

Mathematics Self-Efficacy as a Predictor of Academic Achievement in Mathematics of Higher Secondary School Students

Dr. M. Nandhini^{1*}

ABSTRACT

The Aim of this study was to find out the significant difference between Mathematics Self-Efficacy of Higher Secondary School Students with respect to Gender, Board of Affiliation, Type of School and Management of the School. The Sample of the study was selected by using Simple Random Sampling technique which includes 1050 Higher Secondary School Students in Chennai. Survey Method was used to collect data. Mathematics Self-Efficacy was measured using the Mathematics Self-Efficacy Scale. Differential Analysis was the Statistical Technique used. Study reveals that there exists a significant difference in the Mathematics Self-Efficacy of the Higher Secondary School Students with respect to Gender, Board of Affiliation, Type of School and Management of the School. Based on the results, the Students need to be encouraged to develop their Mathematics Self-Efficacy as they have a role in keeping the Mathematics Marks in check.

Keywords: *Mathematics Self-Efficacy, Type of School, Management of the School, Differential Analysis, Higher Secondary Students*

Mathematics is generally considered as the most difficult subject of all subjects. Students find lots of problems and difficulties in this subject in understanding the concepts, remembering the formulas, solving the problems and applying in practical situations. It is seen that students are doing good in all other subjects but fail to do so in Mathematics. If we consider a group of students, a few students are found to be high achievers on the one hand and a few are low achievers on the other, while a sizable number of students always appear as moderate achievers. The question arises why such a difference in achievement appears? Is this difference due to certain factors? Or is there any single factor or host of factors which account for all the differences in mathematics achievement? These questions often appear in the minds of the Educators, Educationists and the Psychologists. There can be many reasons behind this. One of the main reasons is low self-efficacy towards the subject.

Mathematical self-efficacy is a person's judgement about his or her ability to perform a mathematical task. It is a student's "I can" or "I cannot" belief. Contrary to self-esteem, which reflects how students feel about their value, self-efficacy reflects students' confidence

¹Assistant Professor of Perspectives in Education, Loyola College of Education, Chennai, Tamil Nadu, India

*Corresponding Author

Received: December 01, 2024; Revision Received: February 11, 2025; Accepted: February 16, 2025

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in completing specific tasks. High Self-Efficacy in one area may not coincide with high Self-Efficacy in another area. Just as high confidence in snow skiing may not be associated with high confidence in baseball, high self-efficacy in mathematics does not necessarily go hand in hand with high self-efficacy in spelling. Self-Efficacy is specific to the task being attempted. However, a high degree of self-efficacy does not necessarily mean that students believe they will succeed. While self-efficacy indicates the degree to which students believe they have the skills to succeed, they may believe that other factors will prevent them from succeeding.

REVIEW OF RELATED STUDIES

S.No.	Researchers	Findings
1	Ramesh and Subir (2021)	Self-efficacy in mathematics for higher secondary level students was statistically indifferent for boys and girls
2	Mario and Edfelmar (2021)	Student-Respondents have Moderate Mathematics Self-Efficacy in Mastery Experience, Vicarious Experience-Peers, Vicarious Experience-Adults, Social Persuasions, and Physiological State
3	Gorgun and Tican (2020)	Middle School Students' Mathematics Self-Efficacy Perceptions and Mathematics Problem Posing Attitudes are over the medium level.
4	Samuel and Leonard (2020), Ahuja (2016), Perez (2013)	Significant positive relationship between Mathematics Self-efficacy and achievement in Mathematics
5	Huang et. al (2019)	Direct effect on Mathematics Level implies Mathematics Self Efficacy.
6	Recher et. al (2018)	Female have low self-efficacy and high mathematics anxiety.
7	Emon (2018)	No significant difference in self-efficacy of higher secondary level pupils in relation to their gender and management type
8	Alves et. al (2015)	Gender shows no difference in perceived importance of mathematics anxiety towards mathematics and self-efficacy.
9	Schwery (2015)	Mathematics self-efficacy was a strong predictor of mathematics achievement.
10	Kvedere (2014)	Positive mathematics self-increases mathematics self-efficacy.
11	Thakur and Meena (2014)	High Self-Efficacy group boys and girls have high mathematics attitude and high creativity.
12	Kaur et. al (2013)	No significant interaction effect among instruction strategies, mathematics self-efficacy and mathematics Anxiety on achievement in mathematics.

Operational Definitions of the Key Terms

MATHEMATICS SELF-EFFICACY

In this Study, Mathematics Self-Efficacy was described as an individual's belief about their ability and capabilities to perform Mathematics-related tasks, to solve Specific Mathematics Problems or to succeed in Mathematics -related activities.

A person believes about his/her ability and capacity to accomplish a mathematical task.

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Need and Significance of the Study

Researchers had found that Self-Efficacy beliefs could significantly affect academic achievement in Mathematics. The lack of self-efficacy will not enable the learner to persist and complete the task within a specific time. On the other hand, if an individual had acquired a high level of self-efficacy belief, they would have motivated themselves to put in more effort, persisted longer and completed the task in his best timing. Mathematics is a subject very abstract in nature and the performance will be affected by his /her self- efficacy. A student with higher sense of self-efficacy will achieve better in mathematics.

Objective of the Study

To find out whether there is any significant difference in Mathematics Self-Efficacy of Higher Secondary School Students with respect to the following Demographic Variables:

- Gender
- Board of Affiliation
- Type of School
- School Management

Hypotheses of the Study

There is no significant difference in Mathematics Self-Efficacy of Higher Secondary School Students with respect to the following Demographic Variables:

- i) Gender
- ii) Board of Affiliation
- iii) Type of School
- iv) School Management

METHODOLOGY OF THE STUDY

The present study focuses on the Mathematics Self-Efficacy and Academic Achievement in Mathematics of the Higher Secondary School Students. Normative Survey method was used for the present study.

Sample of the Study

1050 Higher Secondary School students were selected randomly from Government, Government Aided and Private schools in Chennai.

Sampling Techniques Used

Simple Random Sampling technique was adopted to select the sample.

Tools Used for the Study

The following tools were used for the study.

- 1) **Personal Data Sheet** – developed by the investigator and the supervisor.
- 2) **Mathematics Self-Efficacy Scale (2021)** – developed and validated by the investigator and the supervisor. It is used to measure the level of Mathematics Self-Efficacy of the Students. It is a 5-point Likert scale consisting of 31 Items.

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Table 1 Description of Mathematics Self-Efficacy Scale

S. No.	Name of the Tool	Total No. of Items	Dimensions	No. of Items Factor-Wise	No. of Positive & Negative Items	Scoring
1	Mathematics Self-Efficacy Scale	31	Problem Solving	7 Items	<p>Positive Items 1,4,6,7,10,14, 15,17,21,23</p> <p>Negative Items 2,3,5,8,9,11, 12,13,16,18,19, 20,22,24,25,26, 27,28,29,30,31</p>	<p>For Positive Items Never - 1 Sometimes - 2 Rarely - 3 Often - 4 Always - 5</p> <p>For Negative Items Never - 5 Sometimes - 4 Rarely - 3 Often - 2 Always - 1</p>

Statistical Techniques Used

The data were analyzed with SPSS 22 for windows (v.10), using basic statistical measures of central tendency and relationship between variables. The following statistical techniques were adopted to analyze the pilot and final study data.

- Descriptive Analysis (Mean and Standard Deviation)
- Differential Analysis (t-value and F- ratio)

Data Analysis and Interpretation

Mathematics Self-Efficacy with respect to the Gender

The Mean, Standard Deviation and t-values were calculated for the Overall Mathematics Self-Efficacy and its five factors with respect to the Gender of the Students and the same is presented in Table 2.

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Table 2 Summary of Results of Mathematics Self-Efficacy with respect to the Gender

Factors of Mathematics Self-Efficacy	Boys		Girls		t-value	Sign. Level
	Mean	S.D.	Mean	S.D.		
Problem Solving	24.28	4.75	25.21	4.56	3.208	0.001
Confidence to attempt Exam	23.83	5.14	24.12	5.44	0.883	0.377
Students Engagement	16.07	4.19	17.09	4.44	3.773	0.000
Attitude towards Mathematics	22.03	6.27	22.98	6.27	2.424	0.016
Classroom Climate	15.73	4.12	16.60	4.49	3.281	0.001
Over all Mathematics Self-Efficacy	101.93	19.27	105.99	20.18	3.312	0.001

From Table 2, it can be observed that the Overall Mathematics Self-Efficacy score for Boys and Girls were 101.93 and 105.99 respectively.

The t-values calculated for the scores on the Overall Mathematics Self-Efficacy and its five factors with respect to the Gender of the Students revealed that the Boys and Girls differed significantly in the Overall Mathematics Self-Efficacy and in its four factors namely Problem Solving, Students Engagement, Attitude towards Mathematics and Classroom Climate. Girls had better Mathematics Self-Efficacy than Boys in Overall Mathematics Self-Efficacy and in all its factors.

Mathematics Self-Efficacy with respect to the Board

The Mean, Standard Deviation and t-values were calculated for the Overall Mathematics Self-Efficacy and its five factors with respect to the Board of Affiliation and the same is presented in Table 3.

Table 3 Summary of Results of Mathematics Self-Efficacy with respect to the Board

Factors of Mathematics Self-Efficacy	State Board		CBSE		t-value	Sign. Level
	Mean	S.D.	Mean	S.D.		
Problem Solving	24.13	4.55	25.77	4.66	5.67	0.000
Confidence to attempt Exam	22.91	5.07	25.54	5.27	8.08	0.000
Students Engagement	15.89	4.43	17.72	4.04	6.91	0.000
Attitude towards Mathematics	21.60	6.20	23.95	6.16	6.09	0.000
Classroom Climate	15.81	4.39	16.82	4.23	3.75	0.000
Over all Mathematics Self-Efficacy	100.33	18.84	109.78	20.03	7.72	0.000

From Table 3, it can be observed that the Overall Mathematics Self-Efficacy score for State Board and CBSE School Students were 100.33 and 109.78 respectively.

The t-values calculated for the scores on the Overall Mathematics Self-Efficacy and its five factors with respect to the Board of Affiliation revealed that the State Board and CBSE School Students differed significantly in the Overall Mathematics Self-Efficacy and in all its five factors. CBSE School Students had better Mathematics Self-Efficacy than State Board School Students in Overall Mathematics Self-Efficacy and in all its five factors.

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Mathematics Self-Efficacy with respect to the Type of School

The Mean, Standard Deviation and F-ratios were calculated for the Overall Mathematics Self-Efficacy and its five factors with respect to the Type of Schools and the same is presented in Table 4.

Table 4 Summary of Results of Mathematics Self-Efficacy with respect to the Type of School

Factors of Mathematics Self-Efficacy		Boys' (1)	Girls' (2)	Co. Education (3)	F-ratio	Sign. Level	Groups Differed																																																								
Problem Solving	M	23.49	24.59	25.22	9.365	0.000	(1,2)&(1,3)																																																								
	S.D.	4.15	4.51	4.78				Confidence to attempt Exam	M	22.80	23.42	24.52	8.758	0.000	(1,3)&(2,3)	S.D.	4.77	5.34	5.36	Students Engagement	M	14.96	16.23	17.23	19.425	0.000	(1,2),(1,3) & (2,3)	S.D.	4.06	4.57	4.23	Attitude towards Mathematics	M	20.19	21.75	23.48	21.009	0.000	(1,2),(1,3) & (2,3)	S.D.	5.90	6.29	6.18	Classroom Climate	M	15.16	15.82	16.64	8.920	0.000	(1,3)&(2,3)	S.D.	3.84	4.62	4.32	Overall Mathematics Self-Efficacy	M	96.61	101.81	107.09	21.016	0.000	(1,2),(1,3) & (2,3)
Confidence to attempt Exam	M	22.80	23.42	24.52	8.758	0.000	(1,3)&(2,3)																																																								
	S.D.	4.77	5.34	5.36				Students Engagement	M	14.96	16.23	17.23	19.425	0.000	(1,2),(1,3) & (2,3)	S.D.	4.06	4.57	4.23	Attitude towards Mathematics	M	20.19	21.75	23.48	21.009	0.000	(1,2),(1,3) & (2,3)	S.D.	5.90	6.29	6.18	Classroom Climate	M	15.16	15.82	16.64	8.920	0.000	(1,3)&(2,3)	S.D.	3.84	4.62	4.32	Overall Mathematics Self-Efficacy	M	96.61	101.81	107.09	21.016	0.000	(1,2),(1,3) & (2,3)	S.D.	15.64	19.90	20.22								
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	S.D.	4.06	4.57	4.23				Attitude towards Mathematics	M	20.19	21.75	23.48	21.009	0.000	(1,2),(1,3) & (2,3)	S.D.	5.90	6.29	6.18	Classroom Climate	M	15.16	15.82	16.64	8.920	0.000	(1,3)&(2,3)	S.D.	3.84	4.62	4.32	Overall Mathematics Self-Efficacy	M	96.61	101.81	107.09	21.016	0.000	(1,2),(1,3) & (2,3)	S.D.	15.64	19.90	20.22																				
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From Table 4, it can be observed that the Overall Mathematics Self-Efficacy score was high (107.09) for the students of Co-education schools and the same was low (96.61) for those in Boys' Schools.

The F-ratios calculated for the scores on the Overall Mathematics Self-Efficacy and its five factors with respect to Different Type of Schools revealed that the students belonging to Different Type of Schools differed significantly in Overall Mathematics Self-Efficacy and in its all five factors.

Further Analysis of difference between the individual groups tested through Tukey-HSD revealed that in Overall Mathematics Self-Efficacy and its factors, the Students of Boys' schools differed significantly from the students of Co-education schools. The Students of Co-education Schools had a better Mathematics Self-Efficacy than the students of Boys' schools in Overall Mathematics Self-Efficacy and in its all five factors.

Further the Students of Co-education Schools differed significantly from the students of Girls' schools in Overall Mathematics Self-Efficacy and in the factors namely Confidence to attempt Exam, Students Engagement, Attitude towards Mathematics and Classroom Climate. Co-education School Students had better Mathematics Self-Efficacy than the Girls' School Students.

Similarly, the Students of Boys' Schools differed significantly from the students of Girls' schools in Overall Mathematics Self-Efficacy and in the factors namely Problem Solving, Students Engagement and Attitude towards Mathematics. Girls' School Students had better

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Mathematics Self-Efficacy than the Boys' School Students. The Other groups did not differ significantly among themselves.

Mathematics Self-Efficacy with respect to School Management

The Mean, Standard Deviation and F-ratios were calculated for the Overall Mathematics Self-Efficacy and its five factors with respect to the Management of the Schools and the same is presented in Table 5.

Table 5 Summary of Results of Mathematics Self-Efficacy with respect to the School Management

Factors of Mathematics Self-Efficacy		Govt. (1)	Aided (2)	Private (3)	F-ratio	Sign. Level	Groups Differed
Problem Solving	M	23.78	24.28	25.46	12.708	0.000	(1,3)&(2,3)
	S.D.	4.43	4.32	4.82			
Confidence to attempt Exam	M	22.86	23.10	24.87	16.888	0.000	(1,3)&(2,3)
	S.D.	4.66	5.14	5.48			
Students Engagement	M	15.85	15.60	17.47	22.225	0.000	(1,3)&(2,3)
	S.D.	4.30	4.27	4.28			
Attitude towards Mathematics	M	21.32	21.19	23.72	20.837	0.000	(1,3)&(2,3)
	S.D.	5.84	6.17	6.29			
Classroom Climate	M	15.73	15.41	16.81	11.433	0.000	(1,3)&(2,3)
	S.D.	4.47	4.19	4.30			
Overall Mathematics Self-Efficacy	M	99.54	99.58	108.32	26.523	0.000	(1,3)&(2,3)
	S.D.	17.92	17.98	20.61			

From Table 5, it can be understood that the Overall Mathematics Self-Efficacy score was high (108.32) for the students belonging to Private Schools and the same was low (99.54) for those belonging to Government Schools.

The F-ratios calculated for the scores on the Overall Mathematics Self-Efficacy and its five factors with respect to School Management revealed that the students belonging to different Management of the Schools differed significantly in Overall Mathematics Self-Efficacy and in its all five factors.

Further Analysis of differences between the individual groups tested through Tukey-HSD revealed that the Overall Mathematics Self-Efficacy and its factors, the students belonging to the Private Schools differed significantly from those of Government and Government Aided Schools, where they had better Mathematics Self-Efficacy than the students of Government and Government Aided Schools. The Other groups did not differ significantly among themselves.

Delimitations

1. The population of the study was confined to Higher Secondary School Students only.
2. Due to time constrain the study was limited to 1050 samples only.
3. The Study was confined to only 42 schools in the Chennai District.
4. The Study was delimited to Government, Government-Aided, and Private Schools only.

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CONCLUSION

The present study reveals that there was a significant difference in Mathematics Self-Efficacy on Academic Achievement in Mathematics with respect to Gender, Board of Affiliation, Type of the School and Management of the School. Results also show that Mathematics Self-Efficacy was a Significant Predictor of Academic Achievement in Mathematics of Higher Secondary School Students. The Students need to be encouraged to develop their Mathematics Self-Efficacy as they have a role in keeping the Mathematics Marks in check.

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Acknowledgment

The author(s) appreciates all those who participated in the study and helped to facilitate the research process.

Conflict of Interest

The author(s) declared no conflict of interest.

How to cite this article: Nandhini, M. (2025). Mathematics Self-Efficacy as a Predictor of Academic Achievement in Mathematics of Higher Secondary School Students. *International Journal of Indian Psychology*, 13(1), 1022-1030. DIP:18.01.097.20251301, DOI:10.25215/1301.097