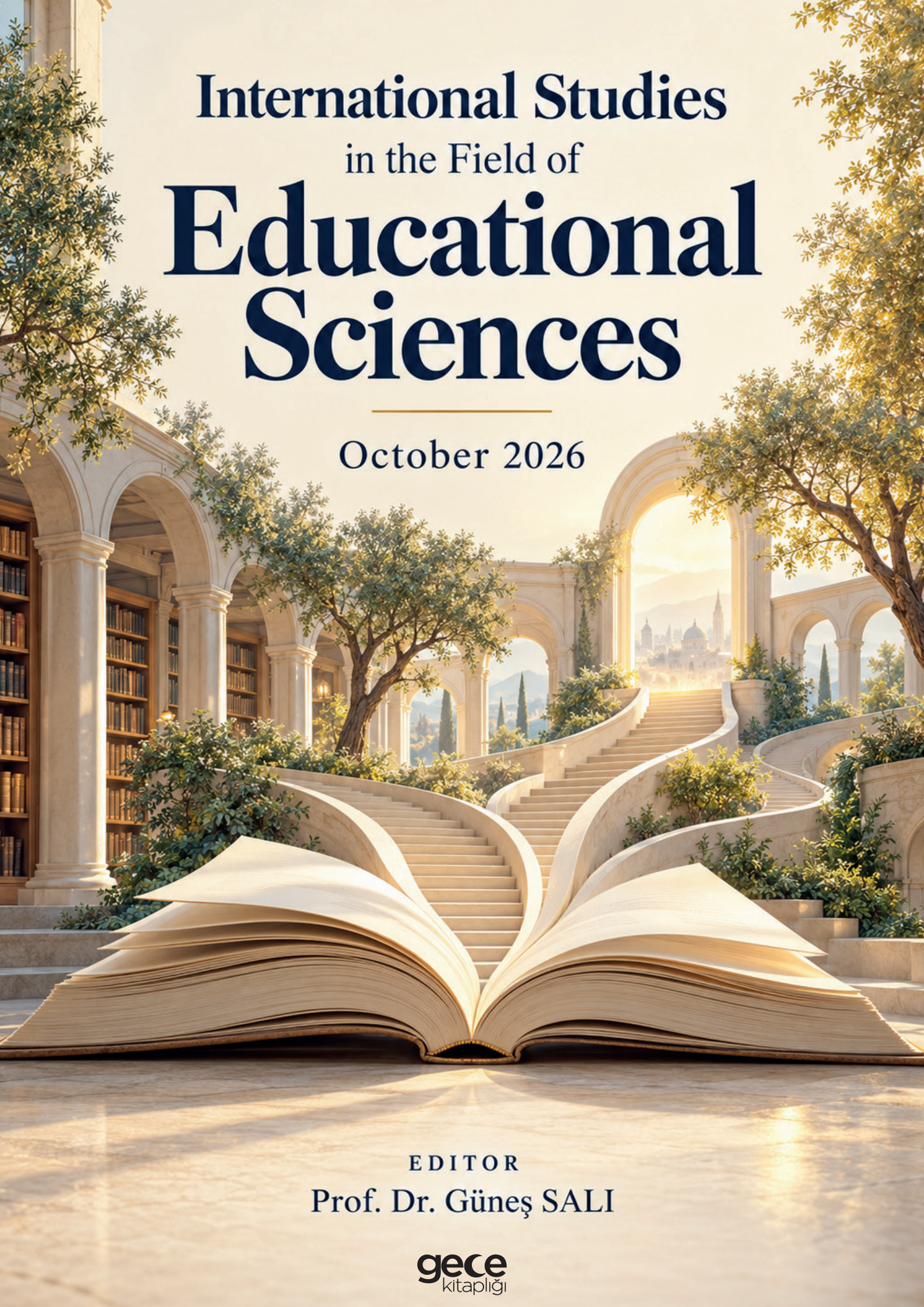




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Prof. Dr. Güneş SALI

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CHAPTER 1

ADOLESCENT LONELINESS IN THE DIGITAL AGE: THE ROLE OF SOCIAL MEDIA

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Introduction

In today's digital age, adolescent loneliness is one of the primary challenges faced by adolescents, and it remains a significant issue in Turkey, as it does in every society. With the widespread use of digital devices within families, it has been observed that loneliness and depression among adolescents are increasing day by day. Family members may feel lonely even when living under the same roof—or even in the same room. This loneliness can leave individuals feeling powerless over their thoughts, emotions, and behaviors. It can even lead to depression. This is because families are no longer spending enough time together or sharing their emotions. Siblings now message each other on WhatsApp instead of talking in person. Zsila and Reyes (2023) note that intensive social media use can lead to negative consequences, including loneliness, sadness, and severe stress.

Along with the decline in shared family meals, sharing among family members during meals has also decreased significantly. Family meals used to involve sharing emotions and conversation; today, they have been replaced by dull, quiet meals. In fact, many adolescents may refuse to eat at the family table. Due to the demands of modern life, such as both parents working, children attending school and taking extra classes, and time spent at tutoring centers, opportunities for family members to spend time together have diminished significantly. Family members' facial expressions appear tense, pale, blank, and emotionless. The introduction of social media has led family members to share their joyful and sorrowful emotions on social media platforms rather than with one another, which is the root of the problem. Adolescents, in particular, fall into this at-risk group. Rogge (2003, p. 322) points out that excessive computer use isolates adolescents from their parents, siblings, and friends. When there are no alternative activities or outside pursuits to fill their free time, they experience feelings of timidity, low self-esteem, and insecurity. This highlights the need for parents to take preventive measures.

In the contemporary era, social media friendships have become an integral part of life, with many individuals leveraging these platforms to connect with friends and acquaintances. Adolescents now primarily socialize on social media. While face-to-face interactions have decreased, some high-achieving adolescents have difficulty expressing themselves in public. Because they spend so much time on social media, addiction to it and depression in adolescents have emerged as major issues of our time.

In a meta-analysis of studies involving adolescents, college students, and older adults, Fam and Männikkö (2025) found that loneliness drives problematic media use. However, they

also found that intense and problematic media use can lead to an increase in feelings of loneliness over time. Uncontrolled social media use can lead individuals towards loneliness. It can lead individuals towards addiction. It can lead individuals towards depression. Yasar Can and Kavak Budak (2021) found that social media addiction affects depression and loneliness among adolescents. In today's digital age, where parents have lost the ability to communicate and engage in meaningful dialogue with their children, loneliness and depression have become increasingly evident among adolescents. Issues related to loneliness and social media have emerged during adolescence. For this reason, it has become crucial for experts in the field to address these issues. Supporting both parents and adolescents in this area is now more important than ever.

Adolescent Loneliness and Social Media Issues in the Digital Age

According to TÜİK, the internet usage rate among individuals aged 16–74 is 90.9%. When broken down by gender, the rate is 93.6% for men and 88.2% for women. Based on this data, Turkey is among the countries with the highest internet usage rates. This issue cannot be disregarded, and parents must cultivate social media literacy to support their adolescents effectively.

According to the 2025 TÜİK data, the most widely used social media and messaging apps are WhatsApp (88.6%), YouTube (72.9%), and Instagram (68.1%). When analyzed by gender, men use WhatsApp (91.3%), YouTube (75.7%), and Instagram (68.7%) the most, while women use WhatsApp (85.9%), YouTube (70.1%), and Instagram (67.4%) the most.

According to TÜİK (2025) data on social media usage, both men and women are at risk. The fact that 90.9% of individuals living in Turkey have high internet usage is a cause for concern when evaluating TÜİK (2025) data. In this context, abruptly stopping usage could be challenging for users. Rather than quitting the internet or banning it for adolescents, it is evident that there is a need to use it appropriately. Intensive, uncontrolled internet use can drive people toward loneliness and lead them to spend more time online when they are lonely.

Lestari's (2024) study highlights the bidirectional relationship between loneliness and internet use. The study shows that increased internet use can lead to feelings of loneliness and that loneliness, in turn, can lead to extended online engagement. Evidently, adolescents' intensive and uncontrolled use of social media contributes to loneliness and negatively impacts their social relationships.

Ince and Yılmaz (2020) found that nearly 90% of adolescents actively use social media daily. The study emphasizes that adolescents in this context report feeling somewhat lonely and that their relationships with their social circles are not as fulfilling as they would like. For this reason, the study underscores the importance of parents becoming proficient in new media literacy.

Adolescents who are dissatisfied with their social circles spend more time on social media. Understandably, lonely adolescents turn to social media. In this context, a great deal rests on parents' shoulders. It is crucial to support parents in either keeping their children away from social media or creating an environment that encourages controlled use. Labeling adolescents' social media use as entirely good or bad does not reflect reality. The way social media is used determines whether it is beneficial or detrimental. What matters is how adolescents use social media.

The impact of social media on adolescents, as noted by Winstone et al. (2021), is contingent on the quality of existing relationships and their utilization. They concluded that social media has a complex effect: it can strengthen social bonds but also deepen loneliness. The study revealed that bonds become stronger for individuals with strong bonds, such as wealthy people. In contrast, individuals with weak family ties and trust issues may find that social media exacerbates their situation.

Close friends may experience difficulty in making by adolescents. Since they primarily socialize through social media, they may struggle to form close friendships. This can push them toward loneliness. Evidently, not only do male students face the risk of social media use disorder, but female students do too. Children of separated parents tend to spend a great deal of time on social media. Spending time on social media can serve as an escape from problems.

Indeed, Alabay et al. (2025) found that students with few close friends felt lonelier and experienced social media use disorder more frequently than those with many close friends. The study also concluded that high school girls have a higher rate of social media use disorder than high school boys. The study also found that social media use disorder is more prevalent among children whose parents are separated, and this phenomenon is particularly pronounced among children who experience frequent conflict or separation between their parents. Loneliness drives adolescents to spend excessive time on social media sharing their happiness and sadness. This can lead to addiction.

Hoşgör and Söyler (2026) found that social media addiction directly and indirectly reduces adolescents' happiness levels by increasing their perceived loneliness. Wang et al. (2025) found that lonely individuals who use desktop computers engage in shorter sessions but interact more frequently throughout the day. However, lonely individuals using mobile devices spend more time on visual sharing, messaging, and networking platforms.

Savcı and Aysan (2018) found that teenagers' ability to make friends, fear of being judged for feeling lonely, and their reward and punishment mechanisms can be used to predict social media addiction. Their study concluded that these factors influence adolescents' social media use, usage patterns, and addiction. Problems with social media use seem to affect families, culture, and teenagers' grades negatively.

Yıldırım and Kişioğlu (2018) note that, today, communication between individuals is increasingly facilitated by social media posts rather than face-to-face interaction. Consequently, our cultural characteristics may be hurt. They also note that due to problematic use of smart devices, individuals are unable to devote sufficient time to their families, friends, work, and studies. This situation may negatively affect young people's academic achievement, in particular, because they tend to use smart devices more frequently. Adolescents' problematic internet use can also lead to peer bullying. Unconscious, uncontrolled internet use and the unconscious sharing of information and private photos can lead others to misuse such content.

Kling and Spethmann point out that peer bullying is carried out via cell phones or the internet. They recommend that adolescents avoid sharing photos and posting them on websites. They advise them to change their phone numbers and email addresses frequently and to share them only with trusted individuals (Kling & Spethmann, 2010, p. 111).

Rogge (2015) notes that certain rules regarding cell phone use are inevitable. He points out that cell phones are now multifunctional, multimedia devices and that fast, unlimited internet access poses many dangers. For example, chat groups (Rogge, 2015, p. 75).

Adolescent Loneliness and Social Media Addiction in the Digital Age

Problems with social media can lead to feelings of loneliness and addiction in adolescents. This addiction can result in physical, mental, and behavioral issues. Aslan (2019), based on a literature review of adolescents, highlights the many problems associated with problematic internet use or internet addiction. He draws attention to physical, mental, and behavioral issues. Physically, there are sleep disorders, obesity, headaches, facial and neck

muscle pain, spinal pain, and eye strain. Mentally, there are depressive symptoms, generalized anxiety, social anxiety, attention deficit, and hyperactivity. Behaviorally, there is substance abuse, suicidal tendencies, and behavioral disorders. Adolescents' posts about themselves on digital platforms can also be harmful. In addition to affecting their psychological well-being, it can also negatively impact their body image and self-esteem. Furthermore, they may develop addiction issues as a result of being unable to control how much time they spend on digital platforms.

A 2024 study by Alluhidan et al. examined posts by adolescents on online peer-support platforms and found that, on Instagram, these posts were most frequently associated with body shaming and loss of self-esteem. On YouTube, however, they were linked to time management and addiction issues.

Problems with social media and feelings of isolation are not only concerns for adolescents; they also affect young adults. Among this group, social media addiction is particularly prevalent among young men. Another important issue is that single, lonely individuals without families tend to spend more time on social media. Just as social media addiction affects life satisfaction, loneliness also harms individuals. Studies have also shown that married individuals have higher life satisfaction than single individuals.

Yüksel et al. (2020) found that social media addiction is more prevalent among young adult men than women. On the other hand, women were found to have higher levels of contentment and solitude. It was revealed through their research that greater loneliness is experienced by individuals who use social media more frequently. Additionally, participants reported higher life satisfaction among married individuals. In conclusion, the more frequently individuals use social media, the more likely they are to become addicted. However, research has shown that social media usage decreases with age. Consequently, as social media addiction increases, life satisfaction decreases, and loneliness increases. Among adolescents, young females are more disadvantaged than their male counterparts in terms of social media addiction.

Güney and Taştepe (2020) found that a significant percentage of adolescents exhibit moderate levels of social media addiction. With respect to gender disparities, the study determined that female adolescents demonstrate elevated levels of social media dependency in comparison to their male counterparts.

Another study on social media addiction, conducted by Erdemir and Ayas (2023), revealed a positive correlation between social media addiction and loneliness scores among

middle school students. They also found that people who are addicted to social media tend to have lower well-being scores, and that loneliness is also linked to lower well-being scores. Social media addiction negatively affects adolescents' well-being. Uncontrolled internet use by adolescents to cope with loneliness can lead to digital game addiction.

Seki and Kurnaz (2022) identified a weak positive relationship between loneliness and internet, smartphone, and digital game addiction. These studies indicate that adolescent loneliness and social media addiction are significant issues in today's digital age.

Adolescent Loneliness and Depression in the Digital Age

Human development is generally divided into three stages: biological, cognitive, and socio-emotional. The biological stage involves physical changes in the body. The cognitive stage involves changes in thinking and intelligence. The socio-emotional stage involves changes in emotions, personality, relationships with others, and social contexts. This stage is characterized by adolescents' defiance toward their parents, aggression toward peers, assertiveness, enjoyment of social activities, and orientation toward gender roles (Santrock, 2014, p. 15).

Negative experiences in this domain can lead adolescents to isolate themselves and become trapped in loneliness. Adolescents experiencing difficulties in this domain generally exhibit two distinct behavioral patterns. One group exhibits defiant, aggressive, and extroverted behaviors, while the other group tends to be introverted and withdrawn.

The transition from childhood to adolescence is an extremely challenging and painful process. Forming a sense of self, experiencing physical changes, and developing feelings for the opposite sex can lead adolescents into a state of distress. They may feel helpless and experience sadness. In a sense, they are experiencing a "second birth." Experiencing these developmental processes can lead adolescents to perceive themselves as depressed.

Nitisch, Beil, and Schilling (2003) emphasize that while some adolescents experience temporary feelings of sadness, distress, and helplessness, for others, these feelings can lead to serious depression. They attribute adolescents' feelings of worthlessness and inadequacy during this period to negative self-evaluations developed in childhood. These negative feelings carry over into adolescence, negatively affecting some adolescents' academic performance and driving others into depression as they seek love and self-acceptance.

However, in some cases, issues such as family conflicts, parental divorce, the death of a close family member, the adolescent's own illness, or moving can lead to depression when experienced during this period. The authors emphasize the need for parents to be particularly attentive in this area and note that girls are at greater risk. Boys tend to express negative experiences through outward behavior, while girls tend to internalize these experiences and appear to be doing fine. This can result in parents failing to recognize that their children are depressed (Nitisch, Beil, & Schilling, 2003, pp. 226–227).

Approaching adolescents experiencing depression can be difficult. Their parents' expectations as they navigate adulthood can overwhelm them, leading to confusion and paralysis. This causes adolescents to withdraw and spend their time sleeping. Deep down, however, they harbor a desire to grow up, become stronger, and find their place in life as soon as possible (Kling & Spethmann, 2010, p. 83).

Adolescents in every society can experience depression; in fact, one in six adolescents experiences depression, and adolescent girls are particularly at risk. Rather than blaming themselves or questioning their parenting styles, parents are encouraged to talk with their adolescents about their observations and concerns. They are encouraged not only to share their feelings but also to seek professional help. The importance of medical and psychotherapeutic assistance is emphasized. Both parents and adolescents are encouraged to seek this help (Kling & Spethmann, 2010, p. 83).

The literature cited above reveals what adolescents may experience during this period, and that depression often occurs during adolescence. Today's adolescents often cannot share their emotions and struggles with family members during this period, which can lead to feelings of isolation and a lack of support. Since adolescence is a developmental stage, teens may express themselves on social media rather than with family and close friends. However, relying solely on social media for self-expression can create a disconnect from one's real-life connections, potentially leading to feelings of isolation. Cabeza et al. (2025) found that heavy use of social networking sites significantly increases loneliness and emotional stress. In contrast, excessive use of messaging apps played a limited role in their findings. The explosion in social media use is a negative legacy of the pandemic. Family members began sharing their anxieties, fears, and feelings of loneliness on social media. This forced situation later became a habit. Family members showed that life could be lived outside of social circles. Initially a temporary situation, it was later embraced by family members, who began spending time on

social media rather than in social settings or alone in their rooms. This situation revealed a social media addiction among family members. Adolescents are particularly affected by this issue.

Coşkun (2021) notes that dependence on digital devices, such as televisions and cell phones, has increased as technological tools have entered people's lives. He emphasizes that social media addiction, in particular, has risen during the pandemic. Those who struggled to maintain social relationships while staying home during the pandemic report turning to social media to alleviate anxiety, stress, uncertainty, and loneliness. In this context, friendship has been replaced by kinship, and social media has supplanted camaraderie. The study emphasizes that young people are particularly at risk. The problems experienced during this period are linked to depression.

Nomophobia Among Adolescents in the Digital Age

As in many societies, individuals in Turkey experience nomophobia. Young people, especially, are pinpointed as a high-risk group in this respect. Numerous field studies have revealed this phenomenon (Pérez-Torres, 2024; Kılıç et al., 2022; Reyhan, Çınar, & Özoruç, 2025; Aydın & Aydın, 2023; Çelik et al., 2024). Adolescents experience a fear of being alone, which can lead to nomophobia and a frequent need to check their phones. To avoid loneliness and confronting themselves, adolescents may spend most of their time on social media on their smartphones.

A 2024 study by Pérez-Torres found that satisfaction-oriented social media use and nomophobia are explanatory variables for problematic use among adolescents. The study identified a relationship between nomophobia, the pursuit of social satisfaction, and problematic use. Kılınc et al. (2022) found that students' nomophobia levels increased with the frequency of phone checking and smartphone usage time. Additionally, their study revealed a weak positive correlation between nomophobia and loneliness.

Aydın and Aydın (2023) concluded that high school adolescents exhibited moderate levels of nomophobia and had high levels of school attachment and belonging. Çelik et al. (2024) conducted a study on a family-supported psychoeducational program designed to reduce nomophobia among adolescents. They found that raising awareness among high school students reduced nomophobia among program participants.

The program provided participants with knowledge and skills regarding nomophobia, including its definition, symptoms, and management of resulting emotions, thoughts, and behaviors, as well as preventive measures. The results indicated a reduction in nomophobic behaviors among students and an increase in their cognitive and emotional resilience. Historically, digital media use disorder was predominantly observed among male students. However, it is now evident that female students are also at risk. In fact, some studies suggest that girls have higher levels of nomophobia.

A study by Reyhan, Çınar, and Özoruç (2025) found that adolescents had moderate levels of nomophobia, with female students scoring higher than male students. The study also found that regular exercise and holding an athletic license significantly affected nomophobia and self-confidence levels. Parents must be knowledgeable and competent in digital media literacy to protect their children from nomophobia. They play a significant role in this area. Parents can help solve or reduce the problem by raising their children's awareness of digital media use.

Conclusion

In conclusion, the aforementioned studies suggest that adolescent loneliness is increasing in today's digital age. The studies conclude that adolescents' intensive and uncontrolled use of digital platforms negatively affects their psychological well-being and social lives. Excessive time spent on digital devices significantly harms adolescents' family communication and face-to-face socialization. Notably, today's adolescents share their joys and sorrows with virtual friends on social media platforms rather than with family members or close friends.

Adolescents experience conflict between the false identities they create on social media and their real-life identities. While they may initially feel comfortable with these false identities, they struggle to be themselves and express their true selves outside of the virtual world. They find themselves caught between their true selves and the ideal selves they have created in the virtual world. The gap between their true and ideal selves widens daily, weakening their psychological well-being. The identities they create in the digital world are driving them toward loneliness in real life. It has become evident that many adolescents are exposed to abuse, bullying, and threats due to their excessive and inappropriate use of social media. Sharing intense emotions and photos/videos of themselves with people of unknown identity in the virtual world can lead to threats and abuse. Failing to share this victimization with their parents

and family members can cause adolescents to feel isolated and vulnerable. Feeling helpless in this self-imposed isolation and dead-end situation can drive many adolescents to suicidal thoughts and attempts.

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CHAPTER 2

EXAMINATION OF THE RELATIONSHIP BETWEEN TEACHERS' ADHERENCE LEVELS TO THE CLASSROOM MANAGEMENT PRINCIPLES AND STUDENT RESISTANCE BEHAVIORS¹

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¹ This study was presented as an oral paper at the 6th International Congress on Education and Innovative Sciences, and the abstract was published. (November 24–25, 2022)

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Classroom management is a crucial skill required to achieve the expected success in educational activities. Its primary objective is to create and maintain the physical, academic, and social environment necessary to realize predetermined educational goals. (Evertson and Emmer, 2013). Classroom management is a holistic and multidimensional construct encompassing both instructional and managerial behaviors. Instructional behaviors relate to the planning, implementation, and evaluation of academic processes (Weber, 2006). The planning process entails selecting materials that spark interest and curiosity, in addition to providing various methods and techniques suited to students' individual differences and developmental characteristics. The practice involves providing feedback and guidance to students, in addition to managing motivation and attention. Managerial behaviors, on the other hand, encompass activities related to the management of order and processes—such as organizing the physical classroom environment, establishing and teaching classroom rules and routines, and managing time and behavior. The physical environment of the classroom should feature a seating arrangement suited to the students' developmental characteristics and instructional activities, while also being safe and engaging. Classroom rules should be established collaboratively with the students and be few in number yet functional. Time management entails the effective and efficient use of the time allocated for the lesson, whereas creating a positive classroom climate involves structuring relationships—both between teacher and students and among the students themselves—based on mutual love and respect (Demirtaş, 2011; Dönmez, 2010). Behavior management, on the other hand, concerns the processes of preventing students' behavioral problems and fostering positive behaviors in them. The goal is to ensure that students are productive in the classroom environment and treat both themselves and others with respect.

In effective classroom management, the characteristics of the students are just as important as the personal and professional qualities of the teacher. Students from diverse cultural and socioeconomic backgrounds—differing in their readiness, interests, aspirations, abilities, needs, and behavioral patterns—come together in the same classroom environment to acquire similar behaviors. In this heterogeneous classroom structure, it is quite difficult for students to share the same environment without encountering any issues. While the positive behaviors students exhibit in the classroom generate positive feedback, their negative behaviors adversely affect the teaching-learning process and the classroom atmosphere. One of the behaviors by students that negatively affects the classroom environment is their resistance to educational activities and the legitimate authority of the school culture. This behavioral pattern, defined as student resistance, varies depending on the process and duration of the behavior's

occurrence. (Giroux, 1983; Mc Laren, 1985; Yüksel, 2003). Unwanted behaviors are typically those that a student decides upon and exhibits in the moment. In contrast, resistant behaviors involve the student making a plan and consistently displaying the behavior at appropriate times. In other words, for a behavior to be classified as resistance, the action must be logical and premeditated. (Erickson, 1984). Spaulding (1995) classified resistance behaviors into passive resistance and aggressive resistance. Behaviors classified as passive resistance involve passive actions such as refraining from speaking or ignoring the teacher, whereas aggressive resistance behaviors consist of aggressive reactions like defying the teacher, causing verbal disturbances, or using profanity. In addition to these two categories, Chan and Treacy (1996) introduced a third classification: compliance. They describe compliance behavior as appearing to cooperate with the teacher or simply not reacting at all. According to Higginbotham (1996), resistance behaviors are classified into three types: verbal resistance behaviors, silent resistance behaviors, and resistance behaviors manifesting as non-participation or avoidance. If a student encounters a situation inconsistent with their own experiences and formulates a plan to verbally oppose it, they are exhibiting verbal resistance behavior; if they remain completely silent, they are exhibiting silent resistance behavior; and if they leave the classroom, they are exhibiting resistance behavior in the form of non-participation or avoidance. Although resistance behaviors are often perceived as negative and destructive, some can yield positive outcomes. Known as "constructive resistance," these behaviors positively influence the teaching-learning process and enhance the level of learning. Students may exhibit resistance behaviors in the classroom for a wide variety of reasons, such as the curriculum, the environment, or their peer group (Sever, 2012). However, teachers may also encounter student resistance stemming from factors outside the classroom environment—such as the students' developmental characteristics or the traits of the society to which they belong. High school students, in particular, are far more prone to developing resistant behaviors because they exhibit characteristics associated with adolescence—such as identity formation, seeking peer acceptance, rebellion, and a desire for group belonging (Başar, 2003). To establish and maintain a classroom environment conducive to learning, teachers must be able to accurately interpret student needs and the behaviors associated with them, as well as respond appropriately to instances of resistance. It is inevitable that students will develop resistant behaviors in response to situations such as not feeling safe in the educational environment, being unable to express themselves, and facing oppressive teacher attitudes. In light of these explanations, a need arose to conduct research examining the relationship between teachers' classroom management behaviors and students' resistance behaviors from the students' perspective.

Purpose of the Study

The primary objective of this program is to increase adherence to classroom management rules in high schools and to address student resistance. In line with this primary objective, answers were sought to the following questions:

Based on student perceptions:

1. What is the level of teachers' adherence to classroom management principles?
2. Are there significant differences in students' perceptions regarding their teachers' adherence to classroom management principles based on gender, school type, grade level, class size, perceived general academic achievement, and general attitude toward school?
3. What is the level of student resistance behaviors?
4. Are there significant differences in the levels of student resistance behaviors based on gender, school type, grade level, class size, perceived general academic achievement, and general attitude toward school?
5. Is there a significant relationship between the level of teachers' adherence to classroom management principles and the level of student resistance behaviors?

Method

Research Design

This study employed the correlational survey design, a quantitative research method. The purpose of correlational survey designs is to identify differences between situations concerning individuals, objects, and the like (Karasar, 2014). In this study, students' perceptions regarding their teachers' adherence to classroom management principles and their own resistance behaviors were examined and compared across various variables (gender, school type, grade level, class size, etc.). Subsequently, the relationship between teachers' levels of adherence to classroom management principles and students' resistance behaviors was analyzed.

Population and Sample

The study population consists of students attending high schools in the central districts of Adana province (Seyhan, Yüreğir, Çukurova, and Sarıçam). A disproportionate cluster sampling method was used to determine the study sample. Each district where the schools are located was treated as a cluster. Subsequently, a total of 20 high schools—four from each district—were selected via random sampling, and the research was conducted with students attending these schools. Participation was voluntary, and 235 students took part in the study. Table 1 presents the personal information of the participating students.

Table 1

Personal Information of Students

Gender	f	%	School type	f	%
Female	136	57.9	General High School (GHS)	188	80.0
Male	99	42.1	Vocational High School (VHS)	47	20.0
Grade level			Class size		
9th Grade	49	20.8	Fewer than 20 students	49	20.8
10th Grade	62	26.4	21–30 students	72	30.6
11th Grade	78	33.2	31–40 students	97	41.3
12th Grade	46	19.6	More than 40 students	17	7.3
Perception of academic achievement			General attitude towards school		
Very low	29	12.3	Very negative	16	6.8
Low	148	63.2	Negative	125	53.2
Medium	49	20.7	Neutral	-	-
High	3	1.3	Positive	74	31.5
Very high	6	2.5	Very positive	20	8.5

As shown in Table 1, 57.9% of the students participating in the study are female. 80% of the students attend a general high school. Regarding grade levels, 20.9% of the participants are in the 9th grade, 26.4% in the 10th grade, 33.2% in the 11th grade, and 19.6% in the 12th grade. The vast majority attend classes with 31–40 students (41.3%) or 21–30 students (30.6%). It is observed that students who perceive their academic achievement as low (63.3%) also predominantly express negative general attitudes toward school (53.2%).

Data Collection Tools

The research data were collected using the Teachers' Classroom Management Principles Adherence Levels Determination Scale (TCMPC), developed by Gündüz and Can (2013); the High School Students' Resistance Scale (HSSRS), developed by Yüksel and Şahin (2005); and the Personal Information Form (PI), developed by the researcher. The TCMPC consists of a total of 33 items organized into two sub-dimensions: adherence to principles regarding teacher-student relationships (15 items) and adherence to principles regarding instruction (18 items). The scale comprises statements concerning behaviors expected of teachers for effective classroom management. The internal reliability coefficients of the scale are 0.89 for the first sub-dimension and 0.88 for the second sub-dimension. Responses are provided using a five-point Likert-type scale ranging from "never" (1) to "always" (5). In this study, internal reliability coefficients were recalculated based on the collected data, yielding values of 0.96 for the first sub-dimension, 0.92 for the second sub-dimension, and 0.96 for the scale as a whole. HSSRS consists of a total of 26 items distributed across six factors: active resistance behaviors

(7 items), thoughts regarding teachers (9 items), thoughts regarding lessons (3 items), thoughts regarding homework (2 items), verbal resistance behaviors (3 items), and peer relationships (2 items). The internal reliability coefficients for the sub-dimensions are .75, .81, .64, .62, .55, and .61, respectively. Based on the data obtained in this study, the recalculated Cronbach's alpha reliability coefficients for the scale were found to be .86, .93, .78, .78, .70, and .78 for the sub-dimensions, and .93 for the scale as a whole. The PI, on the other hand, consists of questions regarding demographic characteristics.

Data Collection and Analysis

Research data were collected online during the 2021–2022 academic year after obtaining the necessary administrative and ethical approvals. Information regarding the scales and the response format was provided on the first page of the instrument, and students were able to access the scale items following parental consent. During data analysis, firstly the scores obtained by students on both scales were calculated; the results were then evaluated based on the following ranges: 1.00–1.80 ("Never" / "Strongly disagree"), 1.81–2.60 ("Rarely" / "Disagree"), 2.61–3.40 ("Sometimes" / "Undecided"), 3.41–4.20 ("Usually" / "Agree"), and 4.21–5.00 ("Always" / "Strongly agree"). Following the descriptive analyses, the kurtosis and skewness coefficients of the data were examined; since the measurements did not meet the assumption of normality, the Mann-Whitney U and Kruskal-Wallis H tests were applied to compare arithmetic means. A significance level of .05 was adopted for all analyses. To examine the relationships between students' scale scores, the Spearman Rank-Order Correlation Coefficient was calculated; the resulting correlation coefficients were interpreted based on their absolute values as indicating "high" (.70–1.00), "moderate" (.69–.30), or "low" (.29–.00) levels of association (Büyüköztürk, 2010).

Findings

1. Findings Regarding Teachers' Levels of Adherence to Classroom Management Principles

Table 2 presents descriptive statistics for the scores obtained by students on the Scale for Determining Teachers' Levels of Adherence to Classroom Management Principles (TCMPC)

Table 2

Descriptive Statistics for Students' TCMPC Scores (N=235)

Subscales	$\bar{X}$	Sd
Adherence to principles regarding the teacher-student relationship	3.60	1.04
Adherence to principles regarding education and instruction	3.50	.83
Total scale score	3.55	.90

As shown in Table 4, the arithmetic means of the scores obtained by students on the TCMPC are 3.60 for the dimension of “adherence to principles regarding teacher-student relationships,” 3.50 for the dimension of “adherence to principles regarding teaching and learning,” and 3.55 for the scale as a whole. This indicates that the participating students perceive their teachers as adhering to classroom management principles at a “generally high level” while managing their classrooms.

2. Findings Obtained from the Examination of Teachers' Levels of Adherence to Classroom Management Principles According to Various Variables

Table 3 presents the Mann-Whitney U test results for students' TCMPC scores according to gender and school type.

Table 3.

Mann-Whitney U test results for TCMPC scores

	Subscales	Group	N	Mean Rank.	Sum of Ranks	U	p
Gender	Teacher-student relationship	Female	136	121.10	16469.50	6310.500	.412
		Male	99	113.74	11260.50		
	Education and instruction	Female	136	120.76	16423.50	6356.000	.465
		Male	99	114.21	11306.50		
	Scale total score	Female	136	121.15	16476.00	6304.000	.405
		Male	99	113.68	11254.00		
School type	Teacher-student relationship	GHS	188	123.60	23236.50	3365.500	.011*
		VHS	47	95.61	4493.50		
	Education and instruction	GHS	188	120.06	22570.50	4493.500	.354
		VHS	47	109.78	5159.50		
	Scale total score	GHS	188	122.19	22971.50	3630.500	.059
		VHS	47	101.24	4758.0		

General High School (GHS); Vocational High School (VHS)

As shown in Table 3, the differences observed in students' scale scores based on gender are not statistically significant ($p > .05$). Regarding the type of high school, significant differences were observed in favor of students attending general high schools [$U = 3365.500$, $p < .05$]. Table 4 presents the Kruskal-Wallis H test results regarding students' TCMPC scores based on grade level, class size, general academic achievement, and attitudes toward school.

Table 4.

Kruskal-Wallis H test results for TCMPC scores

	Subscales	Group	N	Mean Rank	χ^2	df	p
Grade level	Teacher-student relationship	9th Grade	49	110.85	6.626	3	.085
		10th Grade	62	102.73			
		11th Grade	78	128.08			
		12th Grade	46	129.10			
	Education and instruction	9th Grade	49	113.06	2.647	3	.449
		10th Grade	62	110.48			
		11th Grade	78	127.78			
		12th Grade	46	116.83			
	Scale total score	9th Grade	49	111.51	4.659	3	.199
		10th Grade	62	105.56			
		11th Grade	78	127.99			
		12th Grade	46	124.73			
Class size	Teacher-student relationship	Fewer than 20 stu.	49	95.30	10.510	3	.015*
		21–30 students	72	121.83			
		31–40 students	97	130.30			
		More than 40 stu.	17	97.03			
	Education and instruction	Fewer than 20 stu.	49	107.00	4.205	3	.240
		21–30 students	72	117.90			
		31–40 students	97	126.88			
		More than 40 stu.	17	99.47			
	Scale total score	Fewer than 20 stu.	49	99.40	7.799	3	.050
		21–30 students	72	120.96			
		31–40 students	97	128.79			
		More than 40 stu.	17	97.50			
Perception of academic achievement	Teacher-student relationship	Very low	29	101.52	4.971	4	.290
		Low	148	116.70			
		Medium	49	133.35			
		High	3	85.33			
		Very high	6	120.83			
	Education and instruction	Very low	29	105.69	3.748	4	.441
		Low	148	117.10			
		Medium	49	128.53			
		High	3	74.83			
		Very high	6	135.17			
	Scale total score	Very low	29	103.03	4.495	4	.343
		Low	148	116.53			
		Medium	49	132.07			
		High	3	83.67			

General attitude towards school	Very high		6	128.92			
	Teacher-student relationship	Very negative	16	77.25	27.192	3	.000*
		Negative	125	102.74			
		Positive	74	145.00			
		Very positive	20	146.08			
	Education and instruction	Very negative	16	63.06	28.194	3	.000*
		Negative	125	105.66			
		Positive	74	144.93			
		Very positive	20	139.42			
	Scale total score	Very negative	16	70.59	27.767	3	.000*
		Negative	125	103.92			
		Positive	74	145.25			
		Very positive	20	143.10			

An examination of Table 4 reveals that, regarding class size, the observed differences in student scores were statistically significant in the “adherence to principles regarding the teacher-student relationship” sub-dimension, favoring students in classes with 21–40 students [$\chi^2(3) = 10.510$, $p < .05$]. Regarding attitudes toward school, the significant differences observed in the sub-dimensions and the total scale score favored students with “positive” and “very positive” attitudes toward school [$\chi^2(3) = 27.192, 28.194, 27.767$; $p < .05$]. However, the differences observed in students' TCMPC scores based on their grade level and general academic achievement status were not found to be statistically significant ($p > .05$).

3. Findings Regarding Students' Perceptions of Resistance Behaviors

Table 5 presents the descriptive statistics for the scores obtained by the participants on the High School Students' Resistance Scale (HSSRS).

Table 5

Descriptive Statistics for Students' HSSRS Scores (N=235)

Subscales	$\bar{X}$	Sd
Active resistance behaviors	1.45	.58
Thoughts regarding teachers	2.08	1.00
Thoughts regarding lessons	1.92	.95
Thoughts regarding homework	1.90	1.04
Verbal resistance behaviors	1.51	.79
Peer relationships	2.62	1.42
Total scale score	1.92	.69

As shown in Table 5, the arithmetic means of the students' HSSRS scores are relatively higher in the "Peer relationships" ($\bar{X} = 2.62$) and "Thoughts regarding teachers" ($\bar{X} = 2.08$) sub-dimensions, and lower in the "Active resistance behaviors" sub-dimension ($\bar{X} = 1.45$), with an overall scale mean of 1.92. This indicates that the students participating in the study exhibit

active resistance behaviors and verbal resistance behaviors at a "very low" level, while displaying other resistance behaviors at a low level (or rarely).

4. Findings Obtained from the Examination of Students' Resistant Behaviors According to Various Variables

The results of the Mann-Whitney U test regarding students' HSSRS scores based on gender and school type are presented in Table 6.

Table 6.

Mann-Whitney U test results for HSSRS scores

	Subscales	Group	N	Mean Rank.	Sum of Ranks	U	p
Gender	Active resistance behaviors	Female	136	114.72	15602.50	6286.500	.371
		Male	99	122.50	12127.50		
	Thoughts regarding teachers	Female	136	120.14	16339.00	6441.000	.569
		Male	99	115.06	11391.00		
	Thoughts regarding lessons	Female	136	119.52	16254.50	6525.500	.681
		Male	99	115.91	11475.50		
	Thoughts regarding homework	Female	136	114.79	15612.00	6296.000	.371
		Male	99	122.40	12118.00		
	Verbal resistance behaviors	Female	136	119.65	16272.50	6507.500	.657.
		Male	99	115.73	11457.50		
School type	Peer relationships	Female	136	127.39	17324.50	5455.500	.012*
		Male	99	105.11	10405.50		
	Total scale score	Female	136	118.84	16162.00	6618.000	.825
		Male	99	116.85	11568.00		
	Active resistance behaviors	GHS	188	108.93	20478.00	2712.000	.000*
		VHS	47	154.30	7252.00		
	Thoughts regarding teachers	GHS	188	113.38	21315.50	3549.500	.036*
		VHS	47	136.48	6414.50		
	Thoughts regarding lessons	GHS	188	111.55	20971.00	3205.000	.003*
		VHS	47	143.81	6759.00		
	Thoughts regarding homework	GHS	188	109.84	20649.50	2883.500	.000*
		VHS	47	150.65	7080.50		
	Verbal resistance behaviors	GHS	188	121.95	22926.00	3676.000	.070
		VHS	47	102.21	4804.00		
	Peer relationships	GHS	188	128.32	24124.00	2478.000	.000*
		VHS	47	76.72	3606.00		
	Total scale score	GHS	188	113.24	21289.50	3523.500	.032*
		VHS	47	137.03	6440.50		

General High School (GHS); Vocational High School (VHS)

As shown in Table 6, the score difference observed in the "Friendship relations" sub-dimension based on gender is statistically significant in favor of female students [$U=5455.500$, $p<0.12$]. Regarding score differences based on school type, the difference in the "Friendship relations" sub-dimension was statistically significant in favor of general high school students

[$U=2478.000$, $p<0.12$], whereas for active resistance behaviors, attitudes toward teachers, attitudes toward lessons, attitudes toward homework, and the total scale score, the difference was statistically significant in favor of vocational high school students [$U=2712.000$, 3549.500 , 3205.000 , 2883.500 , 3523.500 , $p>0.12$]. The Kruskal-Wallis H test results regarding students' HSSRS scores based on grade level and class size are presented in Table 7.

Table 7.

Kruskal-Wallis H test results for HSSRS scores according to grade level and class size

	Subscales	Group	N	Mean Rank	χ^2	df	p
Grade level	Active resistance behaviors	9th Grade	49	125.61	8.613	3	.035*
		10th Grade	62	135.00			
		11th Grade	78	107.40			
		12th Grade	46	104.95			
	Thoughts regarding teachers	9th Grade	49	117.30	6.092	3	.107
		10th Grade	62	133.31			
		11th Grade	78	105.06			
		12th Grade	46	120.07			
	Thoughts regarding lessons	9th Grade	49	124.40	5.703	3	.127
		10th Grade	62	131.74			
		11th Grade	78	110.12			
		12th Grade	46	106.03			
	Thoughts regarding homework	9th Grade	49	130.57	6.115	3	.106
		10th Grade	62	127.60			
		11th Grade	78	108.06			
		12th Grade	46	108.51			
	Verbal resistance behaviors	9th Grade	49	108.98	2.593	3	.459
		10th Grade	62	113.97			
		11th Grade	78	119.99			
		12th Grade	46	129.66			
	Peer relationships	9th Grade	49	108.01	10.765	3	.013*
		10th Grade	62	99.50			
		11th Grade	78	132.83			
		12th Grade	46	128.42			
	Total scale score	9th Grade	49	119.46	2.676	3	.444
		10th Grade	62	128.65			
		11th Grade	78	110.04			
		12th Grade	46	115.59			
Class size	Active resistance behaviors	Fewer than 20 stu.	49	138.26	8.456	3	.037*
		21–30 students	72	121.64			
		31–40 students	97	108.69			
		More than 40 stu.	17	97.35			
	Thoughts regarding teachers	Fewer than 20 stu.	49	137.96	9.793	3	.020*
		21–30 students	72	118.82			
		31–40 students	97	103.99			
		More than 40 stu.	17	136.94			
	Thoughts regarding lessons	Fewer than 20 stu.	49	128.74	3.847	3	.278
		21–30 students	72	123.30			
		31–40 students	97	108.26			

Thoughts regarding homework	More than 40 stu.	17	120.18	5.696	3	.127
	Fewer than 20 stu.	49	135.02			
	21–30 students	72	119.95			
	31–40 students	97	110.54			
Verbal resistance behaviors	More than 40 stu.	17	103.24	3.825	3	.281
	Fewer than 20 stu.	49	133.78			
	21–30 students	72	111.06			
	31–40 students	97	114.54			
Peer relationships	More than 40 stu.	17	121.68	3.916	3	.271
	Fewer than 20 stu.	49	103.41			
	21–30 students	72	116.15			
	31–40 students	97	124.50			
Total scale score	More than 40 stu.	17	130.79	7.319	3	.062
	Fewer than 20 stu.	49	138.35			
	21–30 students	72	119.08			
	31–40 students	97	106.32			
	More than 40 stu.	17	121.38			

An examination of Table 7 reveals statistically significant differences in students' scores on the "Active resistance behaviors" and "Peer relationships" sub-dimensions of the scale based on grade level [$\chi^2(3) = 8.613, 10.765, p < .05$]. The analyses indicate that the significant difference observed in the "Active resistance behaviors" sub-dimension among 10th, 11th, and 12th-grade students is in favor of the 10th-grade students. Regarding the "Peer relationships" sub-dimension, the significant difference observed among 9th, 10th, and 11th-grade students favors the 11th-grade students, while the difference between 10th and 12th-grade students favors the 12th-grade students. Regarding class size, the differences observed in student scores are consistently significant in the "Active resistance behaviors" and "Thoughts regarding teachers" sub-dimensions. Mann-Whitney U tests revealed a significant difference in "Active resistance" scores between students in classes with fewer than 20 students and those in classes with 31 or more students, favoring the students in classes with fewer than 20 students [$\chi^2(3) = 8.456, p < .05$]. Regarding the significant difference observed in the "thoughts on teachers" sub-dimension, the score difference between students in classes with fewer than 20 students and those in classes with 21–30 and 31–40 students was found to be in favor of the students in classes with fewer than 20 students [$\chi^2(3) = 9.793; p < .05$]. Table 8 presents the Kruskal-Wallis H test results for the participants' HSSRS scores based on their academic achievement status and attitudes toward school.

Table 8

Kruskal-Wallis H test results for HSSRS scores based on perceptions of academic achievement and attitudes toward school

	Subscales	Group	N	Mean Rank	χ^2	df	p
Perception of academic achievement	Active resistance behaviors	Very low	29	123.90	2.094	4	.719
		Low	148	120.90			
		Medium	49	109.04			
		High	3	102.00			
		Very high	6	99.17			
	Thoughts regarding teachers	Very low	29	126.34	7.767	4	.100
		Low	148	124,31			
		Medium	49	97.59			
		High	3	69.83			
		Very high	6	112.67			
	Thoughts regarding lessons	Very low	29	122.50	14.646	4	.005*
		Low	148	128,20			
		Medium	49	91.36			
		High	3	63.50			
		Very high	6	89.42			
	Thoughts regarding homework	Very low	29	116.12	6.031	4	.197
		Low	148	125.13			
		Medium	49	100.35			
		High	3	102.00			
		Very high	6	103.33			
	Verbal resistance behaviors	Very low	29	100.22	5.766	4	.217
		Low	148	118.30			
		Medium	49	132.31			
		High	3	80.67			
		Very high	6	98.33			
	Peer relationships	Very low	29	114.43	4.251	4	.373
		Low	148	123.18			
		Medium	49	104.53			
		High	3	81.67			
		Very high	6	135.67			
	Total scale score	Very low	29	119.40	6.952	4	.138
		Low	148	125.28			
		Medium	49	99.58			
		High	3	70.83			
		Very high	6	105.75			
General attitude towards school	Active resistance behaviors	Very negative	16	117.72	5.657	3	.130
		Negative	125	123.96			
		Positive	74	116.53			
		Very positive	20	86.43			
	Thoughts regarding teachers	Very negative	16	131.72	23.173	3	.000*
		Negative	125	134.56			
		Positive	74	99.71			
		Very positive	20	71.23			
	Thoughts regarding lessons	Very negative	16	104.97	14.426	3	.002*
		Negative	125	131.59			
		Positive	74	108.53			
		Very positive	20	78.53			

Thoughts regarding homework	Very negative	16	114.72	7.164	3	.067
	Negative	125	126.72			
	Positive	74	111.91			
	Very positive	20	88.65			
Verbal resistance behaviors	Very negative	16	94.22	4.915	3	.178
	Negative	125	125.70			
	Positive	74	109.50			
	Very positive	20	120.35			
Peer relationships	Very negative	16	120.84	13.971	3	.003*
	Negative	125	131.87			
	Positive	74	95.36			
	Very positive	20	112.77			
Total scale score	Very negative	16	119.19	18.220	3	.000*
	Negative	125	134.03			
	Positive	74	101.40			
	Very positive	20	78.28			

As shown in Table 8, a statistically significant difference was found in the “Thoughts on homework” sub-dimension of the scale based on students' perceptions of their general academic achievement [$\chi^2 (4) = 23.233$, $p < .05$]. According to the Mann-Whitney U test results, this significant difference occurred between students with low and medium perceptions of academic achievement, favoring those with low academic achievement. Attitudes toward school resulted in statistically significant differences in the “Thoughts on teachers”, “Thoughts on lessons”, and “Peer relationships” sub-dimensions, as well as in the total scale score [$\chi^2 (3) = 23.173$, 14.426 , 13.971 , 18.220 , $p < .05$]. The analyses revealed that these differences favored students whose general attitudes toward school were “negative” and “very negative.”

5. Findings regarding the relationship between teachers' level of adherence to classroom management principles and students' level of resistance behavior

The results of the Spearman rank-order correlation analysis performed on the students' TCMPC and HSSRS scores are presented in Table 9:

Table 9

Results of the Correlation Analysis of TCMPC and HSSRS Scores

HSSRS	TCMPC		
	Teacher-student relationship	Education and instruction	Scale total score
Active resistance behaviors	-.313*	-.258*	-.298*
Thoughts regarding teachers	-.544*	-.484*	-.533*
Thoughts regarding lessons	-.454*	-.336*	-.415*
Thoughts regarding homework	-.392*	-.293*	-.357*
Verbal resistance behaviors	-.038	-.094	-.062
Peer relationships	-.115	-.157*	-.137*
Total scale score	-.497*	-.439*	-.486*
p	.000		
N	235		

An examination of Table 9 reveals that the strongest relationships exist between the TCMPC dimension of "adherence to principles regarding teacher-student relationships" and the HSSRS sub-dimension of "thoughts regarding teachers" ($r = -0.544$), as well as between the TCMPC sub-dimension of "adherence to teaching and learning principles" and the HSSRS sub-dimension of "thoughts regarding teachers" ($r = -0.484$). When analyzing the total scores of the scales, a significant, moderate negative correlation is observed between teachers' levels of adherence to classroom management principles and students' perceptions of resistance behaviors ($r = -0.486$, $p < 0.001$). Accordingly, it can be stated that as teachers' adherence to classroom management principles increases, students' resistance behaviors decrease. Based on the calculated coefficient of determination ($r^2 = 0.23$), it can be concluded that 23% of the total variance observed in students' resistance behaviors is attributable to teachers' classroom management behaviors. The theoretically explained variance can be interpreted in the same manner for the other variable.

Discussion

The study found that students perceived teachers' classroom management behaviors positively at a "high" level, with no statistically significant differences observed in these perceptions based on gender, grade level, or academic achievement. These results—consistent with existing literature (Bolat, 2002; Bozbaş, 2015; Demirtaş and Kahveci, 2010; Gündüz and Can, 2013; Yalçın, 2007)—are significant as they indicate that teachers do not discriminate based on students' gender, grade level, or academic achievement when managing their classrooms. In general, the disadvantages and negative aspects of overcrowded classrooms outweigh their benefits in terms of teaching and learning (İş and Balcı, 2024). Higher levels of achievement, trust, positive communication, active participation, and cooperation are observed in classrooms with smaller student populations and suitable physical conditions (Cemaloğlu and Yenel, 2021). However, in this study, students attending general high schools in classes with 21–40 students perceived their teachers more positively in terms of the teacher-student relationship. This could be due to the fact that large classes offer rich social diversity, a friendly atmosphere, and livelier classroom discussions, or it could stem from students generally holding positive attitudes toward school. Indeed, the finding that students with positive or very positive attitudes toward school perceive their teachers as adhering to a high degree of classroom management principles supports this interpretation. Based on the results obtained, students attending vocational high schools perceive their teachers as adhering relatively less to classroom management principles regarding the teacher-student relationship. This result, which aligns with the literature (Demir Yalaze and Atar, 2021; Genç and Çetin, 2010), may be attributed to the fact that classes in

vocational high schools are predominantly conducted in workshops. Occupational safety is of vital importance in hands-on training. This situation may often limit the communication between teachers and students to systematic steps regarding the application of vocational skills, reminders, rules concerning the work areas, warnings, and the like.

The research findings indicate that students exhibit low levels of resistance behavior in the educational setting. This result was expected, given that students perceive a high level of adherence to classroom management principles on the part of their teachers. This is because behavioral issues are less frequent in well-managed classrooms (İş and Balcı, 2024; İşbilir et al., 2022; Ökmen and Karadaş, 2025), and students do not tend to display significant resistance toward teachers whom they perceive as approachable (Kearney, Plax, and Buroughs, 1991). According to the research findings, the level of resistance behaviors regarding peer relationships is higher among female students than among male students, and higher among vocational high school students than among general high school students. In terms of grade level, active resistance behaviors were found to be higher among 10th-grade students, while resistance behaviors regarding peer relationships were higher among 11th- and 12th-grade students. Students in classes with fewer than 20 students hold more negative views toward their teachers, and their levels of active resistance behavior are statistically significantly higher. It was found that students with low overall academic achievement held negative views regarding lesson; whereas students with negative general attitudes toward school held negative views regarding teachers, lessons, and peer relationships, and exhibited higher levels of resistant behavior. The relevant literature indicates that resistance behaviors are influenced by academic achievement, grade level, and perceptions of the school and teachers, and that student resistance behaviors manifest most frequently in peer relationships (Canoğulları and Sarı, 2019; Johnson and Johnson, 1993; Karaçoban and Sarı, 2023; Wright and Weekes, 2003; Yüksel and Şahin, 2005). When the developmental characteristics of students are taken into account, the period in which identity confusion is most acute corresponds to the 10th-grade level. Adolescents of this age may react impulsively not only toward adults but also toward their peers. For students with negative attitudes toward school and low academic achievement, it is often inevitable that they will exhibit resistant behaviors in response to lessons, teachers, and other students. This is because the needs for social acceptance and achievement serve as crucial, fundamental sources of motivation for an individual's identity development during adolescence. The study revealed a significant, moderate, and negative relationship between teachers' adherence to classroom management principles and their perceptions of students' resistance behaviors. Numerous studies indicate that teachers' classroom management behaviors directly affect not only

students' academic achievement but also their affective characteristics (Akbaşlı, 2010; Alpert, 1991; Varoğlu, 2014). Consequently, it can be stated that as teachers' adherence to classroom management principles increases, students' resistance behaviors will decrease. Research findings indicating that instructional processes fostering student engagement (Sever and Güven, 2014), positive communication (Margonis, 2004), and a fair classroom environment (Paulsel and Chory-Assad, 2005) reduce resistance behaviors support this view. This study was conducted with the participation of students attending general and vocational high schools in the central districts of Adana province. Comparative studies involving students from different types of high schools could be conducted to draw broader generalizations on this subject. This study was carried out with students attending public schools; further research could be conducted to examine the situation in private schools. The study relied solely on student perspectives; future research could examine teachers' observations and views regarding student resistance behaviors.

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CHAPTER 3

INVESTIGATION OF ERRORS AND MISCONCEPTIONS ABOUT GEOMETRIC SHAPES AND SOLIDS OF PRIMARY SCHOOL FOURTH GRADE STUDENTS

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1. Introduction

1.1. Basic Characteristics of Mathematics and Geometry Teaching

Mathematics should not be limited to arithmetic operations. Mathematics is a basic tool that enables logical deduction and solves daily life problems (Altun, 2007; Baykul, 2022). Each subject learned is built on existing knowledge and new concepts are created. Geometry, which constitutes the most concrete pillar of this whole, has an important position in the individual's recognition of his environment, understanding spatial relations and developing visual reasoning skills (NCTM, 2000; Duatepe, 2000). The main purpose of geometry teaching is not merely to force students to memorize definitions or state the names of shapes. On the contrary, thanks to geometry teaching, students are introduced to the processes of analyzing, comparing, making inferences, visualizing abstract ideas and logical proof (Baykul, 1998; Baki, 2001). Geometric experiences gained in early childhood and primary school are directly determinants of the student's high-level mathematical thinking skills in their future academic life (Burns, 2000; Yorulmaz & Uysal, 2021).

1.2. The Place of Geometry in the Primary School Mathematics Curriculum

When the Mathematics Curriculum put into effect by the Ministry of National Education (MEB, 2018) is examined, it is seen that geometry subjects are handled with a spiral approach starting from the 1st grade of primary school. Geometry and Measurement learning area at the primary school level; It is divided into four sub-learning areas: Geometric Solids and Shapes, Spatial Relations, Geometric Patterns and Basic Concepts in Geometry.

When the distribution of geometry learning outcomes in total mathematics learning outcomes at the primary school level is examined, it is noteworthy that the weight of geometry in the program increases as grade levels increase. In Table 1 below, the numerical and percentage distribution of geometry learning outcomes according to grade levels in the MEB curriculum is presented in detail:

Table1. Numerical and percentage distribution of learning outcomes

Grade Level	Total Mathematics Learning Outcomes	Geometry Learning Outcomes Number	Geometry Percentage (%)
1st Grade	36	4	%11,11
2nd Grade	50	8	%16,00
3rd Grade	72	10	%13,88
4th Grade	71	16	%22,53
TOTAL / AVG.	229	38	%16,59

When Table 1 is examined, it is seen that the 4th grade level of primary school is the level where geometry acquisitions are taught most intensively with a rate of 22.53%. According to

the curriculum, children in this class; They are asked to comprehend the side and corner structure of triangles, squares and rectangles, and to distinguish triangles according to their side lengths. In addition, they are asked to notice the faces, corners and edges of three-dimensional solids such as cubes, prisms, cylinders, cones and spheres; It is aimed to be able to make drawings on checkered or isometric paper (MEB, 2018). Considering these listed learning outcomes, the 4th grade is a very sensitive transition period in which children break away from concrete objects and step into abstract relationships.

1.3. Van Hiele's Theory of Geometric Thinking Levels

Expectation from children at the fourth grade level; to define the side and corner of triangles, squares and rectangles, and to distinguish triangles according to their side lengths. It is aimed for students to recognize the surfaces, corners and edges of solids such as cubes, prisms, cylinders, cones and spheres and to be able to draw on checkered or isometric paper (MEB, 2018). Considering all these learning outcomes, the 4th grade is a bridge where children begin to establish abstract conceptual connections without thinking concretely.

Level 1 (Visual Level): Students recognize geometric shapes based on their holistic appearance. They do not consider the geometric properties of shapes, such as sides, angles, or perpendicularities. For example, they call a square simply because it resembles a box; however, they are unaware of the side equality or angle properties of the square (Demir, 2020).

Level 2 (Level of Analysis): Students begin to analyze the properties of shapes (number of sides, number of vertices, parallelism) one by one. However, they cannot establish hierarchical relationships between shapes. For example, they know that all sides of a square are equal and the angles are perpendicular, but they cannot grasp the fact that a square is also a special rectangle (Mason, 2009).

Level 3 (Pre-Logical Deduction Level): The coverage relationships between shapes and classes are understood. Definitions gain meaning, it is realized that one feature requires another (e.g., derivation of square from perpendicularity and edge equality) (Baki, 2018).

Level 4 (Logical Deduction Level): Axiomatic structures are understandable, formal geometric proofs can be made, and theorems are proven by deductive method (Olkun & Toluk, 2007).

Level 5 (Highest Level reasons are): Different axiomatic geometric systems (non-Euclidean geometries) are analyzed comparatively (Baykul, 2009).

Primary school 4th grade students are expected to be in the developmental transition phase from the Visual Level (Level 1) to the Analysis Level (Level 2). Cognitive wavering and teaching deficiencies experienced in this transition phase pave the way for permanent misconceptions in students (Akkaya, 2006; Altıparmak & Gürcan, 2021).

1.4. Qualitative Differences Between Concept, Error and Misconception

In mathematics, error and misconception are often confused. Errors occur due to reasons such as momentary inattention, minor processing shifts, misreading of symbols or mental overload.

Such incorrect answers, which are not permanent, are usually accidental and can be easily corrected by the student (Cockburn, 2005; Hansen, 2014). When the student is warned or examines the question again, he can realize his mistake and correct it himself.

Misconception, on the other hand, is erroneous mental schemas that the student creates in his/her own mind by deviating from scientifically accepted definitions, firmly believes to be true, is systematic, pattern-forming, and is extremely resistant to traditional correction methods (Nesher, 1987; Zembat, 2008). Table 2 summarizes the comparative characteristics of misconception and misconception characterized by Gödek (2022) and Dereli (2015):

Table 2. Error and misconception comparison

Pedagogical Benchmark	Incorrect (Error)	Information	Misconception
Resistance to Conceptual Change	It does not resist, it resolves instantly		Shows high resistance (Stubborn)
Systematism and Pattern Creation	It is accidental, it does not form a pattern		It is systematic, it is constantly repeated
Being Transferred to Different States	Usually not transferred		It is transferred to other fields and problems
Student's Belief and Defense Level	Admits that he is wrong		Persistently defends the correctness of their answer
Detection Method	Determined immediately with simple tests		Requires multi-stage diagnostic tools and specialized evaluation
Removal Method	An eye-opening warning is enough		Conceptual change requires texts
Cognitive Resource	Carelessness, error	processing	Faulty mental schema and pre-learning

1.5. Sources and Classification of Misconceptions

Not a single factor plays a role in the emergence of geometric misconceptions in students, but multifaceted factors that trigger each other. Cornu (1991) and Lezgi (2023) categorize the sources of misconceptions into three basic categories:

1. Epistemological Reasons: These are the difficulties arising from the nature of the concept itself and the level of abstraction in the historical development process. For example, the difficulties in mentally modeling the size difference between two-dimensional plane shapes and three-dimensional space solids are epistemological in nature (Çekiç, 2018).

2. Pedagogical Reasons: Pedagogical reasons are the teacher's lack of field and pedagogical field knowledge, the use of traditional and rote teaching methods, incomplete or erroneous visuals in textbooks, logical disconnections during the presentation of concepts, and the use of limited prototype drawings (Bingölbalı & Özmantar, 2015; Güveli et al., 2018).

3. Psychological Reasons: It is the student's cognitive development level, readiness, mental capacity and intuitive perceptions in daily life and personal experiences that contradict scientific language (Güveli et al., 2018).

In addition, Graeber and Johnson (1991) and Zembat (2008) classify common misconceptions in geometry into four main categories:

Overgeneralization: It is the application of a special rule belonging to a certain geometric class to other classes where it does not apply (for example, thinking that the diagonals of each quadrilateral intersect perpendicularly).

Overspecialization: It is the narrowing of the concept of a general class by reducing it to only a single prototype example (for example, a square is not considered a rectangle due to the equality of sides).

Mis-translation: Systematic errors made in the transitions between verbal, visual and symbolic geometric expressions (for example, incorrect transfer of the given verbal definition to the drawing).

Restricted Conceptualization: It is the incomplete structuring of the concept by ignoring the critical features (e.g. perpendicularity, parallelism) in the definition of the concept.

1.6. Methods for Identifying Misconceptions

Since misconceptions occur in an individual's mental structure (cognitive schema), they are extremely difficult to detect with traditional single-stage multiple-choice tests or classical exams that only check for true and false (Osborne & Gilbert, 1980; Kalemkaş, 2024). The fact that a student selects the wrong option in a single-stage multiple-choice test is insufficient to distinguish whether he really has a misconception or is careless, or whether he answers by shaking (Eryılmaz & Sürmeli, 2002).

In order to overcome this pedagogical limitation, two-stage (Answer+Rationale), three-stage (Answer+Justification+Safety) and four-stage diagnostic tests have been developed in the literature (Peşman & Eryılmaz, 2010; Aykutlu & Şen, 2012; Bozdağ & Ok, 2018).

1.7. Structure of the Three-Stage Misconception Diagnostic Test

Three-stage diagnostic tests are very reliable tools in definitively distinguishing misconception from momentary errors and lack of knowledge. These tests aim to both justify the student's answer and measure how much they stand behind their decision (Altıparmak & Palabıyık, 2017). The application structure proceeds with the following steps:

First Step (Answer): The student is asked to make a definition, mark the correct shape or draw the desired geometric structure.

Second Step (Justification): The reason for the choice in the first stage is expressed by the student in written form in his/her own words.

Third Step (Certainty): The student is asked whether he/she trusts his/her answer and is asked to choose one of the options "I'm sure" or "I'm not sure".

When the data obtained from these three steps are combined, the cognitive level of the student can be considered in four different groups. These response combinations and evaluation criteria are presented in Table 3.

Table 3. Combinations of student answers

Step 1 (Answer)	Stage 2 (Rationale/Justification)	Stage 3 (Certainty/Confidence)	Cognitive Category Status	Diagnostics
True	True	I'm sure	COMPLETE (Scientific Understanding)	LEARNING
False	False (Consistent)	I'm sure	MISCONCEPTION	
False / True	Incorrect / Incomplete	Not sure	LACK OF INFORMATION / ERROR	
True	False	I'm sure	LEARNING MEMORIZATION	

In order for the student to be mentioned in a misconception, the student must give the wrong answer in 1 stage, show a wrong reason in the second stage and be sure of the answer given in the third stage. In addition, the answers given to the questions in the areas where there is a misconception should be in this direction.

Method 2

2.1. Research Model and Pattern Structure

In this study, a qualitative-descriptive research model was designed to determine the errors and misconceptions of primary school 4th grade students about geometric shapes and geometric solids in depth (Altunışık et al., 2010). In the research, document analysis and content analysis techniques, which are one of the qualitative data collection and data analysis methods, were used together.

2.2. Study Group and Sample Characteristics

The study group of the research consists of a total of 94 primary school 4th grade students studying in two different public primary schools affiliated to the Ministry of National Education in the Erciş district of Van province in the spring semester of the 2023-2024 academic year. In determining the study group, convenience sampling technique, one of the purposeful sampling methods, was used (Büyüköztürk, 2012). The distribution of participants by schools is presented in Table 4 below:

Table 4. Distribution of participants

Sequence No	Name of the School	Number of Students (N)
1	A Primary School	36
2	B Primary School	58
TOTAL	Two State Primary Schools (6 Branches)	94

2.3. Data Collection Tool: Error and Misconception Diagnostic Test

In order to determine the errors and misconceptions of the students, the "Errors and Misconceptions Diagnostic Test in Geometric Shapes and solids" developed by Altıparmak and Gürcan (2021) was used. There are 22 questions in the test. The structure of this test is presented in Table 5.

Table 5. Structure of the Diagnostic Test for Errors and Misconceptions in Geometric Shapes and Solids

Errors and Misconceptions	Number of questions
Mistakes and misconceptions about the square.	3
Errors and misconceptions about the rectangle.	3
Errors and misconceptions about the triangle.	5
Errors and misconceptions about measuring length, perimeter and area.	4
Errors and misconceptions about geometric solids.	7

The table of the questions in the diagnostic test related to the grade levels, learning areas and learning outcomes in the MEB (2018) mathematics curriculum is shown in Table 6.

Table 6. Correlation of Errors and Misconceptions in Geometric Shapes and Solids Diagnostic Test according to learning area and learning outcomes

Class	Learning Area	MEB Curriculum Outcome	Number of questions
3rd Grade	Geometric Shapes	M.3.2.1.3. Draws squares, rectangles and triangles using a ruler.	1
3rd Grade	Geometric Shapes	M.3.2.1.4. Recognizes that shapes are named according to the number of sides.	1
4th Grade	Geometric Shapes	M.4.2.1.1. Names the sides and vertices of triangles, squares and rectangles.	2
4th Grade	Geometric Shapes	M.4.2.1.2. Determines the side properties of square and rectangle.	3
4th Grade	Geometric Shapes	M.4.2.1.3. Classifies triangles according to their side lengths.	4
4th Grade	Geometric Shapes	It draws all diagonals of square, rectangle and triangle.	3
4th Grade	Measuring (Length)	M.4.3.1.3. Estimates and measures a length that can be measured directly.	2
4th Grade	Measurement (Environment)	M.4.3.2.1. Explains the relationship between the perimeter and the side of the square and rectangle.	1
4th Grade	Measurement (Area)	M.4.3.3.1. Determines that the area of a shape corresponds to the total number of unit squares covering it.	1
3rd Grade	Geometric Fields	M.3.2.1.1. Specifies the face, vertice, and edge of the cube, prisms, cone, and sphere.	4
3rd Grade	Geometric Fields	M.3.2.1.2. Explains the similar/different aspects of cube, square and rectangular prisms.	3

2.4. Data Collection and Analysis

The data of the research were collected in May of the 2023-2024 academic year. Two schools were visited for two separate weeks. In the first week, the test was applied to 3 different branches, and in the second week, the test was applied to 3 different branches. While the test was administered, students were not limited in time. They answered the test by taking a break as they wished. In this way, there were no problems in the application of the test. The questions of the test were arranged in three stages. Each stage of the questions was evaluated separately and the result was reached. In the first stage, it was determined whether the student answered the question correctly. Then, the student's explanation about why he made the marking was examined. In the last stage, it was examined whether the student was sure of the answer he gave.

The questions determined about geometric shapes and solids will be answered by 4th grade students in the form of written documents. In Table 3.3., at least 2 questions were asked to reveal each type of misconception. Certain steps were considered as conditions when determining the existence of misconception. The conditions are as follows:

- 1) If the student has made all the questions in the test wrong in terms of a certain misconception,
- 2) If the misconception has explained the reasons for all the questions that exist in this misconception in a similar and consistent way, it can be said that it is a misconception.

2.5. Ethical Permissions and Field Implementation Protocol

Before the data collection process of the research, the necessary ethical approvals were obtained from the Scientific Research and Publication Ethics Committee of the Ege University Institute of Educational Sciences. Then, official research permissions were completed from the Van Provincial Directorate of National Education and Erciş District Directorate of National Education.

The field application was carried out in May of the 2023-2024 academic year in a two-week period. The following principles were meticulously followed in the practices carried out in a total of 6 different 4th grade branches in both primary schools:

Voluntary Participation and Parental Consent: Information forms about the study were distributed to students and their parents, and parental consent permission forms were collected. Students who did not want to participate in the study were excluded from the scope.

Exam Anxiety-Free Cognitive Environment: During the application, students were offered a free working environment where they were comfortable, away from exam anxiety and where they could take a break.

Researcher Guidance: The researcher was personally present at each branch and ensured that the students understood the justification and certainty steps in the questions correctly but did not make any guiding interventions.

3. Findings

3.1. Findings on Square and Rectangle Definitions and Drawings

In the 1st and 2nd questions of the Diagnostic Test for Errors and Misconceptions in Geometric Shapes and Solids, students were asked to define and draw the square and rectangle in their own words.

It was observed that all 94 students (100%) did not mention the concept of perpendicularity or right angle in their definitions of square and rectangle.

The numerical and percentage distributions of the missing and incorrect expressions used by the students in the definitions of squares and rectangles are presented in Table 7:

Table 7. Category of student definitions for square and rectangle

Student Expression Category	Definition	and	Square (f)	Square (%)	Rectangle (f)	Rectangle (%)
Complete Definitions			0	%0,00	0	%0,00
Students with Definitions	Incomplete		64	%68,08	62	%65,95
Students Who Make Definitions	Incorrect		24	%25,53	25	%26,59
Those Who Define Geometric Shape as a Body (Prism/Cube)			12	%12,76	11	%11,70
Students Who Didn't Respond			6	%6,38	7	%7,44
TOTAL PARTICIPANTS			94	%100,00	94	%100,00

When the square and rectangular drawings of the students were examined, it was seen that 91 students (96.80%) drew only an ordinary quadrilateral sketch without using any symbols indicating side equality or perpendicularity. Only 1 student (1.06%) showed the side lengths by giving numerical values

3.2. Basic Misconceptions Detected in Squares and Rectangles

Three basic misconceptions were detected in students about square and rectangle. In Table 8, the number of errors made and the number and percentages of students who were determined to have misconceptions are presented:

Table 8. Errors and misconceptions detected in squares and rectangles

Square and Rectangle Misconception	Type of Err (f)	Error (%)	Misconception (f)	Misconception (%)
1. Not Looking for the Expression of Perpendicularity in the Definition and Figures	90	%95,74	25	%26,59
2. Not Accepting a Square as a Rectangle	69	%73,40	23	%24,46
3. Seeing Square and Rectangle as Geometric Solids	15	%15,95	9	%9,57

In 26.59% of the students, "the misconception of not looking for the expression perpendicularity" was detected. The students accepted the rhombus-like shapes given and whose angles were not right as squares only on the grounds that their side lengths were equal.

The students had an erroneous mental scheme that "Vertices do not have to be perpendicular, they are square if their sides are equal".

24.46% of the students had the misconception of "not seeing the square as a rectangle". The students did not mark the given square shapes as rectangles; as a justification, they wrote the phrase "Square is separate, rectangle is separate; all 4 sides of the square are equal, the rectangle has 2 long and 2 short sides" and stated that they were sure of their decision. This is a typical indicator of the overspecialization fallacy.

9.57% of the students argued that squares and rectangles occupy volume and are geometric solids (cube/prism).

3.3. Findings on Triangle Types and Classification

In the Diagnostic Test for Errors and Misconceptions in Geometric Shapes and Solids, isosceles, equilateral and miscellaneous triangles were asked to be defined and drawn. In Table 9, the frequencies and percentages of correct, incomplete and incorrect definitions are given.

Table 9. Student definitions for triangle

Triangle Type	Correct (f/%)	Definition	Incomplete (f/%)	Definition	Incorrect Definition (f / %)
Isosceles Triangle	10 (%10,63)		37 (%39,36)		24 (%25,53)
Equilateral Triangle	20 (%21,27)		18 (%19,14)		29 (%30,85)
Scalene Triangle	11 (%11,70)		20 (%21,27)		38 (%40,42)
TRIANGULAR SUCCESS		Isosceles: 29 (30.85%)		Equilateral: 33 (35.10%)	Scalene Triangle: 33 (35.10%)

The most common misconception about triangles is "not accepting that an equilateral triangle is also an isosceles triangle" (9.57.9% students). It was determined that 59.57% of the students (56 students) made a mistake in this regard. The students who made a misconception about this issue did not mark the shape with three equal sides as isosceles. As a justification, they explained that "This is an equilateral triangle, it cannot be isosceles because only two sides of the isosceles are equal".

3.4. Misconceptions About Measuring Length, Perimeter and Area

The situation of error and misconception in length, perimeter and area measurement is shown in Table 10.

Table 10. Errors and misconceptions about measuring length, perimeter and area

Length, Perimeter, and Type of Area Fallacy	Err (f)	Error (%)	Misconception (f)	Misconception (%)
1. Counting Line Segments of Different Lengths with the Same Name (AB) as Equal	60	%63,82	27	%28,72
2. Calculating Area Instead of Perimeter Calculation (Counting Units)	36	%38,29	20	%21,27
3. Calculating the Perimeter Instead of Calculating the Area	7	%7,44	1	%1,06

28.72% of the students have the misconception of seeing line segments with the same name as equal. They saw line segments of different lengths as equal only because the names of the line segments were the same. Students have an erroneous perception that puts symbolic naming ahead of actual length.

In order to calculate the perimeter length of the square, 21.27% of the students calculated the area by counting all the unit squares in the shape instead of adding the boundaries and expressed the value they found as the perimeter length.

3.5. Findings for Defining the Properties of Geometric Solids

In questions 22, 23 and 24 of the diagnostic test, students were asked to define the elements (face, corner, edge) and surface properties of cube, square prism and rectangular prism. It was observed that none of the students could express exactly which geometric shapes the faces of the solids consisted of. Table 11 shows student definitions for geometric solids.

Table 11. Student definitions for geometric solids

Geometric Solid Type	Incomplete Definition (f / %)	Incorrect Identifier (f / %)	Unable to Define / Empty (f / %)
Cube	21 (%22,34)	37 (%39,36)	36 (%38,29)
Square Prism	13 (%13,82)	39 (%41,48)	42 (%44,68)
Rectangular Prism	13 (%13,82)	43 (%45,74)	38 (%40,42)
AVERAGE DISTRIBUTION	15.66 Students (16.66%)	39.66 Students (42.19%)	38.66 Students (41.13%)

3.6. Basic Misconceptions and Errors Detected in Geometric Solids

In the analyzes made on three-dimensional geometric solids, 6 different misconceptions and 2 specific naming errors were detected. The numerical and percentage distributions of these misconceptions are presented in Table 12 below:

Table 12. Errors and misconceptions for geometric solids

Geometric Field Fallacy and Error Type	Err (f)	Error (%)	Misconception (f)	Misconception (%)
1. Naming the Solid with Geometric Shape Names (Square instead of cube, etc.)	65	%69,14	35	%37,23
2. Using Edge Expression Instead of Side	38	%40,42	17	%18,08
3. Showing the Corner Instead of the Edge	13	%13,82	6	%6,38
4. Showing the Corner Instead of the Face	6	%6,38	1	%1,06
5. Showing the Edger Instead of the Corner	4	%4,25	1	%1,06
6. Don't Call It a Rectangular Prism Instead of a Square Prism	2	%2,12	2	%2,12
7. Using the Expression Triangular Prism Instead of Cone	16	%17,02	-	-
8. Using the Circle/Circle Expression Instead of Sphere	18	%19,14	-	-

The misconception of naming the geometric shape with its Geometric Solid Names (37.23%) is the most common misconception that students fall into. They called the cube image given in question 25 square and the rectangular prism "rectangle"; ignoring the 3-dimensional depth of the solid, they labeled the geometric shape.

18.08% of the students insistently used the word "edge" while showing the distinctions of cubes and prisms. It is understood that the mathematical field language (terminology) has not yet been fully structured.

17.02% of the students called the cone image "triangular prism" because of its vertex and triangular lateral appearance. They also labeled the sphere image as "circle" or "circle" due to its circular cross-section (19.14%).

4. Discussion Conclusion and Recommendations

The findings obtained in this research are highly consistent with the results of independent research conducted in Turkey and abroad. In general, the misconceptions that emerged in the study and the relationship with the literature are as follows.

Lack of hierarchy: The misconception of not accepting the square as a rectangle, which was detected in 24.46% of the students, fully coincides with the studies conducted by Altıparmak and Gürçan (2021) and Akkaya (2018) with 4th grade students. In addition, Ubuz (2017) found that 7th grade students and Aktaş and Aktaş (2012) found that even high school students had

difficulty in seeing the square as a special form of the rectangle. This shows that if the misconception is not eliminated in time, it is carried to the high school level.

Neglecting the Expression of Perpendicularity: The situation of not looking for the concept of perpendicularity, which is seen in 26.59% of the students, can be explained by the fact that the subject of angle and perpendicularity comes after the teaching of geometric shapes in the curriculum of the Ministry of National Education (2018). Ayaz (2016) and Türnüklü et al. (2013) stated that even pre-service teachers do not mention the angle of perpendicularity when defining the square, and that they act with the image of a prototype visual mind.

Geometric Shape and Geometric Solid Confusion: The misconception of naming geometric solids with geometrics shape names, which is seen in 37.23% of the students, supports the findings of Özdemir and Erden (2023) and İncikapi and Kılıç (2013). Nadzeri et al. (2022) also stated that primary school students have the most difficulty in perceiving 3D solids.

Edge-Edge Terminology Confusion: The use of edge instead of edge, which is seen in 18.08% of the students, was also detected in the studies conducted by Koçak and Soylu (2020) and Alaylı (2023) with teacher candidates. This situation points to a lack of pedagogical language that starts from teacher candidates and is conveyed to students.

Pedagogical Suggestions for Classroom Teachers

In order to increase the quality of geometry teaching in primary school and to prevent misconceptions, the following concrete teaching strategies are proposed:

1. Non-Prototype Shape Presentation: Teachers should always avoid drawing squares and rectangles in a horizontal position (prototype) in lessons; they should rotate the shapes and present them in different orientations and different sizes. Thus, students should focus on the geometric features of the shape, not its posture (Akkaya, 2018).

2. Hierarchical Classification Activities: It should be emphasized that the opposite sides of the square are equal.

3. Dynamic Geometry Software and Use of Concrete Materials: Dynamic geometry software such as GeoGebra and Cabri 3D should bring unit cubes, solid expansions, and concrete models to the classroom. Students should be allowed to experience the difference between a 2D surface and a 3D solid by touching and feeling them (Eliyeşil, 2024).

4. Paying Attention to the Language of the Scientific Field: Teachers should carefully emphasize the names of mathematical terms. For example, when expressing the linear boundaries of 3D solids, they should use the term decisively decompose instead of edge, and avoid conceptual language confusion (Özdemir & Erden, 2023).

Curriculum and Recommendations for Future Research

Curriculum Arrangement: In the MEB curriculum, the concept of perpendicularity and angle should be taken before geometric shape definitions or given simultaneously with shape teaching.

Sample Expansion: This research was conducted with 94 students in Van/Erciş. In future research, qualitative-quantitative mixed studies should be carried out with larger samples from different geographical regions that will represent Turkey in general.

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