't nice at all. Can't they build better schools for students like us? I have friends who go to the science and arts centers in other places. I asked them, and they said their schools are just like ours. It's so disappointing. I think we should have way more opportunities available to us.

Some students harbored excessively high expectations that went unmet. There were students who considered themselves exceptional and held correspondingly high expectations; their sense of meaning was built upon these expectations. One student expressed their thoughts as follows:

- I had to take so many exams to get into this school. First, you gave me a test on a tablet. Then my family took me to a place called RAM (Guidance and Research Center), where I had to take another difficult test. I passed all of them. My family told me, "You're a very special child." If I'm such a special child, then everything here should be tailored to my needs. It shouldn't be boring. What's the difference between this place and my regular school? Even in math class, I'm not learning anything more than what I already do at school. My teachers there also give us tough problems.
- I was hoping math classes here would be more fun and focused on improving our intelligence...
- I thought we'd play lots of brain games in math class at the science and arts center. But there's nothing like that, which really frustrates me.

3.3. My Expectations and Wishes

Some mathematically gifted students at the science and arts center desired activities and applications that differed from those offered in regular schools. They expressed a desire for more concrete approaches to mathematics and projects that emphasized the relationship between mathematics and the natural world. Some students expressed their thoughts as follows:

- People told me that the classes here (at the science and arts center) wouldn't be like regular school lessons. That was a bit disappointing because I was hoping for different activities and not the same classes with the same names as school. Our lessons should include much more hands-on activities.
- The math class is way harder than I expected. Of course, I thought it would be somewhat challenging, but this is too much. I'm really struggling.
- I'd like the lessons and topics to be made more concrete. Nature and math are deeply connected, and this could be beautifully demonstrated in our math class. I'd love to see my math lessons developed in this direction, with more fun and engaging materials.
- In our math lessons, I would like to see more real-life examples and more project work related to math.

4. Conclusion and Discussion

The literature suggests that educating gifted students in the same classrooms as typically developing peers can create limitations for gifted learners (Baykoç, 2014; Deizmann & Watters, 2001). This research corroborates these findings. The results indicate that for mathematically gifted students, the mathematics classroom serves as a space of freedom where they can unleash their talent, freely engage with mathematics, and grapple with challenging problems that, upon successful resolution, provide a sense of accomplishment and satisfaction. Grounding mathematics in real-world problems and learning meaningful concepts through instruction facilitates the development of their abilities. The ability to see the practical application of mathematics in their lives is encouraging for these students. Similar findings can be found in literature. Mathematically gifted individuals often independently learn concepts from supplementary materials before they are formally taught in class, using prior knowledge to readily grasp new material. While mathematically gifted students enjoy problem-solving, it is crucial that these problems are challenging and stimulating. They also appreciate the use of manipulatives and concrete representations of concepts in the classroom (Özdemir, 2018).

This research reveals that gifted students reported a lack of engagement with the mathematics curriculum and expressed burnout from attending the courses in the science and arts center. The incorporation of more creative activities is necessary to make mathematics more relevant to their lives. Some students held excessively high expectations that went unmet; some considered themselves exceptional and held correspondingly high expectations, basing their sense of meaning on these expectations. Sometimes, their prior knowledge of concepts (Özdemir, 2018) or their faster learning pace and pursuit of answers to "why" and "how" questions, compared to their peers, led to boredom and disengagement (Gadanidis, Hughes, & Cordy, 2011). Their inherent drive to strive, struggle, push boundaries, and acquire more complex, higher-level knowledge remained unsatisfied (Dimitriadis, 2011; Uyaroğlu, 2011). The time allocated to topics needs to be adjusted to accommodate student capabilities (Özdemir, 2018). The related literature supports the necessity of incorporating differentiated activities and methods into students' learning experiences (Cash, 2017; Dreeszen, 2009; Hertberg-Davis, 2009; Kanevsky, 2011; Renzulli & Reis, 2004).

In this research, some mathematically gifted students at the science and arts center expressed a preference for activities and applications different from those offered in regular schools. They desired more concrete approaches to mathematics and projects that emphasized the relationship between mathematics and the natural world. While the literature indicates that appropriate

programs for gifted students exist in schools, these programs often lack adequate implementation due to factors such as teacher shortages, classroom dynamics, curriculum constraints, and the needs of typically developing students (Westberg et al., 1993). Gifted students often perceive assigned homework as excessive and unnecessary, believing that an abundance of easy, repetitive assignments offers little benefit (Özdemir, 2018).

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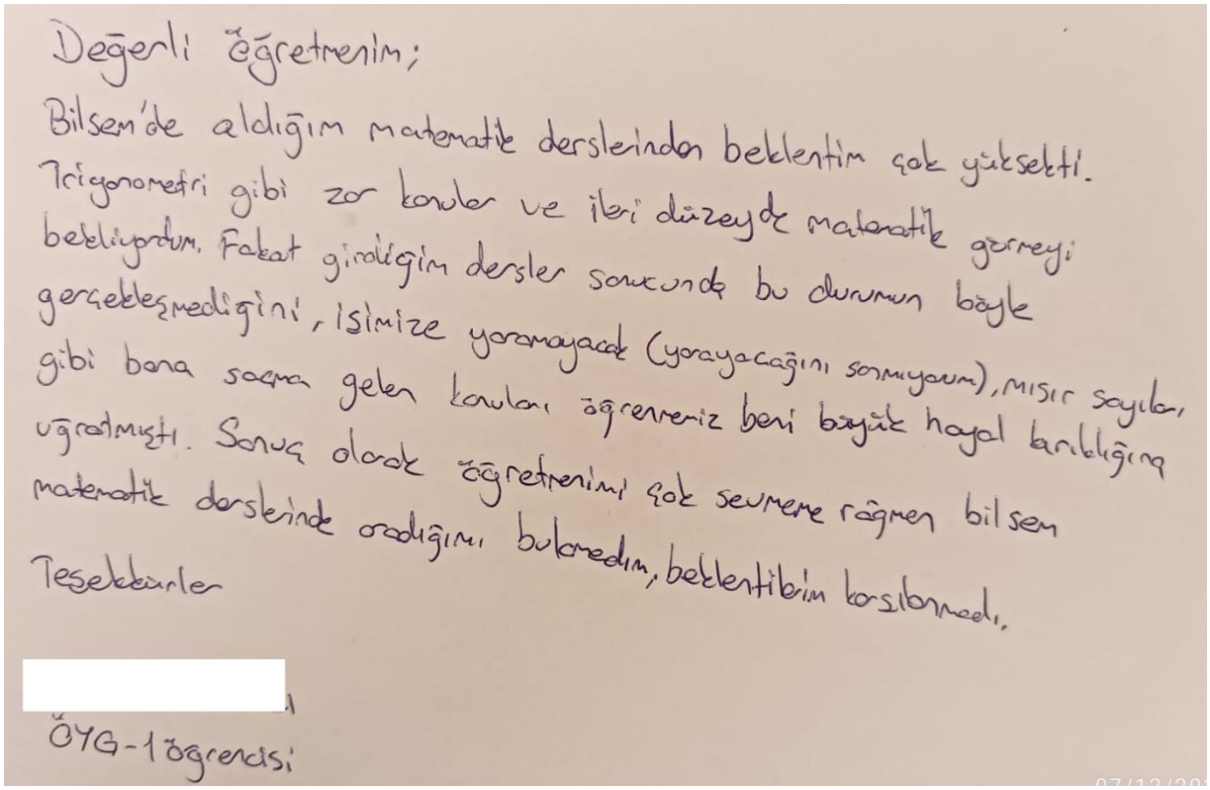
Appendix



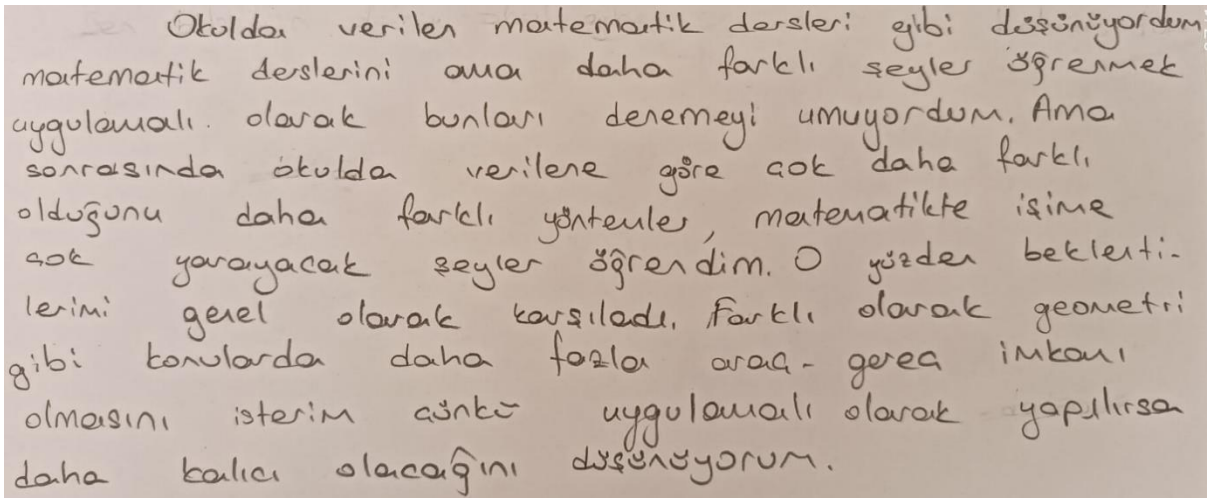
Değerli öğretmenim;

Bilsem'de aldığım matematik derslerinden beklentim çok yüksekti. Trigonometri gibi zor konular ve ileri düzeyde matematik görmeyi bekliyordum. Fakat girdiğim dersler sonucunda bu durumun böyle gerçekleşmediğini, işimize yaramayacak (yarayacağını sanmıyorum), mısır sayıları gibi bana saçma gelen konuları öğrenmeyi beni büyük hayal kırıklığına uğratmıştı. Sonuç olarak öğretmenimi çok sevmeme rağmen bilsem matematik derslerinde olduğumu bulamedim, beklentilerim karşılanmadı.

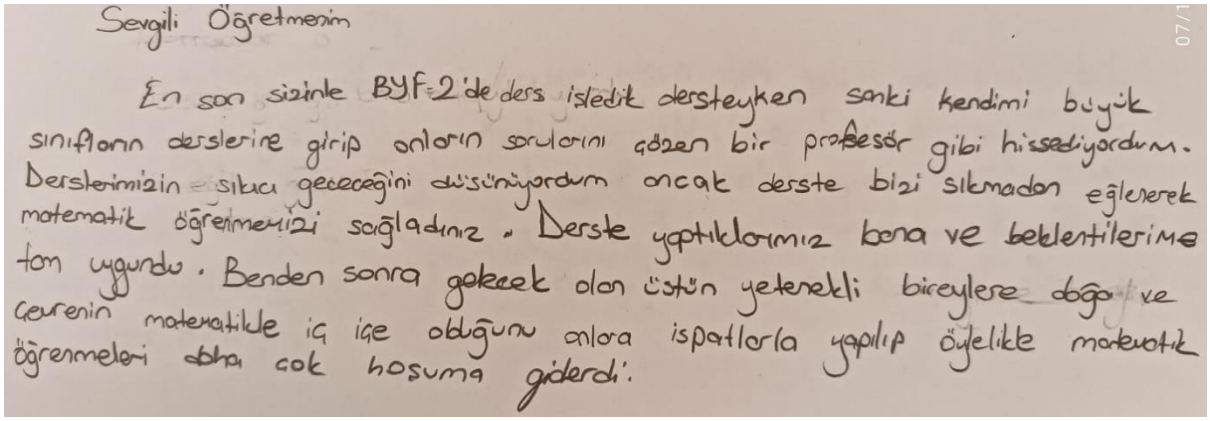
Teşekkürler

[redacted]

ÖYG-1 öğrencisi

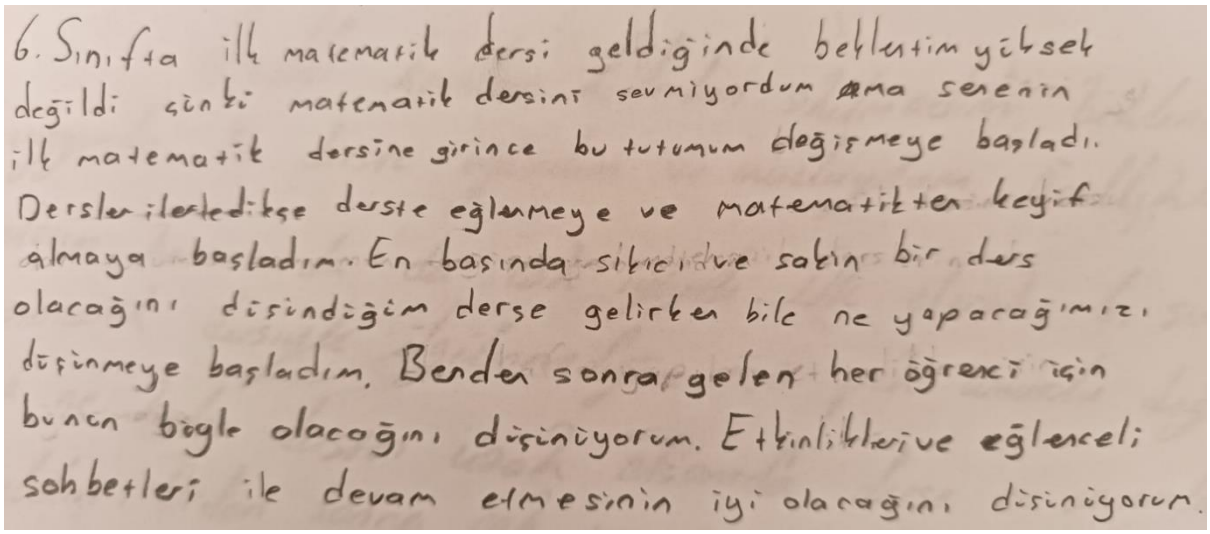


Okulda verilen matematik dersleri gibi düşünüyordum matematik derslerini ama daha farklı şeyler öğrenmek uygulamalı olarak bunları denemeyi umuyordum. Ama sonrasında okulda verilene göre çok daha farklı olduğunu daha farklı yöntemler, matematikte işime çok yarayacak şeyler öğrendim. O yüzden beklentilerimi genel olarak karşıladı. Farklı olarak geometri gibi konularda daha fazla araç-gereç imkanı olmasını isterim çünkü uygulamalı olarak yapılırsa daha kalıcı olacağını düşünüyorum.



Sevgili Öğretmenim

En son sizinle BYF-2'de ders işledik dersteyken sanki kendimi büyük sınıfların derslerine girip onların sorularını çözen bir profesör gibi hissediyordum. Derslerimizin sıkıcı geçeceğini düşünüyordum ancak derste bizi sıkmadan eğlenerek matematik öğretmenizi sağladınız. Derste yaptıklarımız bana ve beklentilerime tam uygundu. Benden sonra gelecek olan üstün yetenekli bireylere doğa ve çevrenin matematikle iç içe olduğunu onlara ispatlarla yapılıp öğelikle matematik öğrenmeleri daha çok hoşuma giderdi.



6. Sınıfta ilk matematik dersi geldiğinde beklentim yüksek değildi çünkü matematik dersini sevmiyordum ama senenin ilk matematik dersine girince bu tutumum değişmeye başladı. Derslerilerledikçe derste eğlenmeye ve matematikten keyif almaya başladım. En başında sıkıcı ve sakın bir ders olacağını düşündüğüm derse gelirken bile ne yapacağımızı düşünmeye başladım. Benden sonra gelen her öğrenci için bunun böyle olacağını düşünüyorum. Etkinlikleriyle ve eğlenceli sohbetleri ile devam etmesinin iyi olacağını düşünüyorum.