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## Mathematics Self-Efficacy as a Predictor of Mathematics Achievement

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### ABSTRACT

The present study investigated the relationship between Mathematics Self-Efficacy and Mathematics Achievement among adolescents. Using a random sampling technique, a sample of 220 students, comprising 111 males and 109 females, were selected from various secondary schools in the 10th grade of Aligarh District. The Mathematics Self-Efficacy Scale, developed by the investigator, was used to gather data. Mathematics Achievement was measured using the students' annual exam scores in the 9th grade. The researcher used Percentage analysis, t-test, and correlation techniques to analyse the data. The results indicated no significant difference in Mathematics Self-Efficacy between male and female students. Furthermore, students who performed better in Mathematics exhibited higher Mathematics Self-Efficacy scores, demonstrating a positive correlation between Mathematics Self-Efficacy and Mathematics Achievement. Most of the sample showed average to high levels of Mathematics Self-Efficacy, with 36.37% classified at the higher level and 63.18% at the average level. Both male and female students followed similar trends in their Mathematics Self-Efficacy scores. In conclusion, this study highlights a positive correlation between Mathematics Self-Efficacy and Mathematics Achievement among adolescents, with no significant gender differences.

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**Introduction:**

Mathematics, a fundamental field of science, studies numbers, relationships, and their practical applications. It encompasses a variety of tasks, such as calculations, computations, and problem-solving, all distinguished by logical structure, correctness, and precision (Steen, 2001). Mathematics has progressed from fundamental skills like counting and measuring to more complicated explorations into physical phenomena (Bishop, 1991). Mathematics' abstraction and logical reasoning principles are fundamental to many parts of daily life, ranging from personal finance management to classroom size optimization (Niss, 1999). Thus, Mathematics remains vital to education and society as the foundation for scientific, technological, and economic advancements (Steen, 2001). Mathematics is essential in education because it promotes critical thinking and logical reasoning more successfully than other disciplines (Kilpatrick, Swafford, & Findell, 2001). Engagement in complex problem-solving tasks improves cognitive abilities and cultivates important attributes such as patience, perseverance, and self-confidence (Boaler, 2002). Furthermore, Mathematics is a foundation for many academic subjects, including physics, chemistry, and economics, making proficiency essential for academic and professional success in various fields (Steen, 2001).

A pivotal factor influencing students' success in mathematics is their self-efficacy. Bandura (1997) defined self-efficacy as an individual's belief in their ability to execute tasks successfully. This belief exerts a powerful influence on motivation, persistence, and performance across various domains, including education. Students with high self-efficacy tend to approach challenges with confidence and resilience, leading to better outcomes. In mathematics, self-efficacy affects students' willingness to engage with complex problems and persevere through challenges, significantly impacting their overall performance (Pajares, 1996).

Mathematics self-efficacy refers to students' confidence in their ability to solve mathematical problems and surmount related obstacles (Bandura, 1997). This belief influences their motivation to engage with Mathematics, persist in facing challenges, and develop problem-solving skills. Research has consistently demonstrated that students with high Mathematics Self-Efficacy perform better in the subject, as their confidence fosters perseverance and greater engagement (Pajares, 1996). Mathematics Self-Efficacy encompasses three dimensions: Students perceive their ability to manage varying levels of task difficulty (magnitude), demonstrate confidence in executing tasks (strength), and apply their skills across different contexts (generality) (Schunk, 1991). By fostering Mathematics Self-Efficacy, educators can help create more motivated, engaged, and successful students.

Mathematics Achievement, typically measured through test scores or academic performance, represents a student's proficiency in the subject. Studies have shown that Mathematics Self-Efficacy is a robust predictor of Mathematics Achievement, with higher Self-Efficacy correlating with improved performance (Fennema & Sherman, 1976). The relationship between self-Efficacy and achievement is reciprocal: as students perform better in Mathematics, their Self-Efficacy increases, creating a positive feedback loop of growth and confidence (Pajares & Miller, 1994). In a modern, data-driven society, excelling in Mathematics is not only critical for academic success but also for professional endeavors in a wide range of fields (Schoenfeld, 2016). Hence, enhancing students' Self-Efficacy is a promising avenue for improving their Mathematics Achievement and ensuring long-term success.

In summary, Mathematics is foundational to both education and society due to its applicability across various fields, from science to economics. However, students' success in Mathematics is greatly influenced by their Mathematics Self-Efficacy, which impacts their motivation, engagement, and performance. High levels of self-efficacy empower students to confidently approach mathematical challenges, fostering perseverance and ultimately improving academic achievement. Research consistently underscores the importance of Self-Efficacy as a predictor of Mathematics success, creating a positive feedback loop where increased achievement further strengthens self-efficacy. Therefore, cultivating students' Mathematics Self-Efficacy is a key strategy for enhancing academic outcomes and addressing educational disparities. By focusing on building Self-Efficacy in Mathematics, educators and policymakers can promote long-term academic and professional success in an increasingly data-driven world.

### **Objectives of the study:**

Following are the main objectives of the study:

1. To study Mathematics Self- Efficacy among adolescents for total sample.
2. To study Mathematics Self- Efficacy for male Adolescents.
3. To study Mathematics Self- Efficacy for female Adolescents.
4. To study the relationship between Mathematics Self- Efficacy and Mathematics Achievement among Adolescents.
5. To study the gender differences in Mathematics Self- Efficacy among Adolescents.

### **Hypotheses**

Corresponding to the objectives the following null hypothesis were formulated:

**Hypothesis (H<sub>01</sub>):** There is no significant relationship between Mathematics Self-Efficacy and Mathematics Achievement for total sample.

**Hypothesis (H<sub>02</sub>):** There is no significant relationship between Mathematics Self-Efficacy and Gender.

**Sample of the study:**

In a study conducted in the Aligarh District, 220 Class Xth students were randomly selected from various secondary schools. The sample comprised 111 males and 109 females and was drawn from AMU and private schools (CBSE) using random sampling techniques. Specifically, 117 students were from AMU schools, and 103 were from private schools.

**Research Tool Used:**

A self-constructed scale on Mathematics Self-Efficacy (MSE) was used for data collection. The scale included 58 items, with 34 positively framed statements and 24 negatively framed statements. Respondents rated their agreement on a 5-point Likert scale, with options ranging from 'Strongly Agree' to 'Strongly Disagree.' Mathematics achievement was assessed based on the percentage of marks obtained in mathematics in the previous class (Class IX)."

**Data Analysis:**

The data for this study was collected from the secondary schools in the Aligarh district. Percentage analysis, t-tests, and correlation techniques were employed to analyse the data.

**Analysis and Interpretation:**

**Objective 1**

To study Mathematics Self-Efficacy among adolescents for total sample.

**Table 1:** Levels of Mathematics Self-Efficacy among adolescents for total sample.

Levels	Range Of Scores	No. Of Students	Percentage Of Students
High	212-290	80	36.37
Average	135-211	139	63.18
Low	58-134	1	0.45

**Analysis of table**

Using MS Excel, the above table was created which shows the following levels of Mathematics Self-Efficacy.

**High level of Mathematics Self-Efficacy:**

The range of scores in this level 212-290, and the number of students belonging to this group is 80 out of total sample which is equal to 36.37%.

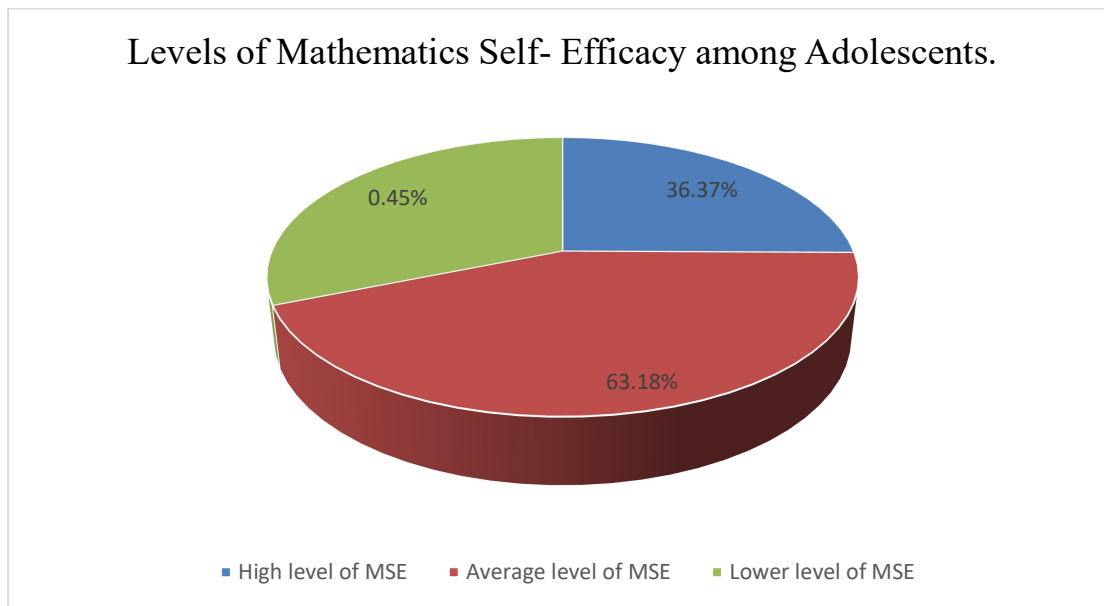
**Average level of Mathematics Self-Efficacy:**

The range of scores in this level 135-211, and the number of students belonging to this group is 139 out of total sample which is equal to 63.18%.

**Low level of Mathematics Self-Efficacy:**

The range of scores in this level 58-134, and the number of students belonging to this group is 01 out of total sample which is equal to 0.45%.

**Figure 1: Levels of Mathematics Self-Efficacy (MSE) among Adolescents.**



From the data analysis of Objective 1, various levels of Mathematics Self-Efficacy were observed among adolescents. It was found that 36.37% of the total sample belonged to the high level of Mathematics Self-Efficacy, 63.18% fell into the average level, and only 0.45% were categorized as having a low level of Mathematics Self-Efficacy. This indicates that nearly all adolescents fall into the high or average categories of Mathematics Self-Efficacy.

**Objective 2**

To Study Mathematics Self-Efficacy for Male Adolescents.

**Table 2:** Levels of Mathematics Self-Efficacy among Adolescents for Male Sample.

Levels	Range Of Scores	No. Of Males	Percentage Of Students
High	212-290	40	36.04
Average	135-211	70	63.06
Low	58-134	1	0.90

**Analysis of table**

Using MS Excel, the above table was created which shows the following levels of Mathematics Self-Efficacy for Male Sample.

**High level of Mathematics Self-Efficacy:**

The range of scores in this level 212-290, and the number of students belonging to this group is 40 out of total sample which is equal to 36.04%.

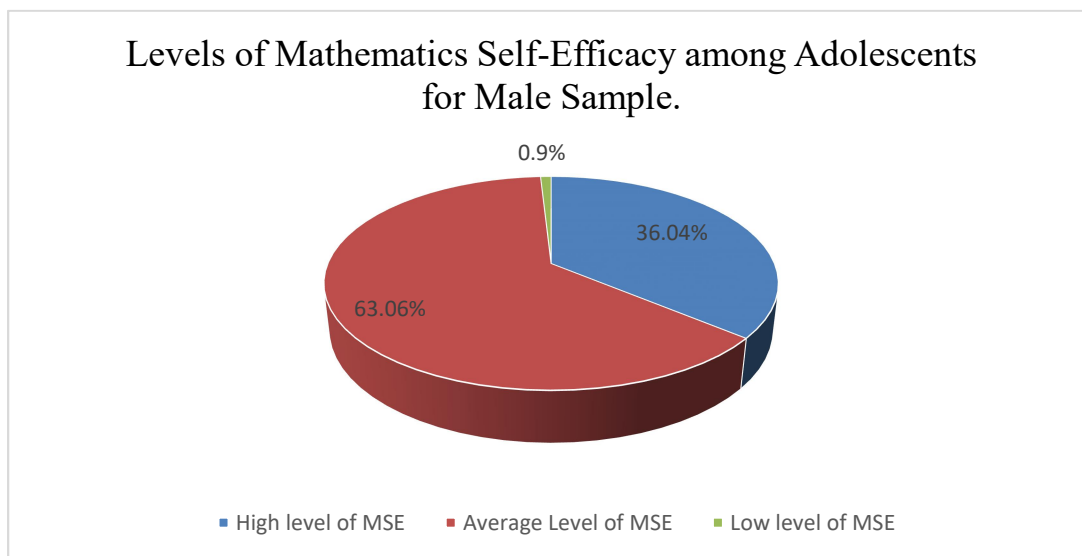
**Average level of Mathematics Self-Efficacy:**

The range of scores in this level 135-211, and the number of students belonging to this group is 70 out of total sample which is equal to 63.06%.

**Low level of Mathematics Self-Efficacy:**

The range of scores in this level 58-134, and the number of students belonging to this group is 01 out of total sample which is equal to 0.90%.

**Figure 2: Levels of Mathematics Self-Efficacy (MSE) among Adolescents for Male Sample**



From the data analysis of the objective 2, various levels of Mathematics Self-Efficacy were found amongst the adolescents for Male sample, it was found that 36.04% of the total sample belonged to high level of Mathematics Self-Efficacy. Similarly, it was also found that 63.06% of the total sample belonged to Average level of Mathematics Self-Efficacy. In addition, it was also found that 0.90% of the total sample belonged to group of low level of Mathematics Self-Efficacy. Thus, it can be concluded that almost all the Male adolescents lie in the category of high and average level of Mathematics Self-Efficacy.

**Objective 3**

To Study Mathematics Self-Efficacy for Female adolescents.

**Table 3:** Levels of Mathematics Self-Efficacy among Adolescents for Female Sample.

Levels	Range Of Scores	No. of females	Percentage of Students
High	212-290	40	36.70
Average	135-211	69	63.30
Low	58-134	0	0

Using MS Excel, the above table was created which shows the following levels of Mathematics Self-Efficacy for Female Sample.

**High level of Mathematics Self-Efficacy:**

The range of scores in this level 212-290, and the number of students belonging to this group is 80 out of total sample which is equal to 36.70%.

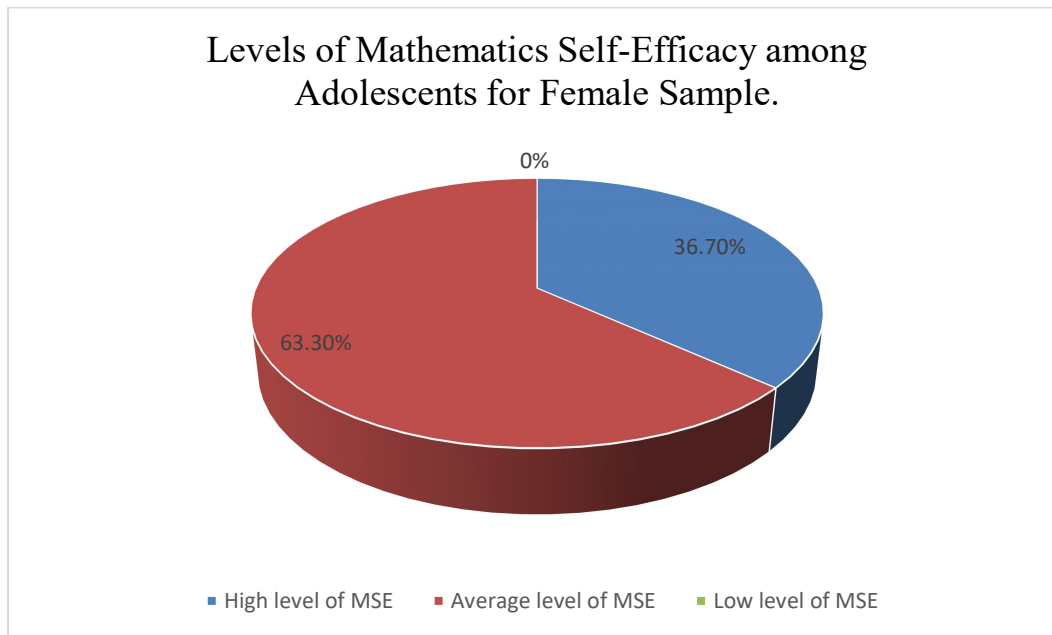
**Average level of Mathematics Self-Efficacy:**

The range of scores in this level 135-211, and the number of students belonging to this group is 139 out of total sample which is equal to 63.30%.

**Low level of Mathematics Self-Efficacy:**

The range of scores in this level 58-134, and the number of students belonging to this group is 00 out of total sample which is equal to 0%.

**Figure 3: Levels of Mathematics Self-Efficacy (MSE) among Adolescents for Female Sample.**



From the data analysis of the objective 3, various levels of Mathematics Self-Efficacy were found amongst the adolescents for Female sample, it was found that 36.70% of the total sample belonged to high level of Mathematics Self-Efficacy. Similarly, it was also found that 63.30% of the total sample belonged to Average level of Mathematics Self-Efficacy. In addition, it was also found that 0% of the total sample belonged to group of low level of Mathematics Self-Efficacy. Hence, it can be concluded that almost all the Female adolescents lie in the category of high and average level of Mathematics Self-Efficacy.

**Objective 4**

To study the relationship between Mathematics Self-Efficacy and Mathematics Achievement among Adolescents.

**Hypotheses 1**

There is no significant relationship between Mathematics Self-Efficacy and Mathematics Achievement for Total Sample.

**Table 4:** Relationship between Mathematics Self-Efficacy and Mathematics Achievement among Adolescents.

Dimension	Mathematics Self-Efficacy	Mathematics Achievement
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Mathematics Self-Efficacy	1	.313**
Mathematics Achievement	.313**	1
N (Total no. of Students)	220	220

### \*\*Significant at 0.01 level

The above table displays the correlation between Mathematics Self-Efficacy and Mathematics Achievement. The Pearson correlation calculated between Mathematics Self-Efficacy and Mathematics Achievement for the total sample reveals a significant positive relationship at the 0.01 level. This means that students who score higher in Mathematics also have higher Mathematics Self-Efficacy.

### Objective 5

To study the Gender Differences in Mathematics Self-Efficacy among Adolescents.

### Hypotheses 2

There is no significant relationship between Mathematics Self-Efficacy and Gender.

**Table 5:** Gender Differences in Mathematics Self-Efficacy among Adolescents.

Variable	Gender	N	Mean	SD	df	t-value	Level of Sig.	Remarks
Mathematics Self-Efficacy	Male	111	200.69	28.022	218	-.021	.983	NS
	Female	109	200.77	26.149				

The above table reveals the Mathematics Self-Efficacy of male and female adolescents. The obtained t-value of -0.021 for Mathematics Self-Efficacy between male and female adolescents is less than the critical value of 1.96 at the 0.05 significance level. This indicates no significant difference in Mathematics Self-Efficacy based on gender. Hence, the null hypothesis that "There will be no significant difference in Mathematics Self-Efficacy between male and female adolescents" is accepted. This study aimed to establish the relationship between Mathematics Self-Efficacy and Mathematics Achievement among adolescents.

### Findings And Conclusion:

#### Findings:

#### 1. Findings based on Percentage Analysis for Total sample

Various levels of Mathematics Self-Efficacy were found among the adolescents. It was found that 36.37% of the total sample belonged to a high level of Mathematics Self-Efficacy. Similarly, it was also found that 63.18% of the total sample belonged to the Average level of Mathematics Self-Efficacy. In addition, it was also found that 0.45% of the total sample belonged to a group with a low level of Mathematics Self-Efficacy.

## **2. Findings based on Percentage Analysis for Male sample**

Various levels of Mathematics Self-Efficacy were found amongst the adolescents for the Male sample; it was found that 36.04% of the total sample belonged to a high level of Mathematics Self-Efficacy. Similarly, it was also found that 63.06% of the total sample belonged to the Average level of Mathematics Self-Efficacy. In addition, it was also found that 0.90% of the total sample belonged to a group with a low level of Mathematics Self-Efficacy.

## **3. Findings based on Percentage Analysis for Female sample**

Various levels of Mathematics Self-Efficacy were found among the adolescents for the Female sample; it was found that 36.70% of the total sample belonged to a high level of Mathematics Self-Efficacy. Similarly, it was also found that 63.30% of the total sample belonged to the Average level of Mathematics Self-Efficacy. In addition, it was also found that 0% of the total sample belonged to a group with a low level of Mathematics Self-Efficacy.

## **4. Findings based on correlation**

At the 0.01 level of significance, Mathematics Self-Efficacy and Mathematics Achievement are significantly correlated. The relationship between Mathematics Achievement and Mathematics Self-Efficacy is positive, indicating that as Mathematics Self-Efficacy increases, Mathematics Achievement tends to increase as well."

## **5. Findings based on t test**

The study found no significant difference in Mathematics Self-Efficacy between male and female students, with a t-value of **-0.21**. This means both males and females have similar confidence in their mathematical abilities, showing that gender does not significantly impact how they feel about doing Mathematics.

## **Conclusion Of The Study:**

This study focused on the relationship between Mathematics Self-Efficacy and Mathematics Achievement in adolescents. The findings showed that almost all the students have either high or average Mathematics Self-Efficacy. About 36.37% of the students had high self-efficacy, while 63.18%

had average levels. This study highlights how important Self-Efficacy is for academic performance, as supported by earlier research (Bandura, 1997; Pajares & Miller, 1994).

The study also found no significant difference between males and females regarding Mathematics Self-Efficacy. Both genders showed similar levels, reflecting changing societal views on gender roles in mathematics. More females are now pursuing Mathematics-related fields, challenging traditional beliefs about gender and math abilities (Ayotola & Adedeji, 2009; Hyde, 2014).

Additionally, the research showed a strong positive link between Mathematics Self-Efficacy and Mathematics Achievement. Students who believe in their ability to do well in Mathematics tend to achieve higher results. This study aligns with previous studies that show how confidence in Mathematics skills helps students perform better (Negara et al., 2021; Hafner & Stacks, 2008).

In conclusion, building Mathematics Self-Efficacy is key to improving Mathematics Achievement. It is also important to promote gender equality in mathematics education to ensure that all students succeed. Future research should explore the factors that influence Mathematics Self-Efficacy and develop ways to help students gain confidence and improve their performance in math. It will make learning mathematics more effective and inclusive for everyone.

### **Educational Implications**

This study highlights how a student's confidence in their Mathematics abilities, known as Mathematics Self-Efficacy, plays a key role in their success in the subject. Building this confidence should be a priority for teachers and educators. They can help students feel more capable by providing encouraging feedback, setting goals that are easy to achieve, and creating opportunities for students to succeed in solving Mathematics problems. Students who experience success are likelier to believe in their abilities and stay motivated to learn.

Including activities that strengthen students' confidence as part of the regular math curriculum can have a significant impact. These activities help students stay motivated, work through challenges, and improve their academic performance. Schools should also focus on training teachers to understand better how to support students' confidence. By doing so, teachers can create classrooms where students feel supported, are not afraid to make mistakes, and are encouraged to try solving problems.

By focusing on students' emotional and learning needs, teachers can help students build confidence in their abilities. This approach can also reduce differences in math achievement, especially for students who might otherwise struggle. When students feel confident in math, it not only helps them succeed in the subject but also gives them skills and self-belief that can help in their overall education and future careers.

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