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Achievement Emotions among Indonesian Senior High School Students in Conducting Mathematics Activities: Differences of Gender, Age, Major, and Demographics

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Abstract: Achievement emotions significantly influence students' mathematics performance, yet many students struggle with emotional instability in learning environments. Exactly, the condition causes their mathematics achievement. Various factors, including gender, age, major, and demographics, predictively influence these emotional experiences. A quantitative survey was conducted to investigate achievement emotions in mathematics activities among Indonesian students. The Achievement Emotions Questionnaire in Mathematics was administered to 198 public upper secondary students at West Java, Indonesia, and data was analyzed using mean, standard deviation, skewness, kurtosis, independent sample t-test, and one-way MANOVA. Results of this study showed different achievement emotions by gender, major, and demographics in doing mathematics activities. For instance, girls exhibited greater pride, boys more frustration; science students felt prouder, social science peers more anxious; and urban students reported positivity, rural counterpart greater despair. Age, however, proved insignificant, underscoring the predominant influence of contextual and environmental determinants. Consequently, these findings highlight the need for targeted interventions, such as implementing problem-based learning and gamification for boy students, providing mentorship programs for girl students, using mathematics' real-world applications for social science students, and providing additional teacher training and fostering a more interactive classroom environment in rural schools, to support students' stable achievement emotions in mathematics learning.

Keywords: achievement emotions, age, demographics, gender, Indonesia, major, mathematics activities

INTRODUCTION

Achievement emotions play a crucial role in students' success in mathematics. Stable achievement emotions, such as confidence, enjoyment, and pride, significantly contribute to higher mathematics achievement by fostering persistence, engagement, and motivation in learning (Suparman, Juandi, & Turmudi., 2025; Suparman, Juandi, et al., 2024). Students with positive and stable emotions are more likely to solve problems effectively. They also participate more actively in class and approach math tasks with a positive mindset. In contrast, students with fluctuating emotions may struggle to maintain focus and motivation, leading to inconsistent academic performance (Hollenstein et al., 2024). Stable emotions help students build resilience, allowing them to overcome challenges and persevere through difficult mathematical concepts. Furthermore, stable emotions create a supportive cognitive environment where students can process and retain mathematical knowledge effectively (Zhang, 2022). The ability to regulate emotions also reduces test anxiety, which is a common barrier to mathematical success (Lazarides & Raufelder, 2021). Without emotional stability, students may experience a fear of failure, leading to avoidance behaviors that hinder their learning progress. Therefore, fostering stable achievement emotions is essential for students to reach their full potential in mathematics and achieve high academic performance.

Many students, however, experience unstable achievement emotions in mathematics learning environments, leading to significant challenges in their academic performance (Liverani et al., 2023; Putwain et al., 2021). A common issue is that students' positive emotions, such as enjoyment and confidence, are often low, while their negative emotions, such as anxiety, frustration, and boredom, are high (Suparman, La'ia, et al., 2024). Several factors contribute to this instability, including teaching methods, assessment pressure, prior experiences, and peer influence. A rigid or unengaging teaching style may fail to create a stimulating and encouraging environment, causing students to feel disconnected from the subject (Putwain & Wood, 2023). Additionally, frequent high-stakes assessments increase students' stress levels, making them more prone to performance anxiety. Students with previous negative experiences in mathematics may develop a fixed mindset, believing they lack the ability to succeed in the subject, which further intensifies their emotional instability (Mata et al., 2022). Social comparison among peers also plays a role, as students who perceive themselves as less capable may experience a decline in self-confidence (Broda et al., 2023). These factors collectively contribute to unstable achievement emotions, ultimately affecting students' ability to perform well in mathematics.

Students' unstable achievement emotions in mathematics learning are also influenced by individual differences, such as gender, age, major, and demographic background (Basarkod et al., 2023; Chen, 2025; Hanin & Gay, 2023; Holm et al., 2020; Stilin et al., 2024). These differences can shape students' experiences and emotional responses to various mathematics-related activities, including attending mathematics classes, solving mathematics tests, and completing mathematics homework. For instance, gender differences in confidence and attitudes toward mathematics have been widely observed, with boy and girl students often demonstrating varying emotional reactions to mathematical challenges (Holm et al., 2020). Additionally, age plays a role, as younger students

may lack the emotional regulation skills needed to manage frustration, while older students might experience increased pressure due to academic expectations (Hanin & Gay, 2023). Similarly, students' academic major and demographic background influence their perceptions and emotional responses to mathematics, with those from different educational tracks or socio-economic backgrounds facing unique challenges (Chen, 2025; Stilin et al., 2024). These variations suggest that understanding and addressing students' unstable achievement emotions require consideration of these individual factors.

Many empirical studies have explored how factors, such as gender, age, grade level, major, and demographics influence students' unstable achievement emotions in mathematics learning (Chen, 2025; Erturan & Jansen, 2015; Frenzel et al., 2007; Hanin & Gay, 2023; Holm et al., 2020; Stilin et al., 2024). Research conducted in various countries has consistently shown that these factors play a crucial role in shaping students' emotional responses to mathematical activities. Several studies consistently show that gender differences in mathematics-related emotions are common, with girls experiencing more anxiety and boys displaying more confidence (Erturan & Jansen, 2015; Holm et al., 2020). These patterns align with age-related findings (Hanin & Gay, 2023), suggesting that both gender and developmental factors influence emotional responses in similar ways. Additionally, students from different academic majors and socio-economic backgrounds demonstrate varying levels of emotional stability in mathematics learning (Chen, 2025; Stilin et al., 2024). While these studies provide valuable insights, there is a need for further research in the Indonesian context, particularly among Indonesian senior high school students regarding achievement emotions. Understanding how these factors influence achievement emotions of Indonesian students can contribute to a more comprehensive understanding of students' emotional experiences in mathematics and inform the development of culturally relevant interventions.

The present study aims to investigate the influence of gender, age, major, and demographic differences on achievement emotions among Indonesian senior high school students in mathematics learning. By examining how these factors contribute to students' emotional stability or instability, this research seeks to provide valuable insights into the emotional challenges faced by Indonesian students in mathematical settings. The findings of this study will contribute to the existing literature by offering a culturally specific perspective on achievement emotions in mathematics. Additionally, this research can inform educators and policymakers about the need for targeted interventions that address students' emotional needs, ultimately enhancing their mathematical achievement. By considering the role of gender, age, major, and demographics, present study supports the development of strategies that promote stable achievement emotions, leading to improved learning outcomes in mathematics education.

THEORETICAL FRAMEWORK

Achievement Emotions

Achievement emotions refer to the emotions experienced by students in academic settings, particularly in response to learning activities, performance outcomes, and academic experiences. Pekrun (2024) defines *achievement emotions* as emotions that are directly related to achievement

activities or achievement outcomes, influencing students' motivation, engagement, and overall academic success. These emotions include both positive emotions, such as enjoyment and pride, and negative emotions, such as anxiety and frustration. According to Pekrun et al. (2023), achievement emotions play a crucial role in shaping students' cognitive processes, as they can either enhance or hinder concentration, memory retention, and problem-solving abilities. Researches emphasize that these emotions are not just momentary reactions but are shaped by personal beliefs, learning experiences, and environmental factors (Loderer et al., 2020; Zhang, 2022). Additionally, Lichtenfeld et al. (2023) highlight that achievement emotions can be stable over time or fluctuate depending on situational factors, such as classroom dynamics and assessment conditions. When students experience positive achievement emotions, they are more likely to engage deeply with the subject matter, develop a sense of competence, and persist in overcoming challenges. Conversely, negative achievement emotions can lead to avoidance behaviors, decreased motivation, and lower academic performance (Suparman et al., 2021). Synthesizing these perspectives, achievement emotions can be understood as fundamental psychological responses that influence students' attitudes, behaviors, and academic achievements in both direct and indirect ways. Recognizing the importance of achievement emotions is crucial for educators and researchers in designing learning environments that promote emotional stability and academic success.

Achievement emotions can be categorized based on three dimensions, including: valence, object focus, and activation (Pekrun, 2024). The first dimension, *valence*, distinguishes between positive and negative achievement emotions. Positive emotions, such as enjoyment, pride, and hope, enhance motivation and learning, while negative emotions, such as anxiety, frustration, and shame, often lead to disengagement and academic difficulties (Juandi & Suparman, 2024). The second dimension, *object focus*, classifies achievement emotions based on their connection to specific aspects of academic activities. Activity-related emotions, such as enjoyment in solving a mathematics problem, arise during the learning process, whereas outcome-related emotions, such as pride in achieving a high-test score or disappointment in failing, emerge after an academic result (Suparman et al., 2021). The third dimension, *activation*, refers to the level of physiological and psychological arousal associated with achievement emotions. Activating emotions, such as excitement and anxiety, increase alertness and readiness to act, whereas deactivating emotions, such as relaxation and boredom, reduce cognitive engagement and effort (Pekrun & Linnenbrink-Garcia, 2012). Pekrun (2024) emphasize that these dimensions interact dynamically, shaping students' emotional experiences in academic settings. For instance, a student who enjoys mathematics (positive, activity-related, activating) may remain highly engaged, whereas a student who feels frustrated with mathematics (negative, activity-related, activating) may struggle with motivation. Particularly in the present study, referring to the valence dimension, five positive emotions, including *enjoyment, pride, hope, contentment, and relaxation*, are involved, as well as five negative emotions, consisting of *anger, anxiety, hopelessness, shame, and boredom*. Understanding these types of achievement emotions allows educators to develop strategies to promote positive emotions while minimizing the impact of negative emotions on students' academic experiences.

Mathematics Activities-related to Achievement Emotions

Achievement emotions, which include both positive and negative emotions, significantly influence students' experiences in mathematics learning (Dettmers et al., 2011; Schukajlow et al., 2017). Positive achievement emotions, such as enjoyment, pride, hope, contentment, and relaxation, can enhance students' motivation and engagement in mathematical activities. Conversely, negative emotions, such as anger, anxiety, hopelessness, shame, and boredom, can hinder students' ability to focus and perform well in mathematics (Di Leo et al., 2019; Goetz et al., 2012). These emotions emerge in various mathematics-related contexts, including attending mathematics classrooms, solving mathematics tests, and doing mathematics homework (Suparman, Juandi, et al., 2024). For instance, students who enjoy mathematics are more likely to actively participate in class discussions and confidently attempt problem-solving tasks. In contrast, students who experience high anxiety during mathematics tests may struggle with time management and question interpretation. A sense of pride can develop when students successfully complete challenging mathematical problems, reinforcing their motivation to continue learning. However, boredom can arise when students find mathematical content uninteresting or repetitive, leading to disengagement. Additionally, shame may occur when students feel embarrassed about making mistakes, preventing them from seeking help when needed. Therefore, understanding how achievement emotions influence students' mathematics experiences is essential for improving learning outcomes.

Students' achievement emotions in mathematics activities serve as critical predictors of their academic success in the subject. When students experience positive emotions, they are more likely to engage deeply with mathematical concepts and develop strong problem-solving skills. Enjoyment and hope encourage students to persist in learning even when faced with challenging problems. Pride in mathematical success reinforces self-efficacy, motivating students to take on more complex mathematical tasks (Camacho-Morles et al., 2021; Pekrun et al., 2017). On the other hand, negative emotions such as anxiety and hopelessness can impair cognitive functioning, making it difficult for students to concentrate and perform calculations accurately. Research suggests that mathematics anxiety is linked to working memory deficits, which reduce students' ability to retain and process mathematical information efficiently. Boredom can lead to decreased effort and avoidance behaviors, further hindering academic achievement in mathematics. Additionally, students who experience shame about their mathematics performance may develop a fear of failure, preventing them from seeking assistance or attempting challenging problems (Lichtenfeld et al., 2023; Raccanello et al., 2018). Motivation and emotional regulation play a crucial role in shaping students' learning behaviors, directly affecting their mathematics achievement (Suparman, La'ia, et al., 2024). Therefore, fostering positive achievement emotions and reducing negative emotions is essential for improving students' performance in mathematics.

Differences of Gender, Age, Major, and Demographics in Achievement Emotions

Gender differences play a significant role in shaping students' achievement emotions in mathematics activities (Erturan & Jansen, 2015; Frenzel et al., 2007; Holm et al., 2020). In the present study, gender is categorized into boy and girl students, as these groups often exhibit different emotional responses toward mathematics. Research has shown that boy students generally report higher levels of confidence and enjoyment in mathematics, while girl students tend to experience higher levels of anxiety and self-doubt (Holm et al., 2020). Societal stereotypes that associate mathematical ability with boys can contribute to these emotional differences, influencing students' self-perceptions and attitudes toward the subject. Girl students may feel more pressure to prove their competence in mathematics, leading to increased anxiety and a fear of making mistakes. In contrast, boy students may be more likely to take risks in problem-solving and participate actively in mathematics discussions (Erturan & Jansen, 2015). Studies have also found that girl students are more likely to experience mathematics-related shame and hopelessness, particularly when facing complex mathematical problems (Erturan & Jansen, 2015; Frenzel et al., 2007). Additionally, teacher expectations and classroom environments can reinforce gender differences in achievement emotions, either encouraging or discouraging students' confidence in their abilities. Addressing these gender disparities is essential to creating a more inclusive mathematics learning environment (Dettmers et al., 2011). By understanding how boy and girl students differ in their emotional responses to mathematics, educators can develop targeted interventions to support all students' emotional well-being and academic success.

Age differences also influence students' achievement emotions in mathematics learning (Bekker et al., 2023; Hanin & Gay, 2023; Sachisthal et al., 2021). In the present study, age is categorized into four groups, including 15-year-old, 16-year-old, 17-year-old, and 18-year-old students, each of whom experiences mathematics-related emotions differently. Younger students, such as those aged 15 and 16, may exhibit higher levels of enjoyment and curiosity in mathematics due to their enthusiasm for learning new concepts. However, as students grow older, academic pressure and increased difficulty in mathematical content can lead to higher levels of anxiety and frustration (Hanin & Gay, 2023). Research has shown that 17- and 18-year-old students are more likely to experience mathematics-related hopelessness and boredom, particularly if they struggle with complex mathematical concepts or feel unprepared for standardized tests (Bekker et al., 2023). Emotional regulation skills also develop with age, meaning older students may be better equipped to manage their emotions during stressful mathematical activities. However, external factors such as college entrance examinations and career expectations can increase anxiety levels among older students. Younger students may be more likely to seek help from teachers and peers, whereas older students may hesitate due to concerns about self-image (Sachisthal et al., 2021). Understanding the emotional experiences of students across different age groups can help educators tailor instructional strategies to support students' mathematics learning at various stages of their academic development.

Academic major also significantly influences students' achievement emotions in mathematics activities (Stilin et al., 2024). In the present study, major is categorized into natural sciences and

social sciences, as these fields involve different levels of engagement with mathematics. Students in the natural sciences often experience higher levels of enjoyment and pride in mathematics, as their field of study requires frequent mathematical applications. These students are more likely to develop positive emotions toward mathematics due to their familiarity and confidence in problem-solving (Adigun et al., 2024). Conversely, students in the social sciences may view mathematics as less relevant to their future careers, leading to lower levels of motivation and higher anxiety (Jenßen et al., 2023). The perception of mathematics as a difficult subject can contribute to frustration and hopelessness among social sciences students, particularly when they struggle to understand abstract concepts. Research suggests that students in mathematics-intensive fields, such as physics and engineering, tend to exhibit greater emotional resilience in mathematics compared to those in humanities-based fields (Suparman, Juandi, et al., 2024). Social sciences students may also be more prone to mathematics boredom, especially if they do not see direct applications of mathematical concepts in their studies (Suparman et al., 2021). The different emotional responses between natural sciences and social sciences students highlight the importance of addressing discipline-specific needs in mathematics education. By understanding how students' academic majors influence their achievement emotions, educators can design instructional approaches that cater to diverse learning needs.

Demographic differences, particularly school location, play a crucial role in shaping students' achievement emotions in mathematics learning (Chen, 2025). In the present study, demographics are categorized into urban and rural schools, as students in these environments face different educational challenges. Students in urban schools often have access to better educational resources, qualified teachers, and extracurricular activities that enhance their mathematics learning experience. As a result, urban students may exhibit higher levels of confidence and enjoyment in mathematics (Merrick & Fyfe, 2023). In contrast, students in rural schools may face limited access to quality mathematics instruction, leading to higher levels of anxiety and hopelessness. Research indicates that students from rural backgrounds are more likely to experience mathematics-related boredom due to a lack of engaging learning opportunities and advanced coursework (Gildehaus & Jenßen, 2023). Additionally, socioeconomic disparities between urban and rural schools can impact students' emotional responses to mathematics, with rural students experiencing greater frustration due to financial and infrastructural constraints. Cultural attitudes toward mathematics also vary between urban and rural settings, influencing students' self-perceptions and emotional engagement with the subject (Gur et al., 2023). Addressing these demographic disparities is essential for promoting equal access to quality mathematics education. By understanding how school location influences students' achievement emotions, educators and policymakers can develop strategies to support students from diverse backgrounds in achieving success in mathematics.

METHOD

Research Design

The present study employed a quantitative survey approach to investigate achievement emotions among Indonesian senior high school students in mathematics-related activities. This method was chosen to systematically analyze students' emotional experiences while attending mathematics classrooms, solving mathematics tests, and doing mathematics homework. The study specifically examined how gender, age, major, and demographic background influenced students' achievement emotions, allowing for a comprehensive understanding of emotional differences across various student groups. A quantitative survey was deemed appropriate because it enables researchers to collect large-scale, standardized data, ensuring objective measurement and statistical analysis of students' emotional responses (Cohen et al., 2018). Additionally, the survey method allowed for efficient data collection from a broad sample of students, enhancing the study's generalizability to the wider population of Indonesian senior high school students. The structured format of a quantitative survey also ensured high reliability and consistency, reducing potential biases in data interpretation (Creswell, 2013). Therefore, a quantitative survey was the most suitable approach to achieve the study's objective of systematically examining achievement emotions in mathematics learning.

Participant

The participants were 198 Indonesian students at public upper secondary schools in West Java selected by purposive sampling. They consisted of 55.05% girl students aged 15 to 17 years (M = 16.23 year, SD = 2.13) and 44.95% boy students aged 15 to 18 years (M = 16.89, SD = 1.74). Moreover, 51.52% students took courses focusing on the natural sciences (e.g., physics, chemistry, and biology), whereas 48.48% students took courses focusing on the social sciences (e.g., economics, sociology, and geography) but all of them were absolutely required to take mathematics as a fundamental course. Additionally, they were differentiated to be 18.18% students aged 15 years, followed by 51.01% students aged 16 years, 28.79% students aged 17 years, and 2.02% students aged 18 years. Subsequently, 48.99% of them lived in the urban area and 51.01% of students lived in the rural area.

Instrument

Achievement Emotions Questionnaire in Mathematics (AEQ-M) was used to measure students' achievement emotions in following mathematics activities. The AEQ-M used in this study was specifically adapted and developed to measure the mathematics achievement emotions of senior high school students. The questionnaire was based on the work of Bieleke et al. (2022) and Pekrun et al. (2023) and reworked by Suparman, Juandi, Turmudi et al. (2025), consisting of 68 items measured on a 4-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree) (See Appendices). Of these, 52 items covered seven categories of achievement emotions: enjoyment, anxiety, pride, shame, hopelessness, anger, and boredom. The remaining 16 items focused on three additional categories: hope, contentment, and relaxation. Following the framework of Pekrun

(2016), the emotions were grouped into five positive categories (enjoyment, pride, hope, contentment, relaxation) and five negative ones (anxiety, anger, shame, hopelessness, boredom). The questionnaire was designed to assess students' emotional experiences during mathematics-related activities, such as attending classes (e.g., I find the material discussed in math class very interesting; I am proud of my contributions in math class), taking exams (e.g., I am optimistic that I can complete the math test; I am satisfied with my performance in math class), and completing homework (e.g., I would rather give up on math homework; I do not really care about the math homework given).

Procedure

The AEQ-M was initially translated into Indonesian by two graduate students fluent in English and Indonesian with expertise in mathematics education. The 68 items were adjusted to align with the Indonesian cultural and educational context. To ensure content validity, the translated questionnaire was reviewed by three experts specializing in educational psychology, and guidance and counseling. After revisions, the finalized Indonesian version was administered to senior high school students in West Java, Indonesia.

Data Analysis

Descriptive statistics, including mean, standard deviation, skewness, and kurtosis, were used to summarize and describe students' achievement emotions in mathematics activities, considering gender, age, major, and demographics. These descriptive statistics allowed for a clear overview of students' achievement emotions, facilitating comparisons between different groups (Creswell & Creswell, 2018). By analyzing the distributional properties of the data, researchers could determine whether further inferential statistical techniques were appropriate for examining group differences. To examine differences in students' achievement emotions based on gender, age, major, and demographics, the study employed inferential statistical techniques, specifically the independent sample t-test and one-way multivariate analysis of variance (MANOVA). The independent sample t-test was used to compare the mean achievement emotions between two groups, such as boy and girl students or urban and rural schools or natural and social sciences, determining whether significant differences existed. One-way MANOVA was conducted to assess the combined effect of age categories (15, 16, 17, and 18 years old) on multiple dependent variables, including positive and negative achievement emotions (Rutherford, 2011). By employing both descriptive and inferential statistical methods, this study provided a comprehensive examination of achievement emotions among Indonesian senior high school students in mathematics activities. All of the calculations in this study were promoted by a few software (e.g., SPSS ver. 26 and Ms. Excel).

RESULTS

To describe positive and negative emotions among students in following mathematics activities, including: attending mathematics classroom, solving mathematics test, and doing mathematics homework, some descriptive statistics, such as mean, deviation standard, skewness, and kurtosis,

were applied (See Table 1). As seen in Table 1, positive emotions (enjoyment, pride, hope, contentment, and relaxation) are generally higher in classroom and test settings, with homework showing the lowest enjoyment (M = 2.358) and relaxation (M = 2.502), suggesting that students may find homework more stressful or less engaging. In contrast, negative emotions (anger, anxiety, shame, hopelessness, and boredom) are more prominent during tests and homework, with the highest anxiety levels during homework (M = 2.493) and the highest anger levels during tests (M = 2.164), indicating that students experience significant pressure in these settings. The skewness values show that emotions are mostly symmetrically distributed, though hopelessness and boredom exhibit slight right-skewness, meaning some students experience particularly high negative emotions. Negative kurtosis across most emotions suggests a broad range of emotional responses rather than a strong concentration around the mean. Overall, students experience moderate positive emotions but also significant negative emotions, particularly in high-pressure activities like tests and homework, emphasizing the need for strategies to enhance emotional well-being in mathematics learning.

To examine gender difference on students' achievement emotions in following mathematics activities, independent sample t-test was applied (See Table 2). The results in Table 2 indicate significant gender differences in students' achievement emotions during mathematics activities. Girl students reported higher positive emotions, particularly enjoyment in classrooms ($p < 0.05$), pride in homework ($p < 0.05$), and contentment in homework and overall ($p < 0.05$), suggesting greater engagement and satisfaction. Boy students exhibited significantly higher negative emotions, including anger in homework, tests, and overall ($p < 0.05$) and boredom in homework ($p < 0.05$), indicating frustration and disengagement. Girl also experienced greater relaxation in classrooms ($p < 0.05$), implying that boy students may feel more stress in this setting. While no significant gender differences were found in overall anxiety, shame, or hopelessness, the findings suggest that emotional disparities are most pronounced in homework and classroom settings, emphasizing the need for gender-responsive strategies to improve students' emotional well-being in mathematics learning.

To examine major difference on students' achievement emotions in following mathematics activities, independent sample t-test was applied (See Table 3). The results in Table 3 indicate significant differences in achievement emotions between natural sciences and social sciences students in mathematics activities. Natural sciences students reported significantly higher pride in tests ($p < 0.05$) and overall ($p < 0.05$), as well as greater relaxation during tests ($p < 0.05$), suggesting they feel more confident and at ease in mathematics-related tasks. Social sciences students exhibited significantly higher shame overall ($p < 0.05$), implying they may experience greater self-doubt and discomfort in mathematics activities. While there were no significant differences in enjoyment, hope, contentment, or anxiety, natural sciences students consistently showed slightly higher positive emotions, whereas social sciences students had slightly elevated negative emotions, particularly in test situations. These findings suggest that students' academic major influences their emotional experiences in mathematics, with natural sciences students generally displaying more confidence and engagement, while social sciences students report greater emotional struggles, particularly in test-related contexts.

To examine demographics difference on students' achievement emotions in following mathematics activities, independent sample t-test was applied (See Table 4). The results in Table 4 reveal significant differences in achievement emotions between students from urban and rural schools during mathematics activities. Urban students reported significantly higher positive emotions, including enjoyment in classrooms and overall ($p < 0.05$), pride in homework, tests, and overall ($p < 0.05$), hope in homework, tests, and overall ($p < 0.05$), and contentment in classrooms, homework, and overall ($p < 0.05$), indicating greater confidence and engagement in mathematics. Conversely, rural students experienced significantly higher negative emotions, such as anger in tests ($p < 0.05$), anxiety in classrooms, tests, and overall ($p < 0.05$), shame in tests ($p < 0.05$), hopelessness in classrooms, homework, and overall ($p < 0.05$), and boredom in all activities ($p < 0.05$), suggesting greater emotional struggles with mathematics. Urban students also exhibited lower overall negative emotions ($p < 0.05$), while rural students displayed more frustration and disengagement, particularly in test-taking and classroom settings. These findings suggest that school location influences students' emotional experiences in mathematics, with urban students generally showing higher motivation and confidence, while rural students may require additional support to manage negative emotions and enhance engagement in mathematics learning.

To examine age difference on students' achievement emotions in following mathematics activities, one-way MANOVA was applied (See Table 5). The results in Table 5 show that age differences do not significantly impact achievement emotions in mathematics activities, as indicated by the lack of statistically significant F-values across all emotions. Younger students (15 and 16 years old) reported slightly higher enjoyment, hope, and relaxation, particularly in classroom and homework settings, while older students (17 and 18 years old) showed slightly higher pride and contentment, especially during tests. Negative emotions, such as anxiety, boredom, and hopelessness, were relatively stable across all age groups, with minor variations in different activities. Although 18-year-old students exhibited the highest levels of pride and contentment in tests, their sample size was very small ($N = 4$), limiting the reliability of these differences. Overall, the findings suggest that students' emotional responses to mathematics activities remain consistent across different ages, indicating that other factors, such as gender, major, and demographics, may have a stronger influence on achievement emotions.

DISCUSSION

The findings reveal that there are significant gender differences in achievement emotions among students in mathematics activities, aligning with previous research on gender disparities in emotional experiences related to mathematics. Girl students exhibited higher levels of enjoyment, pride, contentment, and relaxation, particularly in classroom and homework settings, suggesting a greater sense of engagement and motivation. This supports the findings of Goetz et al. (2012), who reported that girl students tend to display stronger positive emotions in structured learning environments, such as classrooms, where social interaction and teacher support are present. However, boy students demonstrated higher levels of anger and boredom, especially in homework and test situations, indicating greater frustration and disengagement. These results are consistent with the study by Frenzel et al. (2007), which found that boy students are more likely to experience

negative emotions due to lower perceived relevance and interest in mathematics homework. The differences in relaxation levels, with girl students feeling more at ease in classroom settings, suggest that boys may experience greater pressure or stress in structured learning environments. Additionally, previous research has shown that mathematics anxiety is more common among girls (Ali & Das, 2024; Erturan & Jansen, 2015), but in the present study, no significant gender differences were found in overall anxiety levels, suggesting that both boy and girl students experience similar levels of anxiety in mathematics learning. These findings imply that gender-specific interventions are necessary, particularly to help boy students manage frustration and to provide girl students with continued support in maintaining positive emotions. Addressing these emotional differences may contribute to a more balanced and inclusive mathematics learning environment.

Students' academic major significantly influences their achievement emotions in mathematics, particularly in terms of pride and relaxation. Natural sciences students reported higher levels of pride in test-taking and overall mathematics activities, which aligns with the findings of Stilin et al. (2024), who suggested that students in STEM-related fields develop greater confidence in mathematics due to its direct relevance to their studies. This also supports research by Pekrun et al. (2023), which found that students with strong intrinsic motivation for mathematics tend to experience more positive emotions, including pride, when performing well in assessments. In contrast, social sciences students displayed higher levels of shame, particularly in overall mathematics activities, indicating a lack of confidence or discomfort with the subject. These findings are consistent with the work of Rodríguez et al. (2020), which found that students who do not view mathematics as essential for their academic or career goals tend to experience higher levels of negative emotions. The significant differences in relaxation during tests, where natural sciences students felt more at ease than their social sciences counterparts, suggest that frequent exposure to mathematics in STEM-related fields may help students develop emotional resilience in high-stakes situations. Although no major differences were observed in overall anxiety and enjoyment, the trend suggests that social sciences students may require additional support to reduce negative emotions and enhance engagement in mathematics activities. These findings highlight the need for curriculum adjustments and targeted interventions to help social sciences students develop a more positive emotional connection to mathematics.

Students' demographic backgrounds, particularly their school location (urban vs. rural), significantly impact achievement emotions in mathematics. Urban students reported higher enjoyment, pride, hope, contentment, and positive emotions overall, particularly in classroom and homework settings. These results are in line with the findings of Chen (2025), who noted that students in urban schools often have better access to resources, experienced teachers, and supportive learning environments, which contribute to higher positive emotions. Conversely, rural students exhibited higher levels of anger, anxiety, shame, hopelessness, and boredom, particularly in test situations, suggesting greater emotional struggles with mathematics. This aligns with research by Schukajlow et al. (2023), which found that students from underprivileged educational backgrounds often experience higher levels of mathematics anxiety due to limited instructional support and fewer academic opportunities. The lower relaxation levels among rural students in

classroom settings indicate that they may experience greater stress or discomfort in structured learning environments, possibly due to a lack of confidence or prior negative experiences. Furthermore, the higher levels of boredom and hopelessness in rural students support previous research showing that students in resource-limited schools may struggle with motivation due to less engaging teaching methods and a lack of advanced learning opportunities (Ahmed et al., 2013). These findings emphasize the need for targeted interventions in rural schools, such as improved teaching strategies, access to supplementary learning resources, and emotional support programs to help students manage negative emotions in mathematics learning.

Age does not play a significant role in shaping students' achievement emotions in mathematics activities, as there were no statistically significant differences across the four age groups (15, 16, 17, and 18 years old). This contrasts with previous studies, such as the work of Hanin and Gay (2023), which suggested that younger students tend to exhibit higher enjoyment and positive emotions in mathematics, while older students experience increased anxiety and frustration due to growing academic pressures. However, the present study found that enjoyment, pride, hope, contentment, and relaxation remained relatively stable across all age groups, indicating that students' emotional experiences in mathematics learning may be influenced more by external factors such as gender, academic major, or school demographics rather than age alone. This aligns with research by (Pekrun, 2024), who proposed that achievement emotions are shaped by students' personal experiences and environmental factors rather than solely by age-related development. Although 18-year-old students showed slightly higher levels of pride and contentment in test situations, their small sample size limits the generalizability of this finding. Similarly, negative emotions such as anxiety, shame, and hopelessness remained relatively consistent across different age groups, contradicting the assumption that older students necessarily experience more mathematics-related stress. While the study did not find statistically significant differences across age groups, the limited representation of older students suggests caution in interpreting these results as conclusive. Future research should explore whether other psychological or contextual factors contribute to students' emotional experiences in mathematics learning across different age groups.

Implications to Psychology in Mathematics Education

The findings and discussion above have several theoretical implications for understanding students' achievement emotions in mathematics activities, considering gender, age, major, and demographics. First, the results support Control-Value Theory of Achievement Emotions of Pekrun (2024), which suggests that students' emotions are shaped by their perceived control over learning and the value they place on mathematics. The significant gender differences in emotions align with previous research indicating that boy and girl students experience mathematics differently, with boys showing more frustration and girls exhibiting higher engagement (Goetz et al., 2012). The academic major differences further reinforce the idea that students who perceive mathematics as relevant to their future careers (e.g., natural sciences students) are more likely to experience pride and confidence, as suggested by Chen (2025). Moreover, the demographic disparities in emotions, where rural students reported more negative emotions than urban students,

highlight the importance of educational environments in shaping achievement emotions, consistent with Schukajlow et al. (2023). Interestingly, the lack of significant differences across age groups challenges the assumption that achievement emotions naturally evolve over time, suggesting that emotional stability in mathematics learning is influenced more by external factors. These findings contribute to the broader theoretical understanding of how personal and contextual factors shape students' emotional experiences in mathematics learning. Future studies should explore additional psychological and motivational factors that may interact with gender, major, and demographics to influence achievement emotions. Integrating emotional, cognitive, and motivational frameworks can provide a more holistic model for explaining students' mathematics learning experiences.

The practical implications of these findings highlight the need for targeted interventions to support students' achievement emotions in mathematics learning, particularly based on gender, major, and demographics. Given that boy students experience more frustration and boredom, teachers should implement engaging instructional strategies, such as problem-based learning and gamification, to enhance boy students' interest in mathematics. For girl students, who report higher engagement but also experience mathematics anxiety, teachers should create confidence-building activities, such as growth mindset interventions and mentorship programs, to help sustain their positive emotions. The differences between natural sciences and social sciences students suggest teachers to implement mathematics instruction, tailored to increase social sciences students' confidence and reduce their feelings of shame, potentially through real-world applications of mathematics in non-STEM fields. Since rural students report higher anxiety, hopelessness, and boredom, policymakers and educators should focus on improving access to quality mathematics resources, providing additional teacher training, and fostering a more interactive classroom environment in rural schools. Additionally, the lack of significant emotional differences by age implies that emotional support strategies, conducted by teachers should be implemented at all grade levels, rather than assuming that younger students require less emotional regulation support than older students. Schools can incorporate emotional awareness programs that help students identify and manage their achievement emotions effectively. Finally, given that achievement emotions strongly predict mathematics success, integrating emotional well-being support into mathematics curricula can help create a more inclusive and supportive learning environment for all students.

Limitations and Suggestions

This study has several limitations that should be acknowledged, particularly regarding its quantitative survey approach to examining students' achievement emotions in mathematics activities across gender, age, major, and demographics. First, the reliance on self-reported data may introduce social desirability bias, where students may not accurately report their emotions due to personal or cultural influences. Second, while the study examined achievement emotions in three mathematics contexts (classroom, homework, and tests), it did not account for other learning environments, such as group projects, tutoring sessions, or informal study settings, which may also shape students' emotional experiences. Third, the study only focused on senior high school students, limiting the generalizability of findings to other educational levels, such as junior high school or university students, who may exhibit different emotional patterns. Fourth, emotions are

dynamic and context-dependent, but this study used a cross-sectional design, meaning it captured students' emotions at a single point in time, rather than tracking changes over time. Fifth, while the study considered gender, age, major, and demographics, it did not explore other individual factors, such as personality traits, motivation, or prior mathematics performance, which may also influence achievement emotions. Sixth, the sample size of 18-year-old students was relatively small, making it difficult to draw firm conclusions about age-related differences. Seventh, cultural influences on achievement emotions were not explicitly analyzed, despite research suggesting that cultural attitudes toward mathematics can shape students' emotional responses (Pekrun, 2024). Eighth, qualitative insights were not included, meaning the study lacks in-depth explanations of why students experience certain emotions in mathematics learning. Ninth, the study was conducted in Indonesia, limiting its applicability to students from other countries or educational systems with different mathematics curricula. Lastly, teacher-related factors, such as teaching style, classroom climate, and teacher-student relationships, were not examined, despite their potential role in shaping students' achievement emotions.

To address these limitations, future research should adopt a mixed-methods approach, incorporating qualitative methods such as interviews, open-ended surveys, or classroom observations to gain deeper insights into students' emotional experiences. Additionally, longitudinal studies should be conducted to track changes in students' achievement emotions over time, providing a more comprehensive understanding of emotional development in mathematics learning. Future studies should also expand the scope by including students from different educational levels, such as junior high school, university, or vocational education, to examine how achievement emotions evolve across different academic stages. Furthermore, researchers should investigate the role of additional individual factors, such as self-efficacy, learning strategies, and academic resilience, to better understand how students regulate their emotions in mathematics. A larger and more balanced sample for each age group is also necessary to strengthen the validity of age-related findings. Moreover, cultural influences on mathematics emotions should be explored through cross-cultural studies, comparing students from different countries or educational backgrounds to identify potential cultural differences in emotional responses to mathematics. Future studies could also examine how teacher-related factors, such as instructional methods and classroom climate, contribute to students' emotional stability in mathematics learning. Finally, researchers should explore intervention strategies that help students manage negative emotions, such as anxiety and hopelessness, while promoting positive emotions like pride and enjoyment, ultimately fostering a more emotionally supportive mathematics learning environment.

CONCLUSIONS

The findings of this study highlight the significant role of achievement emotions in students' mathematics learning, influenced by gender, academic major, demographics, and to a lesser extent, age. Gender differences were evident, with girl students experiencing higher positive emotions such as enjoyment and pride, while boy students reported greater frustration and boredom, particularly in homework and test settings. Similarly, academic major differences showed that natural sciences students exhibited higher pride and relaxation, whereas social sciences students

reported more shame and anxiety, indicating the need for subject-specific emotional support strategies. Demographic differences were also significant, with urban students demonstrating higher positive emotions, while rural students experienced greater anxiety, boredom, and hopelessness, emphasizing the importance of educational equity. In contrast, age differences did not significantly affect students' achievement emotions, suggesting that external factors such as school environment and subject relevance play a more crucial role in shaping students' emotional experiences. These findings align with Control-Value Theory of Achievement Emotions of Pekrun et al. (2023), reinforcing that students' emotions are shaped by their perceived control over learning and the value they place on mathematics. Given that achievement emotions strongly influence students' engagement and performance, addressing emotional disparities in mathematics education is essential for fostering a more supportive learning environment. Educational interventions should be tailored to gender-specific needs, support social sciences students in building confidence, and provide rural students with improved access to quality mathematics education. Future research should explore cultural and motivational influences on achievement emotions, adopt longitudinal approaches, and consider teacher-related factors in shaping students' emotional responses. By integrating these insights into educational policies and teaching practices, educators can help students develop positive achievement emotions, ultimately leading to greater success and enjoyment in mathematics learning.

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Author Contribution

All of authors were involved in writing this article. Particularly, Suparman and Nana Diana translated and re-designed the instrument, and administrated it to students and collected the data. Bambang Avip Priatna Martadiputra organized, analyzed, and interpreted the data using SPSS 26.0 and Ms. Excel. Dadang Juandi and Turmudi reviewed and supervised this study overall.

Institutional Review Board Statement

The higher educational authority of Universitas Pendidikan Indonesia has been permitted us to do the survey and involve students as human participant in this study (Letter Number: B-11412/UN40.A4.1/PK.01.03/2024).

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APPENDICES

Table 1: Achievement emotions among students in following mathematics activities

Type of Emotions	Mathematics Activities	Mean	Deviation Standard	Skewness	Kurtosis
Enjoyment	Mathematics Classroom	2.694	0.664	-0.416	-0.422
	Mathematics Homework	2.358	0.780	0.294	-0.746
	Mathematics Test	2.522	0.776	-0.011	-0.501
	Overall	2.581	0.634	-0.122	-0.745
Pride	Mathematics Classroom	2.691	0.809	-0.017	-0.629
	Mathematics Homework	2.969	0.860	-0.763	-0.293
	Mathematics Test	2.909	0.848	-0.631	-0.201
	Overall	2.856	0.731	-0.486	-0.546
Hope	Mathematics Classroom	2.568	0.794	-0.096	-0.568
	Mathematics Homework	2.573	0.782	-0.053	-0.648
	Mathematics Test	2.613	0.806	-0.104	-0.676
	Overall	2.584	0.703	-0.095	-0.787
Contentment	Mathematics Classroom	2.641	0.853	0.002	-0.718
	Mathematics Homework	2.767	0.921	-0.504	-0.494
	Mathematics Test	2.833	0.911	-0.599	-0.321
	Overall	2.721	0.757	-0.328	-0.784
Relaxation	Mathematics Classroom	2.553	0.698	-0.315	-0.165
	Mathematics Homework	2.502	0.766	0.102	-0.460
	Mathematics Test	2.494	0.796	0.108	-0.571
	Overall	2.516	0.654	0.078	-0.769
Positive Emotions	Mathematics Classroom	2.629	0.650	-0.069	-0.753
	Mathematics Homework	2.634	0.680	-0.293	-0.744
	Mathematics Test	2.674	0.661	-0.367	-0.585
	Overall	2.641	0.625	-0.193	-0.744
Anger	Mathematics Classroom	2.310	0.803	0.146	-0.575
	Mathematics Homework	1.979	0.748	0.601	0.024
	Mathematics Test	2.164	0.847	0.606	-0.530
	Overall	2.151	0.707	0.470	-0.459
Anxiety	Mathematics Classroom	2.271	0.697	0.333	-0.580

	Mathematics Homework	2.493	0.746	-0.107	-0.787
	Mathematics Test	2.496	0.755	-0.163	-0.654
	Overall	2.413	0.660	-0.088	-0.876
Shame	Mathematics Classroom	2.399	0.758	-0.051	-1.048
	Mathematics Homework	2.111	0.785	0.341	-0.302
	Mathematics Test	2.116	0.818	0.372	-0.409
	Overall	2.236	0.676	0.224	-0.772
Hopelessness	Mathematics Classroom	2.315	0.791	0.206	-0.919
	Mathematics Homework	2.179	0.848	0.545	-0.288
	Mathematics Test	2.356	0.815	0.176	-0.890
	Overall	2.283	0.729	0.381	-0.574
Boredom	Mathematics Classroom	2.276	0.806	0.277	-0.517
	Mathematics Homework	2.159	0.901	0.532	-0.555
	Mathematics Test	2.247	0.889	0.339	-0.681
	Overall	2.234	0.793	0.408	-0.598
Negative Emotions	Mathematics Classroom	2.314	0.626	0.118	-0.798
	Mathematics Homework	2.184	0.640	0.472	-0.308
	Mathematics Test	2.276	0.669	0.345	-0.514
	Overall	2.282	0.618	0.257	-0.522

Table 2: The results of independent sample t-test for gender difference

Mathematics Activities-related Achievement Emotions	Gender	N	Mean	Deviation Standard	T-value
Enjoyment-Classroom	Male	89	2.583	0.707	
	Female	109	2.785	0.615	-2.162*
Enjoyment-Homework	Male	89	2.269	0.787	
	Female	109	2.431	0.771	-1.453
Enjoyment-Test	Male	89	2.455	0.861	
	Female	109	2.578	0.697	-1.109
Enjoyment-Overall	Male	89	2.484	0.675	
	Female	109	2.660	0.590	-1.956
Pride-Classroom	Male	89	2.657	0.880	
	Female	109	2.720	0.749	-0.542
Pride-Homework	Male	89	2.831	0.835	
	Female	109	3.082	0.867	-2.060*
Pride-Test	Male	89	2.814	0.809	-1.419

	Female	109	2.986	0.875	
Pride-Overall	Male	89	2.767	0.758	
	Female	109	2.929	0.704	-1.556
Hope-Classroom	Male	89	2.471	0.870	
	Female	109	2.646	0.721	-1.546
Hope-Homework	Male	89	2.488	0.775	
	Female	109	2.642	0.784	-1.375
Hope-Test	Male	89	2.511	0.801	
	Female	109	2.697	0.805	-1.621
Hope-Overall	Male	89	2.490	0.734	
	Female	109	2.661	0.670	-1.709
Contentment-Classroom	Male	89	2.550	0.879	
	Female	109	2.715	0.828	-1.356
Contentment-Homework	Male	89	2.584	0.914	
	Female	109	2.917	0.903	-2.566*
Contentment-Test	Male	89	2.707	0.955	
	Female	109	2.935	0.863	-1.760
Contentment-Overall	Male	89	2.598	0.776	
	Female	109	2.821	0.728	-2.077*
Relaxation-Classroom	Male	89	2.432	0.773	
	Female	109	2.651	0.618	-2.213*
Relaxation-Homework	Male	89	2.427	0.781	
	Female	109	2.564	0.751	-1.255
Relaxation-Test	Male	89	2.443	0.850	
	Female	109	2.536	0.750	-0.815
Relaxation-Overall	Male	89	2.434	0.709	
	Female	109	2.583	0.601	-1.602
Positive Emotions-Classroom	Male	89	2.538	0.714	-1.785

	Female	109	2.703	0.586	
Positive Emotions-Homework	Male	89	2.520	0.680	-2.152*
	Female	109	2.727	0.669	
Positive Emotions-Test	Male	89	2.586	0.706	-1.703
	Female	109	2.746	0.616	
Positive Emotions-Overall	Male	89	2.545	0.667	-1.957
	Female	109	2.719	0.579	
Anger-Classroom	Male	89	2.348	0.854	0.596
	Female	109	2.279	0.762	
Anger-Homework	Male	89	2.162	0.775	3.181*
	Female	109	1.830	0.694	
Anger-Test	Male	89	2.309	0.930	2.195*
	Female	109	2.045	0.756	
Anger-Overall	Male	89	2.273	0.777	2.210*
	Female	109	2.051	0.631	
Anxiety-Classroom	Male	89	2.278	0.751	0.120
	Female	109	2.266	0.653	
Anxiety-Homework	Male	89	2.427	0.807	-1.131
	Female	109	2.547	0.692	
Anxiety-Test	Male	89	2.396	0.834	-1.693
	Female	109	2.578	0.677	
Anxiety-Overall	Male	89	2.361	0.724	-1.006
	Female	109	2.456	0.604	
Shame-Classroom	Male	89	2.307	0.756	-1.552
	Female	109	2.474	0.755	
Shame-Homework	Male	89	2.191	0.810	1.296
	Female	109	2.045	0.762	
Shame-Test	Male	89	2.196	0.848	1.253

	Female	109	2.050	0.790	
Shame-Overall	Male	89	2.245	0.704	
	Female	109	2.230	0.656	0.122
Hopelessness-Classroom	Male	89	2.286	0.793	
	Female	109	2.339	0.793	-0.467
Hopelessness-Homework	Male	89	2.297	0.922	
	Female	109	2.082	0.774	1.785
Hopelessness-Test	Male	89	2.348	0.860	
	Female	109	2.362	0.781	-0.120
Hopelessness-Overall	Male	89	2.311	0.783	
	Female	109	2.261	0.684	0.473
Boredom-Classroom	Male	89	2.359	0.849	
	Female	109	2.208	0.767	1.316
Boredom-Homework	Male	89	2.314	0.995	
	Female	109	2.032	0.800	2.214*
Boredom-Test	Male	89	2.376	0.957	
	Female	109	2.142	0.819	1.854
Boredom-Overall	Male	89	2.350	0.855	
	Female	109	2.138	0.729	1.880
Negative Emotions-Classroom	Male	89	2.316	0.658	
	Female	109	2.313	0.601	0.025
Negative Emotions-Homework	Male	89	2.278	0.701	
	Female	109	2.107	0.577	1.883
Negative Emotions-Test	Male	89	2.325	0.734	
	Female	109	2.235	0.611	0.936
Negative Emotions-Overall	Male	89	2.314	0.673	
	Female	109	2.256	0.570	0.658

* < 0.05

Table 3: The results of independent sample t-test for major difference

Mathematics Activities-related Achievement Emotions	Major	N	Mean	Deviation Standard	T-value
Enjoyment-Classroom	Natural Sciences	102	2.758	0.605	1.420
	Social Sciences	96	2.625	0.718	
Enjoyment-Homework	Natural Sciences	102	2.323	0.705	-0.650
	Social Sciences	96	2.395	0.855	
Enjoyment-Test	Natural Sciences	102	2.598	0.731	1.411
	Social Sciences	96	2.442	0.817	
Enjoyment-Overall	Natural Sciences	102	2.626	0.556	1.030
	Social Sciences	96	2.533	0.707	
Pride-Classroom	Natural Sciences	102	2.784	0.749	1.662
	Social Sciences	96	2.593	0.862	
Pride-Homework	Natural Sciences	102	3.068	0.802	1.675
	Social Sciences	96	2.864	0.910	
Pride-Test	Natural Sciences	102	3.102	0.679	3.401*
	Social Sciences	96	2.703	0.958	
Pride-Overall	Natural Sciences	102	2.985	0.621	2.581*
	Social Sciences	96	2.720	0.814	
Hope-Classroom	Natural Sciences	102	2.578	0.730	0.187
	Social Sciences	96	2.557	0.861	
Hope-Homework	Natural Sciences	102	2.504	0.719	-1.268
	Social Sciences	96	2.645	0.842	
Hope-Test	Natural Sciences	102	2.632	0.783	0.336
	Social Sciences	96	2.593	0.834	
Hope-Overall	Natural Sciences	102	2.572	0.656	-0.263
	Social Sciences	96	2.598	0.753	
Contentment-Classroom	Natural Sciences	102	2.686	0.832	0.761
	Social Sciences	96	2.593	0.877	
Contentment-Homework	Natural Sciences	102	2.745	0.852	-0.355
	Social Sciences	96	2.791	0.993	
Contentment-Test	Natural Sciences	102	2.951	0.883	1.885
	Social Sciences	96	2.708	0.928	
Contentment-Overall	Natural Sciences	102	2.767	0.716	0.885
	Social Sciences	96	2.671	0.798	
Relaxation-Classroom	Natural Sciences	102	2.578	0.612	0.526
	Social Sciences	96	2.526	0.782	
Relaxation-Homework	Natural Sciences	102	2.514	0.683	0.230
	Social Sciences	96	2.489	0.849	
Relaxation-Test	Natural Sciences	102	2.617	0.679	2.257*
	Social Sciences	96	2.364	0.889	

Relaxation-Overall	Natural Sciences	102	2.570	0.544	1.180
	Social Sciences	96	2.460	0.753	
Positive Emotions-Classroom	Natural Sciences	102	2.677	0.590	1.061
	Social Sciences	96	2.579	0.708	
Positive Emotions-Homework	Natural Sciences	102	2.631	0.613	-0.063
	Social Sciences	96	2.637	0.748	
Positive Emotions-Test	Natural Sciences	102	2.780	0.555	2.341*
	Social Sciences	96	2.562	0.745	
Positive Emotions-Overall	Natural Sciences	102	2.692	0.536	1.200
	Social Sciences	96	2.586	0.705	
Anger-Classroom	Natural Sciences	102	2.392	0.729	1.477
	Social Sciences	96	2.224	0.870	
Anger-Homework	Natural Sciences	102	1.955	0.710	-0.462
	Social Sciences	96	2.005	0.789	
Anger-Test	Natural Sciences	102	2.137	0.817	-0.459
	Social Sciences	96	2.192	0.880	
Anger-Overall	Natural Sciences	102	2.161	0.649	0.212
	Social Sciences	96	2.140	0.768	
Anxiety-Classroom	Natural Sciences	102	2.281	0.584	0.216
	Social Sciences	96	2.260	0.803	
Anxiety-Homework	Natural Sciences	102	2.500	0.692	0.131
	Social Sciences	96	2.486	0.803	
Anxiety-Test	Natural Sciences	102	2.482	0.689	-0.256
	Social Sciences	96	2.510	0.823	
Anxiety-Overall	Natural Sciences	102	2.414	0.576	0.019
	Social Sciences	96	2.412	0.743	
Shame-Classroom	Natural Sciences	102	2.333	0.729	-1.252
	Social Sciences	96	2.468	0.785	
Shame-Homework	Natural Sciences	102	1.980	0.670	-2.444
	Social Sciences	96	2.250	0.873	
Shame-Test	Natural Sciences	102	2.019	0.667	-1.720
	Social Sciences	96	2.218	0.945	
Shame-Overall	Natural Sciences	102	2.143	0.573	-
	Social Sciences	96	2.334	0.762	2.005*
Hopelessness-Classroom	Natural Sciences	102	2.240	0.773	-1.385
	Social Sciences	96	2.395	0.807	
Hopelessness-Homework	Natural Sciences	102	2.102	0.784	-1.307
	Social Sciences	96	2.260	0.908	
Hopelessness-Test	Natural Sciences	102	2.294	0.818	-1.102
	Social Sciences	96	2.421	0.812	
Hopelessness-Overall	Natural Sciences	102	2.334	0.762	-1.429
	Social Sciences	96	2.212	0.692	

Boredom-Classroom	Natural Sciences	102	2.189	0.735	-1.563
	Social Sciences	96	2.368	0.871	
Boredom-Homework	Natural Sciences	102	2.093	0.831	-1.061
	Social Sciences	96	2.229	0.970	
Boredom-Test	Natural Sciences	102	2.142	0.790	-1.726
	Social Sciences	96	2.359	0.975	
Boredom-Overall	Natural Sciences	102	2.148	0.712	-1.576
	Social Sciences	96	2.325	0.865	
Negative Emotions-Classroom	Natural Sciences	102	2.287	0.555	-0.634
	Social Sciences	96	2.343	0.695	
Negative Emotions-Homework	Natural Sciences	102	2.126	0.541	-1.318
	Social Sciences	96	2.246	0.728	
Negative Emotions-Test	Natural Sciences	102	2.215	0.567	-1.320
	Social Sciences	96	2.340	0.760	
Negative Emotions-Overall	Natural Sciences	102	2.238	0.523	-1.013
	Social Sciences	96	2.328	0.704	

* < 0.05

Table 4: The results of independent sample t-test for demographics difference

Mathematics Activities-related Achievement Emotions	Demographics	N	Mean	Deviation Standard	T-value
Enjoyment-Classroom	Urban School	97	2.859	0.514	3.542*
	Rural School	101	2.534	0.749	
Enjoyment-Homework	Urban School	97	2.417	0.786	1.041
	Rural School	101	2.302	0.774	
Enjoyment-Test	Urban School	97	2.577	0.754	0.970
	Rural School	101	2.470	0.796	
Enjoyment-Overall	Urban School	97	2.698	0.534	2.582*
	Rural School	101	2.468	0.702	
Pride-Classroom	Urban School	97	2.773	0.803	1.387
	Rural School	101	2.613	0.812	
Pride-Homework	Urban School	97	3.113	0.792	2.329*
	Rural School	101	2.831	0.903	
Pride-Test	Urban School	97	3.030	0.759	1.995*
	Rural School	101	2.792	0.914	
Pride-Overall	Urban School	97	2.972	0.646	2.201*
	Rural School	101	2.745	0.793	
Hope-Classroom	Urban School	97	2.680	0.715	1.962
	Rural School	101	2.460	0.853	
Hope-Homework	Urban School	97	2.757	0.729	3.333*
	Rural School	101	2.396	0.794	
Hope-Test	Urban School	97	2.768	0.753	2.681*

	Rural School	101	2.465	0.831	
Hope-Overall	Urban School	97	2.735	0.619	3.009*
	Rural School	101	2.440	0.750	
Contentment-Classroom	Urban School	97	2.768	0.790	2.062*
	Rural School	101	2.519	0.897	
Contentment-Homework	Urban School	97	2.907	0.842	2.106*
	Rural School	101	2.633	0.976	
Contentment-Test	Urban School	97	2.896	0.783	0.962
	Rural School	101	2.772	1.018	
Contentment-Overall	Urban School	97	2.835	0.658	2.096*
	Rural School	101	2.611	0.829	
Relaxation-Classroom	Urban School	97	2.670	0.616	2.336*
	Rural School	101	2.440	0.755	
Relaxation-Homework	Urban School	97	2.505	0.737	0.047
	Rural School	101	2.500	0.796	
Relaxation-Test	Urban School	97	2.515	0.751	0.354
	Rural School	101	2.475	0.840	
Relaxation-Overall	Urban School	97	2.563	0.584	0.984
	Rural School	101	2.471	0.716	
Positive Emotions-Classroom	Urban School	97	2.750	0.560	2.593*
	Rural School	101	2.513	0.710	
Positive Emotions-Homework	Urban School	97	2.740	0.609	2.165*
	Rural School	101	2.532	0.731	
Positive Emotions-Test	Urban School	97	2.757	0.562	1.738
	Rural School	101	2.595	0.739	
Positive Emotions-Overall	Urban School	97	2.750	0.523	2.439*
	Rural School	101	2.536	0.695	
Anger-Classroom	Urban School	97	2.273	0.803	-0.641
	Rural School	101	2.346	0.805	
Anger-Homework	Urban School	97	1.876	0.753	-1.919
	Rural School	101	2.079	0.733	
Anger-Test	Urban School	97	2.030	0.789	-
	Rural School	101	2.292	0.883	2.189*
Anger-Overall	Urban School	97	2.059	0.701	-1.795
	Rural School	101	2.239	0.706	
Anxiety-Classroom	Urban School	97	2.149	0.641	-
	Rural School	101	2.388	0.731	2.442*
Anxiety-Homework	Urban School	97	2.594	0.766	-1.949
	Rural School	101	2.373	0.670	
Anxiety-Test	Urban School	97	2.613	0.815	-
	Rural School	101	2.336	0.755	2.259*
Anxiety-Overall	Urban School	97	2.296	0.591	

	Rural School	101	2.526	0.705	-2.476*
Shame-Classroom	Urban School	97	2.459	0.759	-1.135
	Rural School	101	2.005	0.768	
Shame-Homework	Urban School	97	2.212	0.791	-1.872
	Rural School	101	1.984	0.761	
Shame-Test	Urban School	97	2.242	0.853	-2.241*
	Rural School	101	2.175	0.729	
Shame-Overall	Urban School	97	2.141	0.637	-1.946
	Rural School	101	2.327	0.703	
Hopelessness-Classroom	Urban School	97	2.450	0.829	-2.477*
	Rural School	101	1.958	0.779	
Hopelessness-Homework	Urban School	97	2.391	0.861	-3.697*
	Rural School	101	2.304	0.789	
Hopelessness-Test	Urban School	97	2.405	0.841	-0.877
	Rural School	101	2.099	0.769	
Hopelessness-Overall	Urban School	97	2.146	0.659	-2.646*
	Rural School	101	2.416	0.770	
Boredom-Classroom	Urban School	97	2.445	0.808	-3.079*
	Rural School	101	1.984	0.817	
Boredom-Homework	Urban School	97	2.328	0.949	-2.712*
	Rural School	101	2.082	0.782	
Boredom-Test	Urban School	97	2.405	0.958	-2.595*
	Rural School	101	2.207	0.565	
Boredom-Overall	Urban School	97	2.061	0.714	-3.063*
	Rural School	101	2.400	0.833	
Negative Emotions-Classroom	Urban School	97	2.417	0.666	-2.385*
	Rural School	101	2.042	0.565	
Negative Emotions-Homework	Urban School	97	2.320	0.679	-3.128*
	Rural School	101	2.155	0.571	
Negative Emotions-Test	Urban School	97	2.392	0.736	-2.523*
	Rural School	101	2.698	0.534	
Negative Emotions-Overall	Urban School	97	2.159	0.534	-2.783*
	Rural School	101	2.400	0.671	

* < 0.05

Table 5: The results of one-way MANOVA for age difference

Mathematics Activities-related Achievement Emotions	Demographics	N	Mean	Deviation Standard	F-value
Enjoyment-Classroom	15th Years Old	36	2.705	0.789	0.073
	16th Years Old	101	2.701	0.665	

	17th Years Old	57	2.684	0.603	
	18th Years Old	4	2.550	0.341	
Enjoyment-Homework	15th Years Old	36	2.693	0.664	
	16th Years Old	101	2.555	1.005	1.562
	17th Years Old	57	2.376	0.766	
	18th Years Old	4	2.201	0.632	
Enjoyment-Test	15th Years Old	36	2.375	0.478	
	16th Years Old	101	2.358	0.780	1.285
	17th Years Old	57	2.736	0.989	
	18th Years Old	4	2.500	0.764	
Enjoyment-Overall	15th Years Old	36	2.678	0.807	
	16th Years Old	101	2.584	0.637	0.496
	17th Years Old	57	2.524	0.519	
	18th Years Old	4	2.445	0.206	
Pride-Classroom	15th Years Old	36	2.447	0.645	
	16th Years Old	101	2.250	0.288	1.051
	17th Years Old	57	2.522	0.776	
	18th Years Old	4	2.847	0.939	
Pride-Homework	15th Years Old	36	2.633	0.818	
	16th Years Old	101	2.728	0.713	1.347
	17th Years Old	57	2.250	0.500	
	18th Years Old	4	2.691	0.809	
Pride-Test	15th Years Old	36	2.805	0.965	
	16th Years Old	101	2.940	0.911	0.201
	17th Years Old	57	3.087	0.688	
	18th Years Old	4	3.500	0.408	
Pride-Overall	15th Years Old	36	2.828	0.903	
	16th Years Old	101	2.829	0.755	0.222
	17th Years Old	57	2.923	0.584	
	18th Years Old	4	2.831	0.362	
Hope-Classroom	15th Years Old	36	2.969	0.860	
	16th Years Old	101	2.833	1.041	1.896
	17th Years Old	57	2.915	0.839	
	18th Years Old	4	2.956	0.751	
Hope-Homework	15th Years Old	36	2.750	0.645	
	16th Years Old	101	2.909	0.848	0.583
	17th Years Old	57	2.777	0.921	
	18th Years Old	4	2.599	0.784	
Hope-Test	15th Years Old	36	2.394	0.717	
	16th Years Old	101	2.375	0.478	0.302
	17th Years Old	57	2.568	0.794	

	18th Years Old	4	2.652	0.868	
Hope-Overall	15th Years Old	36	2.717	0.854	
	16th Years Old	101	2.595	0.741	0.826
	17th Years Old	57	2.493	0.523	
	18th Years Old	4	2.417	0.315	
Contentment-Classroom	15th Years Old	36	2.833	1.021	
	16th Years Old	101	2.628	0.814	1.208
	17th Years Old	57	2.578	0.822	
	18th Years Old	4	2.125	0.250	
Contentment-Homework	15th Years Old	36	2.666	0.925	
	16th Years Old	101	2.782	0.975	0.245
	17th Years Old	57	2.789	0.839	
	18th Years Old	4	3.000	0.816	
Contentment-Test	15th Years Old	36	2.694	1.009	
	16th Years Old	101	2.811	0.935	1.157
	17th Years Old	57	2.912	0.808	
	18th Years Old	4	3.500	0.577	
Contentment-Overall	15th Years Old	36	2.756	0.899	
	16th Years Old	101	2.712	0.756	0.034
	17th Years Old	57	2.714	0.693	
	18th Years Old	4	2.687	0.314	
Relaxation-Classroom	15th Years Old	36	2.611	0.879	
	16th Years Old	101	2.544	0.707	0.240
	17th Years Old	57	2.517	0.574	
	18th Years Old	4	2.750	0.288	
Relaxation-Homework	15th Years Old	36	2.763	0.929	
	16th Years Old	101	2.480	0.767	1.960
	17th Years Old	57	2.377	0.635	
	18th Years Old	4	2.500	0.408	
Relaxation-Test	15th Years Old	36	2.652	0.977	
	16th Years Old	101	2.509	0.790	1.068
	17th Years Old	57	2.359	0.679	
	18th Years Old	4	2.625	0.629	
Relaxation-Overall	15th Years Old	36	2.675	0.840	
	16th Years Old	101	2.511	0.643	1.180
	17th Years Old	57	2.418	0.540	
	18th Years Old	4	2.625	0.372	
Positive Emotions-Classroom	15th Years Old	36	2.755	0.835	
	16th Years Old	101	2.621	0.648	0.707
	17th Years Old	57	2.580	0.530	
	18th Years Old	4	2.410	0.249	

Positive Emotions-Homework	15th Years Old	36	2.688	0.821	
	16th Years Old	101	2.637	0.720	0.210
	17th Years Old	57	2.586	0.513	
	18th Years Old	4	2.750	0.443	
Positive Emotions-Test	15th Years Old	36	2.727	0.878	
	16th Years Old	101	2.663	0.667	0.106
	17th Years Old	57	2.657	0.507	
	18th Years Old	4	2.725	0.221	
Positive Emotions-Overall	15th Years Old	36	2.725	0.818	
	16th Years Old	101	2.636	0.636	0.310
	17th Years Old	57	2.599	0.470	
	18th Years Old	4	2.582	0.247	
Anger-Classroom	15th Years Old	36	2.083	0.874	
	16th Years Old	101	2.351	0.795	1.227
	17th Years Old	57	2.386	0.773	
	18th Years Old	4	2.250	0.645	
Anger-Homework	15th Years Old	36	1.930	0.829	
	16th Years Old	101	2.059	0.800	0.855
	17th Years Old	57	1.886	0.597	
	18th Years Old	4	1.750	0.500	
Anger-Test	15th Years Old	36	2.166	0.918	
	16th Years Old	101	2.193	0.883	0.240
	17th Years Old	57	2.096	0.764	
	18th Years Old	4	2.375	0.478	
Anger-Overall	15th Years Old	36	2.059	0.815	
	16th Years Old	101	2.201	0.740	0.399
	17th Years Old	57	2.122	0.589	
	18th Years Old	4	2.122	0.415	
Anxiety-Classroom	15th Years Old	36	2.250	0.908	
	16th Years Old	101	2.264	0.683	0.159
	17th Years Old	57	2.280	0.584	
	18th Years Old	4	2.500	0.540	
Anxiety-Homework	15th Years Old	36	2.342	0.931	
	16th Years Old	101	2.458	0.706	1.375
	17th Years Old	57	2.631	0.674	
	18th Years Old	4	2.750	0.741	
Anxiety-Test	15th Years Old	36	2.395	0.843	
	16th Years Old	101	2.438	0.804	1.302
	17th Years Old	57	2.644	0.599	
	18th Years Old	4	2.750	0.353	
Anxiety-Overall	15th Years Old	36	2.328	0.825	0.855

	16th Years Old	101	2.380	0.675	
	17th Years Old	57	2.508	0.517	
	18th Years Old	4	2.657	0.396	
Shame-Classroom	15th Years Old	36	2.445	0.976	
	16th Years Old	101	2.330	0.711	0.670
	17th Years Old	57	2.474	0.703	
	18th Years Old	4	2.665	0.386	
Shame-Homework	15th Years Old	36	2.083	1.003	
	16th Years Old	101	2.108	0.740	0.164
	17th Years Old	57	2.114	0.744	
	18th Years Old	4	2.375	0.250	
Shame-Test	15th Years Old	36	2.222	0.865	
	16th Years Old	101	2.108	0.859	0.482
	17th Years Old	57	2.043	0.739	
	18th Years Old	4	2.375	0.250	
Shame-Overall	15th Years Old	36	2.277	0.866	
	16th Years Old	101	2.203	0.662	0.329
	17th Years Old	57	2.248	0.590	
	18th Years Old	4	2.500	0.180	
Hopelessness-Classroom	15th Years Old	36	2.361	0.975	
	16th Years Old	101	2.207	0.768	1.604
	17th Years Old	57	2.447	0.705	
	18th Years Old	4	2.750	0.288	
Hopelessness-Homework	15th Years Old	36	2.291	0.951	
	16th Years Old	101	2.248	0.884	0.273
	17th Years Old	57	2.157	0.738	
	18th Years Old	4	2.250	0.500	
Hopelessness-Test	15th Years Old	36	2.347	1.005	
	16th Years Old	101	2.302	0.800	0.425
	17th Years Old	57	2.447	0.723	
	18th Years Old	4	2.500	0.707	
Hopelessness-Overall	15th Years Old	36	2.333	0.929	
	16th Years Old	101	2.219	0.733	0.592
	17th Years Old	57	2.350	0.583	
	18th Years Old	4	2.502	0.471	
Boredom-Classroom	15th Years Old	36	2.277	0.874	
	16th Years Old	101	2.208	0.794	1.115
	17th Years Old	57	2.420	0.792	
	18th Years Old	4	1.917	0.571	
Boredom-Homework	15th Years Old	36	2.152	1.047	0.335
	16th Years Old	101	2.113	0.882	

	17th Years Old	57	2.254	0.861	
	18th Years Old	4	2.000	0.707	
Boredom-Test	15th Years Old	36	2.333	1.007	
	16th Years Old	101	2.222	0.876	0.172
	17th Years Old	57	2.228	0.866	
	18th Years Old	4	2.375	0.629	
Boredom-Overall	15th Years Old	36	2.258	0.907	
	16th Years Old	101	2.184	0.780	0.406
	17th Years Old	57	2.318	0.761	
	18th Years Old	4	2.072	0.600	
Negative Emotions-Classroom	15th Years Old	36	2.283	0.828	
	16th Years Old	101	2.272	0.617	0.576
	17th Years Old	57	2.401	0.498	
	18th Years Old	4	2.415	0.395	
Negative Emotions-Homework	15th Years Old	36	2.160	0.836	
	16th Years Old	101	2.177	0.639	0.054
	17th Years Old	57	2.208	0.516	
	18th Years Old	4	2.225	0.371	
Negative Emotions-Test	15th Years Old	36	2.293	0.841	
	16th Years Old	101	2.253	0.685	0.174
	17th Years Old	57	2.292	0.533	
	18th Years Old	4	2.475	0.357	
Negative Emotions-Overall	15th Years Old	36	2.263	0.819	
	16th Years Old	101	2.255	0.624	0.262
	17th Years Old	57	2.334	0.465	
	18th Years Old	4	2.405	0.356	

* < 0.05

ACHIEVEMENT EMOTIONS QUESTIONNAIRE-MATHEMATICS (AEQ-M)

Full Name :
Age :
Gender :
Class :
School Origin :

Questionnaire Instructions

1. The achievement emotions questionnaire consists of ten emotional types, namely enjoyment, pride, hope, contentment, relaxation, anxiety, boredom, shame, hopelessness, and anger.
2. Each statement from all emotional types can be rated on a scale of 1 – 4 where each scale is described as follows:
   (1) = (Strongly disagree)
   (2) = (Disagree)
   (3) = (Agree
   (4) = (Strongly Agree)
3. Please select one scale between 1 – 4 for each statement by checking (✓) in the space provided.
4. Please fill out this questionnaire in a way that reflects achievement emotions that you feel or experience when doing math activities, such as: attending math classes, doing math homework, and taking math exams.

No	Statements	Scale			
		SD	D	A	SA
1	I look forward to math class every week				
2	I enjoy attending math class				
3	I find the material discussed in math class very interesting				
4	I am happy because I can understand math material well				
5	I smile happily at the teacher while learning in math class				
6	I am in a good mood when doing math homework				
7	I really enjoy doing math homework				

8	I feel happy when taking a math test				
9	I smile joyfully when a math test goes well				
10	I am proud of my knowledge in mathematics				
11	I am proud of my contributions in math class				
12	I am proud of my own work after completing math homework				
13	I feel proud when I can do my math homework well				
14	I am proud of myself after completing a math test				
15	I feel proud when I can do a math test well				
16	I am optimistic about learning mathematics				
17	I believe I can master math material				
18	I am optimistic that I can complete my math homework				
19	I choose not to give up on math homework				
20	I believe that the math test will go well				
21	I am optimistic that I can complete the math test				
22	I am satisfied with my knowledge in mathematics				
23	I am satisfied with my performance in math class				
24	I am satisfied with my own work after completing math homework				
25	I feel satisfied after being able to complete a math test independently				
26	I follow math lessons in a relaxed manner				
27	I express my math ideas in front of the class calmly				
28	I do my math homework calmly				
29	I do not feel burdened when doing difficult math homework				
30	I take math tests calmly				
31	I do not feel burdened when taking a difficult math test				
32	I feel upset to the point of wanting to leave math class				
33	I feel frustrated because math material is too difficult				
34	I am annoyed because math homework takes up most of my playtime				
35	I want to throw my math homework in the trash				
36	I want to tear my math test paper into pieces				
37	I am frustrated because the teacher asks difficult questions in the math test				
38	I feel nauseous when thinking about math class				
39	I am worried if the math material is too difficult				
40	I choose not to go to school because math is scary				
41	I am worried about my ability to fully understand math material				
42	I am worried that I will not complete my math homework on time				
43	My heart races when I cannot finish my math homework				
44	I would rather not do difficult math homework				
45	I feel tense and nervous when taking a math test				
46	I worry about getting a bad grade on a math test				

47	I am afraid of failing even before the math test starts				
48	I feel nauseous when thinking about an upcoming math test				
49	My face turns red when expressing ideas in math class				
50	I feel embarrassed when I cannot answer a math question well				
51	I feel ashamed of my lack of knowledge in mathematics				
52	I do not want to tell anyone when I do not understand my math homework				
53	I avoid eye contact with classmates when discussing math homework				
54	My face turns red after taking a math test				
55	I do not want to talk about anything after taking a math test				
56	I feel hopeless about math class				
57	I keep thinking that I cannot understand the math material being taught				
58	I would rather give up on math homework				
59	I no longer try to do my math homework				
60	I feel hopeless during a math test				
61	I keep thinking that I will never get a good grade on a math test				
62	I find math lessons boring				
63	I do not focus when the teacher explains math material				
64	I feel so bored that I do not want to study math anymore				
65	I do not really care about the math homework given				
66	Math homework bores me to death				
67	Math tests make me very bored				
68	I do not really care about the math tests given				