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ORIGINAL ARTICLE

An Investigation into the Effects of Perceived Teacher Immediacy Behaviors on Students' Academic and Affective Variables

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Ethical Statement
This research was conducted in accordance with the principles of the Declaration of Helsinki. Since the study did not involve clinical or biomedical intervention and was carried out in an educational setting with voluntary student participation, formal ethical committee approval was not required. Informed consent was obtained from all participants and their legal guardians, and all data were collected anonymously with full confidentiality ensured.

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Conflict of Interest
The authors declare that there is no conflict of interest regarding the conduct, analysis, or publication of this research.

ABSTRACT

This research aims to investigate the relationships between middle and high school students' perceptions of teacher proximity behaviors and their mathematics anxiety, class participation levels, and academic achievement, supported by student perspectives. Utilizing a relational screening model within a general survey design, data were collected from a total of 485 students (217 middle school, 268 high school) in the Burhaniye district of Balıkesir, Turkey. The data collection instruments included the "Teacher Immediacy Behaviors Scale," the "Mathematics Anxiety Scale," and the "Classroom Engagement Level Scale." Data were analyzed using SPSS 23.0, and normality tests confirmed the suitability of parametric tests. Correlation analysis was employed to examine relationships, independent samples t-tests were used to determine gender differences, and ANOVA was applied to analyze differences among multiple groups. Finally, an open-ended question was posed to 88 students to ascertain whether their mathematics-related anxiety and class participation were perceived as being associated with their feelings of teacher proximity. The study revealed that as the educational level progresses, perceived teacher immediacy and classroom engagement decrease, while mathematics anxiety increases. Furthermore, significant relationships were found between teacher immediacy and both mathematics anxiety and classroom engagement. It was also determined that teacher and student gender, along with class size, significantly influence perceived teacher immediacy. The data of open-ended analysis strongly suggests that a teacher's perceived closeness, when interpreted as supportive and caring, significantly mitigates math anxiety and fosters greater classroom engagement for the majority of students. This research is expected to contribute to the existing literature and re-emphasize the importance of the teacher factor in education.

Keywords: Teacher Immediacy Behaviors, Values Education, Anxiety, Classroom Engagement

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INTRODUCTION

"We recall with appreciation intelligent and brilliant educators from the past, and with gratitude those who touched our emotions."

Carl Jung

Mathematical education plays a pivotal role in individual development. Mathematical thinking skills, problem-solving abilities, and analytical reasoning capabilities are utilized across numerous domains. Mathematics education assists students in cultivating these proficiencies and constitutes a fundamental educational component. Mathematics facilitates the comprehension of the natural world's mechanisms and is indispensable for technological advancements (OECD, 2019). The significance of mathematical education has been investigated in a multitude of studies. Boaler (2016) explored the impact of mathematics education on students' cognitive development, motivation, and career choices. The research revealed that mathematics education positively influences students' cognitive growth, and that motivation plays a substantial role in the acquisition of mathematical skills.

Despite the acknowledged importance of mathematics education, numerous challenges persist. These difficulties significantly impair students' mathematical achievement. Among these obstacles are students perceiving mathematics courses as difficult and unengaging, a lack of concrete examples in mathematical instruction, insufficient mathematical knowledge among educators, students' anxiety towards mathematics courses, and the absence of teaching methods tailored to students' mathematical learning styles (Özgür, 2018).

Specifically, mathematics learning anxiety is a frequently encountered issue in mathematics education. Students experiencing mathematics learning anxiety can suffer adverse effects on their mathematical performance (İpek, 2020). The underlying causes of mathematics learning anxiety may include the perceived difficulty of mathematics courses, negative beliefs towards mathematics, discrepancies in students' mathematical learning styles, and pre-existing biases related to mathematics (Fidan, 2017; Bozkurt, 2020).

Mathematics anxiety is characterized by students experiencing negative thoughts and emotions concerning mathematics. This anxiety can adversely affect mathematical achievement and reduce engagement in mathematics courses. It can lead students to harbor a fear of failure in mathematics. Consequently, it is crucial in mathematics education to address mathematics anxiety and foster increased student participation in mathematical instruction. Numerous studies indicate that mathematics anxiety negatively impacts mathematical performance (Acar, 2013). Students' mathematics anxiety can result in suboptimal performance during mathematics lessons and a decline in their involvement. Given that mathematics anxiety causes students to fear failure in mathematics, actively combating this anxiety is a significant objective in mathematics pedagogy (Eren, 2017).Participation in mathematics courses is a critical factor in students' mathematical learning experiences. Students who regularly attend mathematics classes consistently demonstrate higher levels of mathematical achievement. Increased participation can lead students to engage in more practice and become more deeply involved in the learning process. Therefore, in mathematics education, it's essential to boost student participation and make mathematics courses more engaging (Kocakülah & Özçelik, 2018).

Teachers represent one of the most critical components within the educational system. Their role is paramount for student success and future prospects (Özcan & Şişman, 2013). Teachers primarily function as facilitators, transmitting knowledge and skills to students. However, their impact extends beyond mere information dissemination; they also

enhance student motivation, thereby fostering active engagement in the learning process. Consequently, it is crucial for educators to unleash and cultivate students' full learning potential. Moreover, teachers contribute significantly to students' personal development. By bolstering students' self-confidence, they empower them to believe in themselves and express their individuality. This, in turn, influences students' academic achievement. The mechanisms through which teachers influence student success are extensive. Comprehending students' learning styles and implementing appropriate pedagogical approaches significantly aids student comprehension. Furthermore, the teacher-student relationship is vital; establishing a positive rapport can substantially facilitate student learning (Yıldırım, 2008).

Teacher proximity, or warmth, is a reflection of the human values an educator holds toward their students, such as interest, affection, respect, empathy, and trust. When teachers establish close relationships with their students, it not only helps students succeed in their learning processes but also contributes to their social and emotional development.In this context, teacher proximity is intrinsically linked to human values because teachers foster students' self-confidence by demonstrating love, respect, understanding, and support. Furthermore, by accepting students' individual differences, teachers enhance their self-confidence and self-esteem (Özdemir & Kaya, 2018).

It can be argued that teacher proximity and the possession of humanistic values by a mathematics teacher are nearly synonymous, as both significantly influence student mathematical achievement. Numerous studies indicate that not only a teacher's mathematical proficiency but also their human qualities are crucial. Teacher-student interactions have a substantial impact on students' motivation and self-confidence within the mathematical learning process (Pekdoğan, 2019).What distinguishes this project from previous studies is its emphasis on the effect of mathematics teachers' values on students' anxiety levels, participation in class, and academic achievement in mathematics. In this context, the study aims to examine the impact of middle school students' perceptions of teacher proximity behaviors on their mathematics anxiety, class participation, and achievement, considering various variables such as student gender, teacher gender, years of experience, and class size. The research seeks to answer the questions: "Do middle school students' perceptions of teacher proximity behaviors differ according to certain variables? Is there a relationship between the perception of teacher proximity and levels of mathematics anxiety and class participation?" The sub-problems derived from this central problem statement are outlined below.

1. *What are the perceived levels of teacher proximity behaviors, mathematics anxiety, and class participation among middle school and high school students?*
2. *Is there a relationship between middle school and high school students' perceived teacher proximity and their mathematics anxiety, class participation levels, and academic achievement?*
3. Do perceived teacher behaviors differ based on teacher gender, student gender, *teacher's years of professional experience, class size, and for high schools, school type?*
4. Is there a relationship between their mathematics-related anxiety and class participation and their feelings of teacher proximity according to students' perceptions?

METHOD

This section will meticulously detail the research design, study group, data collection instruments, and the procedures for data acquisition and analysis.

Research Design

This research was conducted using a mixed-methods approach, specifically employing a descriptive survey model, which integrates both quantitative and qualitative methodologies. The descriptive survey model is utilized in studies aiming to describe an existing situation as it is (Karasar, 2014). Within the scope of this research, the Teacher Proximity Behaviors Scale was administered to middle school students. Initially, the students' perceived levels of teacher proximity were determined. Subsequently, the relationships between these perceived teacher proximity levels and variables such as student gender, teacher gender, mathematics anxiety, and class participation levels were analyzed. For the qualitative component of the research, 88 students participated.

Sample

The sample for this research comprises a total of 217 randomly selected middle school students residing in the Burhaniye district of Balıkesir. The necessary permissions for the study were obtained, and students' voluntary participation was ensured. For the qualitative component of the research, 88 students (36 male, 52 female) participated.

Table 1: Classification of Participating Middle School Students by Gender and Grade Level

Gender	5th Grade	6th Grade	7th Grade	8th Grade	Total
Female	41	53	39	20	112 (51.61%)
Male	32	46	29	30	105 (48.39%)
Total	73	99	68	50	217 (100.0%)

The student participants in the study comprised 51.61% female students (n=112) and 48.39% male students (n=105). Furthermore, while the majority of students were from 6th grade (n=99), it can be noted that the participation of 8th-grade students (n=50) was comparatively lower than other grade levels.

Table 2. Classification of Participating High School Students by Gender and Grade Level

Gender	9th Grade	10th Grade	11th Grade	12th Grade	Total
Female	43	21	56	33	153 (57.1%)
Male	19	20	43	33	115 (42.9%)
Total	62	41	99	66	268 (100.0%)

Among the students who participated in the study, 57.1% were female (n=153), while 42.9% were male (n=115). Furthermore, it can be observed that the majority of students were from 11th grade (n=99), whereas the participation of 10th-grade students (n=41) was comparatively lower than other class levels.

Table 3. Distribution of Participating Students' Mathematics Teachers by Gender

Teacher Gender	Middle School		High School	
	Frequency (f)	Percentage	Frequency (f)	Percentage
Female	163	% 75.11	101	% 37.7
Male	54	% 24.99	167	% 62.3

Total	217	% 100	268	% 100

Table 3, which presents the distribution of participating students' mathematics teachers by gender, indicates that 75.11% of middle school students (n=163) had female mathematics teachers, while 24.99% (n=54) had male mathematics teachers. For high school students, 37.7% (n=101) had female mathematics teachers, and 62.3% (n=167) had male mathematics teachers.

Table 5. Distribution of Participating Students by Class Size

Class Size	Middle School		High School	
	Frequency (f)	Percentage	Frequency (f)	Percentage
13-20 students	17	% 7.83	46	% 17.2
21-28 students	50	% 23.04	53	% 19.7
29-36 students	88	% 40.55	169	% 63.1
36 and over students	62	% 28.57	0	% 00.0
Total	217	% 100		Total

*Kategori yaş ortalaması ile frekanslar çarpılıp kişi sayısına bölündüğünde 28,31 çıkmıştır.

Upon examining Table 5, which illustrates the distribution of students by class size, it is evident that the most prevalent class size range for both middle school and high school levels is 29–36 students, accounting for 40.55% in middle schools and 63.1% in high schools. While middle school class sizes exhibit a broader distribution, the proportion of students in classes with 36 or more individuals is notably high at 28.57%. Conversely, no classes of this density are observed in high schools. Furthermore, less crowded classes (13–28 students) are more common among high school students, representing 36.9%, whereas in middle schools, this proportion remains at 30.87%.

Table 6. Classification of Participating High School Students by School Type and Grade Level

School Type[1]	9th Grade	10th Grade	11th Grade	12th Grade	Total
Vocational High School	10	13	28	12	63 (23.5%)
General High School	12	8	14	17	51 (19.0%)
Qualified Anatolian High School	24	14	25	15	78 (29.1%)
Science High School	16	6	32	22	76 (28.4%)
Total	62	41	99	66	268 (100.0%)

Finally, an examination of the distribution of participating high school students by school type and grade level reveals that the highest participation originated from qualified Anatolian high schools at 29.1% (n=78), closely followed by science high schools at 28.4% (n=76). Vocational high schools ranked third with 23.5% (n=63), while general high schools had the lowest participation rate at 19.0% (n=51). This distribution indicates that the study predominantly included students from academically oriented school types and higher grade levels.

[1] Here's a brief explanation of each, in an academic context for Turkey:
Vocational High School: These schools provide vocational and technical education, preparing students for specific trades and professions in addition to general academic subjects. They aim to equip students with the skills needed for direct employment or further education in vocational fields.
General High School: Historically, this term referred to a standard, non-specialized high school in Turkey. While the "Anatolian High School" (Anadolu Lisesi) model has largely superseded the traditional "Düz Lise," the term might still be used to denote a more general academic high school curriculum as opposed to a specialized one. In many contexts, "Düz Lise" is synonymous with "Anadolu Lisesi" or a standard academic high school.
Qualified Anatolian High School: This likely refers to Anatolian High Schools, which are prominent academic high schools in Turkey. "Qualified" used to emphasize the competitive nature and higher academic standards of certain Anatolian High Schools, often determined by national entrance exams. These schools typically offer a strong academic curriculum with an emphasis on foreign language education.
Science High School: These are highly selective high schools in Turkey that specialize in science and mathematics. They are designed for academically gifted students and provide an intensive curriculum in natural sciences (physics, chemistry, biology) and mathematics, preparing students for higher education in scientific and engineering fields.

Data Collection Instruments

To measure students' perceived levels of teacher proximity, the "Teacher Proximity Behaviors Scale" was utilized, with separate versions prepared for middle school and high school students. For assessing mathematics anxiety and class participation, the "Mathematics Anxiety Scale" and the "Class Participation Level Scale" were employed, respectively. Additionally, a personal information form was developed to gather students' demographic data, which also included questions about their scores on the first two mathematics exams. All scales were designed using a five-point Likert type format. Details regarding their developers, development years, number of items, and sample items are provided in Table 7.

Table 7. Data Collection Tools Information

Scale Name	Source (Year) / Number of Items	Sample Items
Perceived Teacher Proximity Behaviors Scale (PTPBS)	Geçer (2002) Middle School 34 Items High School 45 Items	O12- My teacher explains the lesson in a soft tone and has a loving expression on their face. O14- My teacher shares news that makes me happy. L12- My teacher takes my thoughts by giving me the right to speak during the lesson. L33- Our teacher makes us feel that they love and value us with their behaviors (e.g., puts their arm around our shoulder, pats our back, sits at our desk).
Mathematics Anxiety Scale (MAS)	Bindak (2005) 10 Items	1-When I think of mathematics, complex, incomprehensible things come to my mind. 3-I always worry about being asked questions in mathematics classes. 10-I am afraid to ask questions in mathematics class.
Lesson Participation Scale (LPS)	Sever (2014) 17 Items	1-I listen to the lesson carefully without being interested in anything else. 5-I ask my teacher questions where I don't understand. 7-I indicate that I am listening to the lesson with my gestures and facial expressions.

Data Analysis

Responses collected from the research instruments were initially organized within Microsoft Excel and subsequently transferred to SPSS Version 23.0, where necessary coding and mean calculations were performed. Following this preliminary preparation, expert assistance was sought for normality and mean comparison test analyses. Given that the data concerning the relationship between Turkish Language and Literature (TDE) teachers' proximity behaviors and students' attitudes towards TDE courses and their participation exhibited a normal distribution, a Correlation test was utilized. For relationships between binary groups (e.g., gender), an independent samples t-test was applied, while for groups exceeding two (e.g., professional seniority, class size), an ANOVA test was conducted. During the analyses, reverse-scored items were appropriately adjusted. Normality analyses were performed in terms of skewness and kurtosis values, revealing that the data were normally distributed (Table 8). As the skewness and kurtosis values fell between -1.5 and 1.5, parametric data analysis methods, suitable for normal distributions, were employed (Tabachnick & Fidell, 2007).

Table 8. Skewness-Kurtosis Table

Scale	X	S	Min.	Mak.	Kurtosis	Skewness
Middle School – Teacher Proximity Scale	3,9576	0,4452	2,15	4,88	-0,886	1,496
High School – Teacher Proximity Scale	2,7680	0,3943	2,02	3,46	-0,196	-1,038
Middle School – Math Class Participation Scale	3,2887	0,5149	2,35	4,12	-0,651	-0,542
High School – Math Class Participation Scale	2,7759	0,4840	1,33	3,89	-0,364	-0,140
Middle School – Mathematics Anxiety Scale	1,9899	0,9182	1,15	4,90	0,996	0,327
High School – Mathematics Anxiety Scale	2,8150	0,4882	1,93	4,89	0,166	1,684

FINDINGS

In this section, the findings will be presented separately for both quantitative and qualitative data.

Quantitative Findings

This section begins by presenting the mean scores derived from the responses of both middle school and high school students to the "Perceived Teacher Proximity Behaviors Scale," the "Mathematics Anxiety Scale," and the "Class Participation Level Scale." Subsequently, the relationships among these constructs are examined. Finally, the association between teacher proximity and variables such as student gender, teacher gender, professional seniority, and class size is investigated independently for both educational levels.

Table 9. Descriptive Statistics of Students' Responses to Data Collection Tools

Ölçek	Level	N	X*	S	Min.	Mak.
Perceived Teacher Proximity Behaviors Scale (PTPBS)	Middle School	217	3,9576	0,4452	2,15	4,88
	High School	268	2,7680	0,3943	2,02	3,46
Lesson Participation Scale (LPS)	Middle School	217	3,2887	0,5149	2,35	4,12
	High School	268	2,7759	0,4840	1,33	3,89
Mathematics Anxiety Scale (MAS)	Middle School	217	1,9899	0,9182	1,15	4,90
	High School	268	2,8150	0,4882	1,93	4,89
Achievement	Middle School	217	72,345	0,4556	49,00	100,00
	High School	268	57,998	0,5670	32,00	100,00

* Average scores were evaluated on a 5-point scale for the scales.

Upon examining the table, it is observed that middle school students (X^{-}=3.9576, N=217) exhibit a higher mean score on the "Teacher Proximity Scale" compared to high school students (X^{-}=2.7680, N=268). Similarly, on the "Mathematics Class Participation Scale," middle school students (X^{-}=3.2887, N=217) were found to have a higher level of participation than high school students (X^{-}=2.7759, N=268). Conversely, on the "Mathematics Anxiety Scale," high school students (X^{-}=2.8150, N=268) are observed to have a higher level of anxiety compared to middle school students (X^{-}=1.9899, N=217). While it can be stated that middle school students' perceived teacher proximity and class participation are above average, and their anxiety is below average, for high school students, all scale evaluations remained below average. Additionally, the level of academic achievement is also higher among middle school students compared to high school students. These findings may indicate a decrease in students' relationships with their teachers, a decline in their participation in mathematics classes, an increase in their anxiety towards mathematics, and consequently lower achievement as they progress through educational levels. Figures 1 and 2 illustrate the distribution of the average scores obtained from the data collection instruments, specifically showing their position relative to the overall mean. These figures provide a visual representation of how the collected data points, on average, deviate from or align with the central tendency.

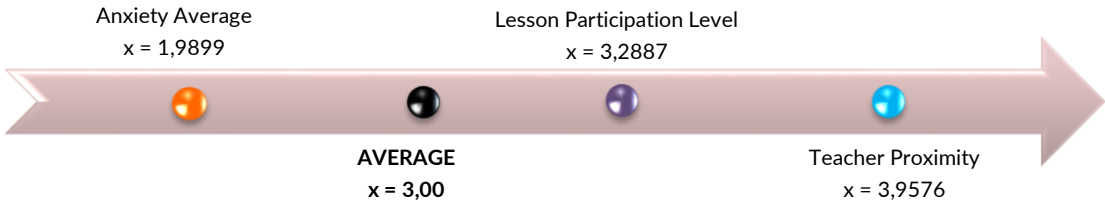

Figure 1. Middle School Students' Scale Score Averages

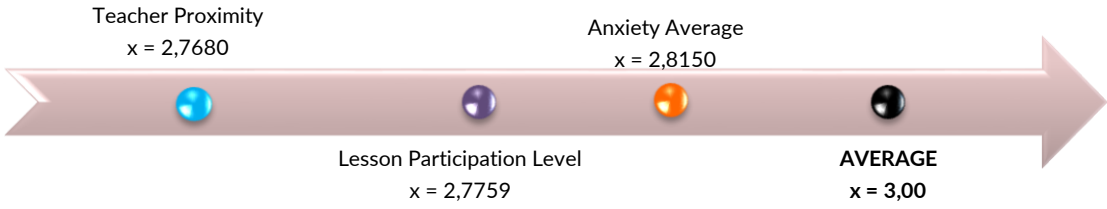

Figure 2. High School Students' Scale Score Averages

The investigation into the relationship between middle school students' perceived teacher proximity and their mathematics anxiety, class participation level, and academic achievement is presented in Table 10.

Table 10. Relationship Between Perceived Teacher Proximity and Mathematics Anxiety, Class Participation Level, and Student Achievement Among Middle School Students

		Class Participation	Anxiety	Teacher Proximity	Achievement
Lesson Participation	Correlation	1			
	Significance				
	N	217			
Anxiety	Correlation	-247	1		
	Significance	0.031*			
	N	217	217		
Teacher Proximity	Correlation	687	-804	1	
	Significance	0.006*	0.027*		
	N	217	217	217	
Achievement	Correlation	85	-123	435	1
	Significance	52	67	0.048*	
	N	217	217	217	217

A highly significant, negative correlation was observed between students' perceived teacher proximity behaviors and their mathematics anxiety ($r = -0.804$, $p = 0.027$; $p < 0.05$). This relationship indicates that as students' perception of teacher proximity increases, their mathematics anxiety tends to decrease. Furthermore, a high-level, positive, and statistically significant correlation was found between students' perceived teacher proximity behaviors and their mathematics class participation levels ($r = 0.687$, $p = 0.006$; $p < 0.05$). This suggests that students who perceive greater teacher proximity are more likely to participate actively in mathematics classes. Additionally, a moderately positive and significant correlation was identified between students' academic achievement and the perceived proximity behaviors

from their teachers. This finding can be interpreted as students who experience more proximal teacher behaviors exhibiting higher mathematics class participation, lower anxiety, and consequently, greater academic success. Finally, a low-level, negative, and significant correlation was also established between students' anxiety levels and their class participation ($r = -0.247$, $p = 0.006$; $p < 0.05$). This implies that students with lower anxiety levels tend to participate more in mathematics classes.

Table 11. Relationship Between Perceived Teacher Proximity and Mathematics Anxiety, Class Participation Level, and Student Achievement Among High School Students

		Class Participation	Anxiety	Teacher Proximity	Achievement
Lesson Participation	Correlation	1			
	Significance				
	N	268			
Anxiety	Correlation	-0,095	1		
	Significance	0,120			
	N	268	268		
Teacher Proximity	Correlation	0,857	0,928	1	
	Significance	0,001*	-0,087		
	N	268	268	268	
Achievement	Correlation	0,567	-0,045	0,612	1
	Significance	0,020*	0,056	-0,001*	
	N	268	268	268	268

Table 11 illustrates the relationships between perceived teacher proximity and mathematics anxiety, class participation level, and student achievement among high school students. An examination of the correlation coefficients reveals a strong, positive correlation between class participation and teacher proximity ($r = 0.857$, $p < 0.001$). This finding suggests that students who establish closer relationships with their teachers tend to have higher levels of participation in mathematics classes. Additionally, a moderately positive correlation was identified between teacher proximity and achievement ($r = 0.612$, $p < 0.001$). This result indicates that high school students with positive relationships with their teachers may also exhibit higher achievement in mathematics. Conversely, no statistically significant relationship was found between anxiety and class participation ($r = -0.095$, $p = 0.120 > 0.05$) or between anxiety and achievement ($r = -0.045$, $p = 0.056 > 0.05$). However, a low-level, negative relationship was observed between teacher proximity and anxiety ($r = 0.928$, $p = 0.087$). In conclusion, this table supports that, at the high school level, teacher proximity is positively associated with mathematics class participation and student achievement. The relationships between the anxiety variable and other variables were not found to be statistically significant in this particular sample.

Table 12. Comparison of Teacher Proximity Behaviors by Student Gender

Scale	Student Gender	N	Mean	Standard Deviation (s)	sd	t value	p value
Middle School PTPBS	Female	112	3.8875	5.786	215	0,554	0,146
	Male	105	4.0277	6.592			
High School PTPBS	Female	153	2.8875	4.331	266	0,366	0,715
	Male	115	2.6485	3.292			

Table 12, which compares perceived teacher proximity behaviors by student gender at the middle school level, indicates that female students' PTPBS (Perceived Teacher Proximity Behaviors Scale) mean score ($\bar{X}=3.8875$, N=112) is lower than that of male students ($\bar{X}=4.0277$, N=105). However, the results of the independent samples t-test show that this

difference is not statistically significant (t(215)=0.554, p=0.146). This suggests there is no significant difference in how middle school male and female students perceive their teachers' proximity behaviors. At the high school level, female students' AÖYDÖ mean score (X^{-}=2.8875, N=153) is higher than male students' mean score (X^{-}=2.6485, N=115). Yet, the independent samples t-test results again reveal that this difference is not statistically significant (t(266)=0.366, p=0.715). This indicates that, at the high school level as well, there is no significant difference in the perceived teacher proximity behaviors between female and male students. In conclusion, according to this table, student gender does not lead to a statistically significant difference in the perceived proximity behaviors of their teachers at either the middle school or high school level.

Table 13. Comparison of Teacher Proximity Behaviors by Teacher Gender

Scale	Student Gender	N	Mean	Standard Deviation (s)	sd	t value	p value
Middle School PTPBS	Female	163	4,3456	0,5112	215	-3,541	0,000
	Male	54	3,5660	0,7541			
High School PTPBS	Female	101	2,5841	0,4047	266	-6,143	0,000
	Male	167	2,8792	0,3385			

Upon examining Table 13, which compares the perceived proximity behaviors of female and male teachers at both middle school and high school levels, a significant difference emerges at the middle school level. Female teachers' AÖYDÖ (Perceived Teacher Proximity Behaviors Scale) mean score (X^{-}=4.3456; N=163) is significantly higher than that of male teachers (X^{-}=3.5660, N=54). The independent samples t-test confirms this difference is highly statistically significant (t(215)=-3.541; p=0.000). This indicates that, at the middle school level, female teachers are perceived by students as exhibiting greater proximity behaviors compared to their male counterparts. Conversely, at the high school level, female teachers' AÖYDÖ mean score (X^{-}=2.5841; N=101) is significantly lower than that of male teachers (X^{-}=2.8792; N=167), as also confirmed by the independent samples t-test (t(266)=-6.143, p=0.000). These findings suggest that at the high school level, male teachers are perceived by students as exhibiting greater proximity behaviors than female teachers. In light of these results, teacher gender creates a statistically significant difference in students' perceived proximity behaviors from their teachers at both middle school and high school levels. While female teachers are perceived as more proximal in middle school, this trend reverses in high school.

Table 14. ANOVA Comparison of Perceived Teacher Proximity Behaviors by Class Size for Middle and High School Students

Educational Level	Source of Variance	Sum of Squares (SS)	df	Mean Square (MS)	F	p	Significant Difference*
Middle School	Between Groups	2,434	3	0,811	4,279	0,006	Yes 2^-4 3^-4
	Within Groups	40,384	213	0,190			
	Total	42,818	216				
High School	Between Groups	1,341	2	0,671	4,493	0,012	Yes 1-2^ 2^-3
	Within Groups	39,557	265	0,149			
	Total	40,898	267				

*Note: Class Sizes: 1: 13-20 students; 2: 21-28 students; 3: 29-36 students; 4: 36 and over.

One-Way Analysis of Variance (ANOVA) results for perceived teacher proximity behaviors based on class size for middle school and high school students are presented in Table 13. For middle school students, the ANOVA results indicated a statistically significant difference in perceived teacher proximity behaviors among different class size groups (F(3,213)=4.279, p=0.006). The sum of squares between groups was 2.434, and the sum of squares within groups was

40.384. According to the LSD Post-hoc analysis results (as specified in the "Significant Difference" column of the table), significant differences were observed between groups 2-4 and 3-4. As indicated at the bottom of the table, "1" represents class sizes of 13-20 students, "2" represents 21-28 students, "3" represents 29-36 students, and "4" represents 36 or more students. Accordingly, the perceived teacher proximity level for middle school students in classes of 21-28 students (X^{-}=3.6754) and 29-36 students (X^{-}=3.6041) is significantly higher than that of students in classes of 36 or more students (X^{-}=3.3423).

For high school students, a statistically significant difference was also found in perceived teacher proximity behaviors among different class size groups (F(2,265)=4.493, p=0.012). The sum of squares between groups was 1.341, and the sum of squares within groups was 39.557. According to the LSD Post-hoc analysis results, a significant difference was observed between groups 1-2 and 2-3. This implies that the perceived teacher proximity level for students in classes of 13-20 students (X^{-}=2.7233) and 29-36 students (X^{-}=2.7376) is significantly different from that of students in classes of 21-28 students (X^{-}=2.9102). In summary, at both the middle school and high school levels, class size leads to significant differences in students' perceived proximity behaviors from their teachers. Interestingly, the highest perception of teacher proximity at both middle school and high school levels is observed in classes with 21-28 students.

Table 15. Comparison of Teacher Proximity Behaviors by School Type

Scale	School Type	N	Mean	Standard Deviation (s)	p-value
Teacher Proximity Behaviors	Vocational High School	63	2,7381	0,3716	0,855
	General High School	51	2,7720	0,4003	
	Qualified Anatolian High School	78	2,7548	0,4019	
	Science High School	76	2,8005	0,3853	

Analysis of Table 15, "Comparison of Teacher Proximity Behaviors by School Type," indicates that perceived teacher proximity among high school students does not vary significantly across different school types. The observed p-value of 0.855 for this comparison, being considerably greater than the conventional significance threshold of 0.05, precludes the rejection of the null hypothesis. Furthermore, the descriptive statistics reveal highly similar mean scores for perceived teacher proximity across Vocational High Schools (x=2.7381), General High Schools (x=2.7720), Qualified Anatolian High Schools (x=2.7548), and Science High Schools (x=2.8005), reinforcing the conclusion that school type does not exert a statistically significant influence on students' perception of teacher proximity.

Table 16. ANOVA Comparison of Perceived Teacher Proximity Behaviors by School Type for High School Students

Educational Level	Source of Variance	Sum of Squares (SS)	df	Mean Square (MS)	F	p	Significant Difference*
High School	Between Groups	0,120	3	0,040	0,259	0,855	Non
	Within Groups	40,778	264	0,154			
	Total	40,898	267				

Upon evaluating the One-Way Analysis of Variance (ANOVA) results presented in Table 16, derived from the descriptive statistics in Table 15, it is observed that perceived teacher proximity behaviors among high school students do not exhibit a statistically significant difference based on school type (F(3,264)=0.259,p=0.855). The sum of squares between groups was calculated as 0.120, and the sum of squares within groups was 40.778. The indication of "no" in the significant difference column further confirms that no significant difference was found between any pair of school types as a result

of the LSD post-hoc analyses.

Qualitative Findings

This section presents the qualitative findings of the study. The responses to the question, "In your mathematics lessons, how do your teacher's proximity behaviors (e.g., how close they are to you, his/her engagement with individual students, his/her overall presence in the classroom) affect your level of anxiety about mathematics and your willingness to participate in class discussions and activities?" were analyzed, and common response codes were developed. To ensure research rigor and trustworthiness, direct quotations from the students' responses are included.

Table 17. Content Analysis of Students' Responses to the Open-Ended Question

Theme Category	Specific Sub-Themes	Number of Students Mentioning (Count)	Percentage of Total Students (n=86)	Illustrative Student Quotes
I. Teacher Presence & Support (Positive)	a. Perceived Warmth & Care	45	52.3%	"When my teacher smiles at me or asks how I am, it makes me feel like he actually cares, and that calms me down about math." "He makes sure everyone feels okay."
	b. Availability & Accessibility	50	58.1%	"My teacher is always walking around the room, so it's easy to catch their eye if I need help without feeling like I'm bothering them." "It makes me feel less anxious knowing he is there if I get stuck."
	c. Individualized Attention	55	64.0%	"When my teacher sits next to me for a bit and explains something just to me, it helps me understand way better, and I'm not afraid to ask questions." She doesn't just teach the whole class, She actually helps me one-on-one."
	d. Encouragement & Reassurance	38	44.2%	"If I look confused, my teacher will come over and say, 'You got this,' and that really motivates me to try harder and participate." "She makes me feel like it's okay to get things wrong."
II. Impact on Anxiety	a. Reduced Anxiety	60	69.8%	"Their presence makes me less worried about making mistakes in front of the class." "I feel calmer when she is nearby because I know I can get help."
	b. Increased Anxiety (Feeling Watched/Judged)	15	17.4%	"Sometimes if he stands too close, I feel like he's watching my every move and it makes me more stressed." "I get nervous when she just stand over my shoulder."
	c. No Direct Impact on Anxiety	11	12.8%	"My anxiety is about the math itself, not where the teacher is." "I'm always anxious in math, it doesn't matter if the teacher is close or far."
III. Impact on Class Participation	a. Increased Willingness to Participate	58	67.4%	"I'm more likely to raise my hand if I feel like the teacher is approachable and near." "When she is walking around, it's easier to ask a quick question privately."
	b. Increased Confidence to Ask Questions	47	54.7%	"It makes me feel safe to ask 'dumb' questions because my teacher right there to help, not judge." "I won't ask if he is far away, but if he is close, I feel brave enough."
	c. Reduced Willingness to Participate	10	11.6%	"If the teacher is right there, I clam up and don't want to say anything." "I prefer to hide if she is too close."
	d. No Direct Impact on Participation	18	20.9%	"I only participate if I know the answer for sure, regardless of the teacher's position." "My participation depends on how well I understand the topic, not the teacher's closeness."
IV. Specific Proximity Behaviors Mentioned	a. Teacher Walking Around	50	58.1%	"I like when the teacher just walks around the room, it feels like he's checking on everyone." "She moves around, so you feel like she is available."
	b. Individual Desk Visits/Sitting Nearby	45	52.3%	"When he sit down next to me and explain something, that's the best." "He comes to my desk when I'm stuck."
	c. Eye Contact/Acknowledging Presence	30	34.9%	"She makes eye contact and nod, so you know the teachers see you." "Just knowing she is there and looking around helps."
	d. Direct Questioning (during proximity)	25	29.1%	"He comes up and ask 'Do you get it?' directly, which makes me think harder."
V. Other Factors Influencing Impact	a. Teacher Personality/Approach	20	23.3%	"It depends on the teacher, some teachers are good at being close without being creepy." "If she is friendly, then proximity helps; if she is strict, it makes me more nervous."
	b. Difficulty of Math Topic	15	17.4%	"If the math is really hard, no amount of teacher proximity will make me less anxious." "I only participate when I understand the material easily."
	c. Student's Own Personality	10	11.6%	"I'm shy anyway, so even if the teacher is close, I probably won't talk much." "I prefer to figure things out on my own, so I don't always want the teacher right there."

The thematic quantification of student responses revealed that teacher presence and support were overwhelmingly

perceived positively, with high percentages of students noting perceived warmth and care (52.3%), availability and accessibility (58.1%), individualized attention (64.0%), and encouragement (44.2%) as beneficial aspects of teacher proximity. This positive perception directly correlated with reduced mathematics anxiety (69.8%) and increased willingness to participate (67.4%), particularly in asking questions (54.7%). Specific proximity behaviors like teachers walking around (58.1%) and individual desk visits (52.3%) were frequently cited as impactful. While a smaller segment of students reported increased anxiety (17.4%) due to feeling watched or no direct impact (12.8%), and some showed reduced participation (11.6%) or no direct impact (20.9%), the data strongly suggests that a teacher's perceived closeness, when interpreted as supportive and caring, significantly mitigates math anxiety and fosters greater classroom engagement for the majority of students.

RESULTS AND DISCUSSION

This study investigated the impact of perceived teacher proximity behaviors, specifically concerning mathematics teachers, on middle and high school students' mathematics anxiety, class participation, and academic achievement. A total of 485 students participated, comprising 217 middle school and 268 high school students. Data were collected using the Teacher Proximity Behavior Scale, the Mathematics Anxiety Scale, and the Class Participation Level Scale. Additionally, students' academic grades were evaluated to assess their achievement.

The initial finding of the research indicates a decrease in perceived teacher proximity as students advance in their educational level. Specifically, middle school students perceive their teachers as being closer than high school students do. This phenomenon can be attributed to several factors associated with adolescence, including the expansion of students' social circles, an increased emphasis on peer relationships, and a relative decrease in the influence of the teacher figure (Ryan & Patrick, 2001). Furthermore, the demanding high school curriculum and the exam-centric educational system may limit individual teacher-student interaction (Wentzel, 1998). Similarly, mathematics class participation levels also decline from middle school to high school. In an environment where perceived teacher proximity diminishes, a decrease in students' motivation and active participation in class is an expected outcome (Connell & Wellborn, 1991). Conversely, mathematics anxiety was found to be higher among high school students compared to middle school students. This can be linked to the increasing abstraction of mathematics topics at the high school level, heightened academic pressure, and future-related anxieties (Hembree, 1990). The observation that academic achievement is higher in middle school than at the high school level further supports these negative trends. It can therefore be argued that the decrease in perceived teacher proximity, the decline in class participation, and the increase in mathematics anxiety as students progress through their education levels may indirectly and negatively impact academic success.

A strong, negative correlation was identified between perceived teacher proximity and mathematics anxiety among middle school students. This finding indicates that students who establish close relationships with their teachers tend to experience reduced anxiety concerning mathematics. Teachers' supportive and empathetic attitudes can foster a sense of security in students, thereby lowering their anxiety levels (Pianta, 1999). Similarly, a strong, positive correlation was found between teacher proximity and class participation. Students who have positive relationships with their teachers may be more inclined to actively participate in class (Patrick et al., 2007). Furthermore, a moderate positive correlation was observed between teacher proximity and mathematics achievement. Yenilmez and Özabacı (2003) identified three factors contributing to low student attitudes and lack of participation in class: teacher authority, time constraints, and

pressure from expectations. Students frequently encountering these factors tend to develop negative attitudes and reduced participation in class. From this perspective, it can be argued that teacher behaviors play a crucial role in enhancing student attitudes and class participation. Students can participate in class by asking questions, providing explanations, or even through mental engagement (Senemoğlu, 2012). Cognitive processes such as thinking and making connections are also indicators of class participation (Ayçiçek, 2018). Thus, it can be inferred that students who perceive greater teacher proximity tend to participate more in class, experience less anxiety, and consequently achieve higher academic success. The presence of a low-level, negative, and significant correlation between students' anxiety levels and their class participation further suggests that anxiety negatively impacts engagement in class.

The findings for high school students exhibit similar patterns to those observed in middle school. A strong and positive correlation was observed between teacher proximity and class participation. This implies that, even at the high school level, students who establish close relationships with their teachers tend to engage more actively in mathematics classes. The presence of a positive and moderate correlation between teacher proximity and academic achievement further supports the beneficial impact of this variable on academic outcomes. However, at the high school level, no statistically significant relationship was found between anxiety and either class participation or academic achievement. While a negative, low-level correlation was observed between teacher proximity and anxiety, this relationship was also not statistically significant. This suggests that mathematics anxiety in high school students may not have a direct impact on class participation and achievement, or that this relationship might operate indirectly through other mediating variables.

When examining the effect of student gender on perceived teacher proximity, no statistically significant difference was found at either the middle school or high school level. This suggests that teachers do not differentiate their proximity behaviors based on student gender, or that students do not perceive these behaviors differently based on their own gender.Conversely, the impact of teacher gender on perceived teacher proximity varies by educational level. At the middle school level, female teachers were perceived as significantly closer than male teachers. This might be attributed to middle school students perceiving female teachers as more supportive and caring (Downer et al., 2006). However, at the high school level, this trend reverses, with male teachers being perceived as having greater proximity than female teachers. This shift could be explained by factors such as evolving student expectations at the high school level, or the possibility that male teachers' authoritative yet supportive demeanor is perceived as more reassuring by some students.

The impact of class size on perceived teacher proximity was found to be significant at both middle and high school levels. Interestingly, the highest perception of teacher proximity was observed in medium-sized classes (21-28 students) at both educational stages. This suggests that classroom environments that are neither excessively large nor too small to preclude individual teacher attention may be ideal for fostering student-teacher interaction. In overly large classes, teachers may struggle to adequately engage with every student, while in very small classes, a perceived restriction of student autonomy might negatively affect proximity. A comprehensive study conducted in the UK by Blatchford et al. (2003), the "Class Size and Pupil Adult Ratio (CSPAR) in Primary and Secondary Schools" project, investigated the effect of class size on student achievement, noting that teachers' classroom management strategies and capacity to provide individual student support are influenced by class size. Tuncer and Ercan (2014) demonstrated that as class size increases, teachers exhibit lower proximity behaviors and dedicate less time to students. Similarly, Yücel and Bıkmaz (2018) found that with an increase in class size, teachers provide less individual attention and exhibit fewer proximity behaviors towards students. In essence, large class sizes can make it challenging for teachers to maintain an equally close demeanor with all students. Furthermore, high school type was found to have no statistically significant effect on perceived teacher

proximity. The similar levels of perceived teacher proximity among students in different high school types may suggest that teachers generally adopt comparable approaches with students, or that students in various school types hold similar expectations regarding teacher proximity. No direct studies examining the effect of high school type on teacher-student relationships were found in the extant literature.

The thematic quantification of student responses revealed that teacher presence and support were overwhelmingly perceived positively, with high percentages of students noting perceived warmth and care, availability and accessibility, individualized attention, and encouragement as beneficial aspects of teacher proximity. This positive perception directly correlated with reduced mathematics anxiety and increased willingness to participate, particularly in asking questions. Specific proximity behaviors like teachers walking around and individual desk visits were frequently cited as impactful. While a smaller segment of students reported increased anxiety due to feeling watched or no direct impact, and some showed reduced participation or no direct impact, the data strongly suggests that a teacher's perceived closeness, when interpreted as supportive and caring, significantly mitigates math anxiety and fosters greater classroom engagement for the majority of students. Given these compelling findings, it's clear that teacher proximity, when perceived as supportive and caring, significantly impacts students' mathematics anxiety and class participation. To leverage this, teacher training programs and professional development initiatives should emphasize the cultivation of intentional proximity behaviors. This includes strategies for actively moving around the classroom, providing brief individualized check-ins, and using encouraging non-verbal cues that convey warmth and accessibility, as supported by research highlighting the importance of positive teacher-student relationships (Pianta, 1999). Furthermore, educational policies could explore the impact of class size on a teacher's ability to maintain meaningful proximity, as larger classes may inadvertently limit these crucial interactions (Blatchford et al., 2003; Yücel & Bıkmaz, 2018). By fostering an environment where students consistently experience supportive teacher proximity, schools can proactively address mathematics anxiety and enhance student engagement, ultimately contributing to improved academic outcomes.

In conclusion, this study reveals that teacher proximity plays a significant role in students' mathematics class participation and academic achievement. However, this relationship may vary depending on the educational level and certain demographic variables. Notably, at the middle school level, teacher proximity appears to be a critical factor in reducing students' anxiety and increasing their class participation. While the importance of teacher proximity persists at the high school level, its relationship with anxiety exhibits a more complex structure. The impact of class size on student-teacher interaction is also a crucial finding that warrants consideration.These results underscore the necessity of raising awareness in teacher training programs regarding the importance of the teacher-student relationship and tailored approaches to meet the needs of students at different educational stages. Furthermore, a more detailed investigation into the effects of class size on the learning environment and the determination of optimal class sizes could prove beneficial for educational policy.

RECOMMENDATIONS

Based on the research findings, actionable recommendations have been developed for various stakeholders, focusing on each significant discovery and considering different target audiences (teachers, school administrators, parents).

1. Suggestions Regarding the Finding of Decreased Teacher Closeness as Educational Level Progresses:

For Teachers:

- ✓ It is suggested that high school teachers become aware of the evolving needs of adolescent students and endeavor to establish a more supportive and engaged communication. This can be achieved through demonstrating individualized attention, active listening, and providing constructive feedback that fosters students' academic and socio-emotional development.
- ✓ It may be beneficial for middle school and high school teachers to collaborate on developing projects that ensure continuity in teacher closeness during student transition processes. For instance, high school teachers visiting middle schools to meet students and share expectations could facilitate a smoother transition.

For School Administrators:

- ✓ In-service training sessions and workshops can be organized in schools to strengthen teacher-student relationships. These training programs could focus on topics such as communication skills, empathy development, and responsiveness to diverse student needs.
- ✓ Social and cultural activities that foster a genuine and supportive school environment where teachers can engage more frequently with their students can be encouraged.

2. Suggestions Regarding the Findings of Decreased Mathematics Class Participation and Increased Anxiety:

For Teachers:

- ✓ Instructional methodologies that make mathematics classes more engaging and student-centered can be implemented. These could include approaches such as problem-based learning, project-based learning, and collaborative learning.
- ✓ A supportive classroom atmosphere should be fostered to mitigate students' mathematics anxiety. It's crucial to emphasize that errors are an inherent part of the learning process and to provide constructive feedback.
- ✓ To encourage every student's participation, differentiated instructional approaches should be adopted, catering to individual learning paces and needs.

For Parents:

- ✓ Parents should be encouraged to actively participate in their children's mathematics learning processes, ensure a supportive learning environment at home, and exhibit positive attitudes towards mathematics.

3. Suggestions Regarding the Effect of Class Size on Perceived Teacher Closeness:

For Policy Makers and School Administrators:

- ✓ Class sizes should be carefully regulated to ensure they do not adversely affect student-teacher interaction. Research findings suggest that medium-sized classes (21-28 students) may be more conducive to fostering a higher perception of teacher closeness.

- ✓ For teachers working in large classes, additional support and resources can be provided to enhance individual student interaction. This could include, for instance, teaching assistants or volunteers.
- ✓ The integration of technology could be explored to assist teachers in establishing more personalized communication with students in crowded classrooms.

4. General Recommendations

- ✓ The findings of this research consistently demonstrate the critical role of positive teacher-student relationships in influencing student achievement, class participation, and anxiety levels. Consequently, enhancing the quality of these relationships should be a fundamental priority at every level of the educational system. To achieve this, all educational processes, ranging from teacher training programs to school policies, should be structured to foster supportive and effective student-teacher interactions. This necessitates the provision of ongoing professional development for teachers aimed at refining their communication skills and cultivating a school culture that champions such relationships. Furthermore, allocating the necessary time and resources to enable teachers to fulfill this crucial role is of paramount importance.
- ✓ Moreover, the research findings indicate a discernible decline in teacher closeness and adverse shifts in student outcomes as the educational level progresses. To counteract these trends and support the holistic development of students, it is imperative to establish early intervention mechanisms and comprehensive support systems. Rather than solely concentrating on academic achievement, schools should also prioritize and support students' socio-emotional well-being, motivation, and active engagement in learning. This can be realized through collaborative efforts among teachers, guidance counselors, and parents, ultimately leading to the creation of student-centered, participatory learning environments.

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