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Gender-based Study of Motivation for Learning Mathematics among Secondary School Students

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KEYWORDS Amotivation. Extrinsic. Influence. Intrinsic

ABSTRACT There is a gender gap in mathematics among high school pupils that did not exist previously. The belief that girls dislike mathematics and are not as proficient at it as boys persists. Is it true that girls do not like mathematics and are not as good at it as boys? This survey study looked at gender disparities in secondary school students' motivation for learning mathematics. It considered the dimensions of intrinsic and extrinsic motivations, and amotivation in a sample of 158 secondary school students from the Kollam district. The findings show that among secondary school pupils, the reason for learning mathematics does not differ considerably by gender except for extrinsic motivation.

INTRODUCTION

Students learn the foundations of fundamental mathematics from a very young age because mathematics is a required school subject. Various elements influence learning, both inner and outer influences. Self-efficacy, motivation, curiosity, and attitude all are major predictors of mathematical achievement in many researches (Butler 2016). One of the inherent variables that serve as a drive and stimulant for effort and performance is motivation, described as the active driving force for goal-oriented behaviour (Fuqoha et al. 2018). Although mathematics is an integral part of the educational curriculum, students lack the interest, attitude, and drive to master its and only a small percentage of pupils develop a genuine desire to understand mathematics. At the same time, as students progress through school from primary to secondary level, their motivation, enthusiasm, and expectations of ability in mathematics decrease (Gottfried et al. 2001; Fredricks and Eccles 2002). A positive learning incentive will yield positive effects in learning a complex subject like mathematics. Motivated students are more likely to put more effort into acquiring the content, demonstrate perseverance in facing obstacles, and achieve higher levels of success. Improved understanding of concepts and processes, attainment and satisfaction in academics, social adjustment, self-esteem, and school completion rates, and many other constructs has been connected to higher motivation to learn. The key to improving student achievement is to find an effective method of motivating students, and one of the essential aspects that require immediate attention is motivation (Fuqoha et al. 2018).

Various psychologists have examined motivation in multiple ways, which resulted in a diversity of motivation theories. Among the many perspectives of motivation in the present study, the Self-Determination Theory of Motivation put forward by Deci and Ryan tries to spell out people's goal-directed behaviour in a continuum with varying degrees of autonomy of an individual (Ryan and Deci 2000). The theory of self-determination (SDT) offers a structured conceptual framework that seeks to explain human behaviour by studying human motivation. It explores three factors of motivation, that is, intrinsic and extrinsic motivation and amotivation. An individual performs tasks or operations with intrinsic motivation mainly because doing so would produce pleasure or fun. In contrast, extrinsic motivation is doing something purely for fear of punishment or a kind of reward or gain upon completion. Intrinsic motivation has a more significant influence on students than extrinsic motivation when challenged with intellectual tasks. Amotivation refers to the lack of self-efficacy to engage in an activity. It is a failure to appreciate anything. It results from the absence of a contingency between one's actions and results. The researcher studied sources of motivation in this

article by collecting data using the Mathematics Motivation Inventory prepared by the investigator based on the Self-Determination Theory of Motivation.

Students' motivation for mathematics education will differ significantly depending on their experiences and gender norms in the family, educational institutions, and community, contributing to gender discrepancies. Gender disparities in maths and science are a national problem because they are issues of academic inequality with far-reaching outcome for women. With the world's economy becoming increasingly reliant on science and technology, gender disparities in mathematics may hurt women's employment and economic chances.

A myth remains that students do not like mathematics, and are less motivated to learn mathematics, which varies with gender. Is this popular view a poor reflection of fact, or does a real lack of motivation in learning mathematics exist among students? Does gender influence students' motivation in learning mathematics? A number of studies have been undertaken to investigate various fields, to study gender inequalities in students' motivation in learning, especially mathematics, which gives varied results. The findings of a study examining gender differences in students' attitudes towards mathematics support prior studies indicating that girls have fewer positive attitudes toward mathematics than their male classmates, with lower motivation, poorer perceptions of ability, and higher rates of anxiety, but the impact sizes were small in all situations (Rodríguez et al. 2020). Among high school pupils, gender disparities in motivation to learn mathematics have been discovered, which did not exist previously (Gallagher and Kaufman 2004). The apparent performance disparity favours boys compared to girls on many academic tasks in related subjects, wherein mathematics has gotten much attention. The findings support prior studies indicating girls have a lesser positive attitude toward mathematics than boys, with poorer motivation, a lower feeling of ability, and higher rates of anxiety. However, the impact sizes were small in all situations. Boys have high talents and interest in mathematics and science, but girls have self-confidence and inclination in the arts and language writing (Halpern 2000). This impacts their desire to learn mathematics. Butler (2014) points out that girls outperformed boys in mathematics despite having lower perceived mathematical skills than boys. The issue of gender stereotyping in student motivation for mathematics and statistics warrants further research. The topic of determining the impact of gender on student motivation and students' requirements for competence, relatedness, and autonomy needs further exploration to contribute to the growing body of knowledge in mathematics motivation (Arthur et al. 2017). Boys' arithmetic ability is considered higher than girls' in elementary and high schools. The stereotype that girls dislike mathematics persists. Is it true that girls do not like mathematics? Based on this background, this paper aims to learn about students' motivation in learning mathematics based on gender.

Problem Statement

Even in a state with a high literacy rate and minor gender gaps like Kerala in India, mathematics achievement remains low compared to other subjects. In addition, the researchers discover that boys prefer mathematics or related courses in higher education, whereas girls do not. Student achievement in schools and entrance exams reflect gender inequalities. It is not easy to understand gender differences because the size and direction of disagreements vary with age, material, measurement, and context (Hyde et al. 1990). This research investigates gender disparities in students' motivation to learn mathematics at secondary school level.

Definition of Key Terms

Gender-based Study*:* Gender differences vary between boys and girls based on biological adaptations and socio-cultural factors. A gender-based study here refers to the gender variations in motivation for learning mathematics.

Motivation in Learning Mathematics*:* Motivation is a set of skills that allows a person to learn and do things connected to learning mathematics in various settings.

Secondary School Students*:* Secondary school students in the study refer to students between the ages of 12 and 16 who are enrolled in Kerala schools and are studying at the secondary level.

Objectives

The objectives of the study are

1. To find out the relationship between gender and the variables of:

a. Intrinsic motivation for learning mathematics
b. Extrinsic motivation for learning mathematics

c. Amotivation for learning mathematics
d. Motivation for learning mathematics of secondary school students
2. To compare boys and girls with regard to the motivation of secondary school students for:
a. Intrinsic motivation for learning mathematics
b. Extrinsic motivation for learning mathematics
c. Amotivation for learning mathematics
d. Motivation for learning mathematics

Hypotheses

The hypotheses of the study are
H_1: There exists no significant relationship between gender and the variables of:
a. Intrinsic motivation for learning mathematics
b. Extrinsic motivation for learning mathematics
c. Amotivation for learning mathematics
d. Motivation for learning mathematics of secondary school students
H_2: There exists no significant difference between boys and girls for the variables of:
a. Intrinsic motivation for learning mathematics
b. Extrinsic motivation for learning mathematics
c. Amotivation for learning mathematics
d. Motivation for learning mathematics in secondary school students.

Review of Literature

Liou et al. (2021) considered whether motivational attitudes of students about science learning differed significantly between grade levels and genders (that is, self-concept and intrinsic worth of science). Boys' science motivating views were considerably more significant than girls' motivational beliefs in science for both grades. According to the findings of independent samples t-tests, the differences in mean scores between male and females increased from grade 4 to grade 8. The study's findings reveal disparities in motivational ideas about learning science by grade level and gender, as well as their links to science achievement.

Rodríguez et al. (2020) found in a study that girls have fewer positive views toward mathematics than boys, with poorer motivations, lower perception of ability, and higher anxiety rates, but the effect sizes were small in all situations. Attitudes toward mathematics had a significantly greater explanatory power in boys than in girls.

The investigation by Awofala et al. (2020) revealed mixed results regarding gender differences in motivation to learn mathematics. Female students outperformed male students on extrinsic motivation, self-determination, assessment anxiety, and self-efficacy, while male students outperformed female students on intrinsic motivation and goal orientation. However, there were no statistically significant variations in mean ratings between male and female students on motivation to learn mathematics. The relationships found between gender and motivational factors were also not statistically significant.

The study by Huang et al. (2018) assessed a suggested model consisting of mathematics anxiety and self-efficacy, and theories of intelligence that forecast scientific and mathematics career interest among middle school children. The findings indicated both parallels and variances in the gendered relationships between the desired variables. Mediated by mathematics self-efficacy was the relationship between implicit ideas of intelligence and science and mathematics career interest among boys. Girls' fear of mathematics directly impacts their desire to pursue a profession in mathematics. Deringöl (2018) aimed to assess the cause and stress of children in the third and fourth grades in primary schools in Istanbul province. The researcher found no gender differences in students' mathematics motivation, which was found to be medium, and their mathematics fears were very low. Fourth-grade students' reason for mathematics was more potent than that of third-graders.

Guo et al. (2015) investigated the relationships between motivation in learning mathematics (considering academic self-concept and task values) and background characteristics of pupils in predicting analysed educational success. The findings suggested that, firstly, lower utility students' self-concept is more critical in predicting educational outcomes, while all students irrespective of gender had same levels of mathematics self-concept and utility values. Also, females had higher achievement and educational ambitions in mathematics, and boys' socio-economic status of family is linked more firmly to educational ambitions.

Sartawi et al. (2012) investigated how much self-efficacy and motivation may predict mathematics achievement in fifth-grade pupils in the United Arab Emirates (UAE), regardless of gender or achievement level. Self-efficacy was measured using two

scales, namely, Category Specific and Task-Specific, which differed in their levels of specificity. Amotivation, External Regulation, Introjected Regulation, and Intrinsic Motivation were the four subconstructs of motivation studied. The six predictors explained a large thirty-two percent of the variance in mathematics achievement in the multiple regression model. Task-Specific, External Regulation, and Intrinsic Regulation were the strongest three predictors. The regression model run across gender, and showed that the six variables explained thirty percent of the variance in mathematics achievement for the male group but only twenty-one percent for the female group.

The review article by Meece et al. (2006) authenticated that girls' and boys' motivation-related attitudes and behaviours continue to follow gender differences across all theories. Boys have greater confidence and interest in mathematics and physics, whereas girls have more confidence and interest in language arts and writing. Ability, ethnicity, financial position, and classroom context are all factors that moderate gender impacts.

The study by Halat (2006) looked into the basis of sixth-grade kids taking geometry classes. The researcher used a questionnaire to determine sixth-grade pupils' motivation for learning. Gender was not a factor in motivation for studying geometry, according to the study, because there was no statistically significant difference in motivation between boys and girls.

Prior studies reveal mixed results regarding gender differences in motivation for learning Mathematics and Science subjects. However, considering the socio-economic development of modern society, gender disparities have reduced to a certain extent in many aspects. In a country like India, it is complicated to confirm the non-existence of gender differences among students without proper investigation. Hence it becomes necessary to probe deeply into the problem and find if there is a significant difference between boys and girls in their motivation levels for learning. It is more critical for a subject like Mathematics, where the general belief is that boys are more motivated in learning Mathematics. It is also essential to adopt measures to remove gender discrepancies in motivation to learn mathematics, as mathematics is the basis for acquiring scientific knowledge. Gender differences, especially in favour of boys having greater motivation, can cause girls to lag in their learning of Mathematics. Because motivation is the driving force to study more, a drop in motivation could significantly affect pupils' low mathematical success (Rao 2000). So, it becomes essential to find if gender difference exists concerning students' motivation in learning Mathematics. Hence it is significant to undertake such research.

MATERIAL AND METHODS

Method

A survey is the method when the goal of a study is to get a particular or general image of the group under inquiry in various aspects. The study adopts a normative survey because it aims to determine the current state of secondary school students' motivation to learn mathematics.

Variables

Independent Variable

The independent variable is that whose value is unaffected by other factors in the study. In the present study, the categorical variable is gender, which is dichotomous, as boys and girls are the independent variables.

Dependent Variable

The changes in the independent variable determine the value of the dependent variable. In the present study, motivation in learning mathematics is a continuous variable, and is a dependent variable.

Population

The population is the entire group of people of interest to the researcher. It is from this group that the researcher concludes. The target population in this survey study includes all secondary school students in Kerala following the state curriculum.

Sample

A sample is a sub-group of the population selected by the investigator for data collection. The present sample included 158 secondary school students comprising 55 boys and 103 girls from two schools in Kerala's Kollam district.

Tools Used

A measuring device in a Likert form of a 5-point rating scale, standardised by the investigator the Mathematics Motivation Inventory (MMI), was the tool employed in the study. It consisted of three sub-scales of Intrinsic Motivation, Extrinsic Motivation, and Amotivation. The tool was validated by experts and its reliability was established as 0.91.

Statistical Techniques Adopted

i. Point Biserial Correlation
ii. t-test

RESULTS

After administering and collecting data, the tool was scored and analysed. First, the researcher did a preliminary analysis by calculating the Mean and Standard Deviation of motivation in learning mathematics. The details are given in Table 1.

Table 1: Group statistics mean and standard deviation

Variable	*Groups*	*N*	*Mean*	*SD*
Intrinsic Motivation	Boys	55	63.16	10.65
	Girls	103	60.89	12.27
Extrinsic Motivation	Boys	55	69.95	12.34
	Girls	103	65.96	11.61
Amotivation	Boys	55	25.29	7.11
	Girls	103	25.42	6.72
Motivation in Learning Mathematics	Boys	55	158.40	26.89
	Girls	103	152.27	26.89

Source: Author

Relationship Between Gender and Motivation in Learning Mathematics

The strength of the relationship and its direction between a dichotomous variable and a continuous variable is measured using point biserial correlation. The investigator ran a point-biserial correlation to determine the relationship between motivation for learning mathematics and the gender of secondary school students. This relationship used the Point Biserial correlation coefficient, as gender is a dichotomous variable and motivation in learning mathematics is a continuous variable. Table 2 gives the details of the Point Biserial Correlation calculated.

Table 2: Results of Point Biserial correlation between gender and motivation in learning mathematics

Continuous variable value	*df*	r_{pb}	*p*
Intrinsic motivation	156	0.09	p =0.25
Extrinsic motivation	156	0.16*	p <0.05
Amotivation	156	0.01	p =0.91
Motivation in bearning mathematics	156	0.11	p =0.17

* *Significant at 0.05 level*

From Table 2, it is evident that all values of Point Biserial correlations are very low correlations. There is a low correlation between intrinsic motivation and gender, which was not statistically significant (rpb = 0.09, n = 156, p = 0.25). There was a low correlation between extrinsic motivation and gender, which is statistically significant (rpb = 0.16, n = 156, p < 0.05). There was a low correlation between amotivation and gender, which is not statistically significant (rpb = 0.01, n = 156, p = 0.91). There was a low correlation between motivation for learning mathematics and gender, which is not statistically significant (rpb = 0.11, n = 156, p = 0.17). It concludes that there is only a negligible relationship between motivation for learning mathematics and gender among secondary school students.

Gender Difference of Motivation in Learning Mathematics

The investigator conducted an Independent Sample t-test to determine whether there is a significant difference between boys and girls in the motivation for learning mathematics. The significant difference t-test of means for the variables intrinsic motivation, extrinsic motivation, amotivation, and motivation for learning mathematics was conducted. Table 3 details the test results.

Table 3 reveals that the mean score of motivation for learning mathematics is more for boys when compared to girls for all the variables namely intrinsic motivation, extrinsic motivation, amotivation and motivation to learn mathematics. There is no significant effect for gender at 0.05 level of

Table 3: Results of t-test between boys and girls for the variable motivation in learning mathematics

Variables	*Groups*	*N*	*Mean*	*SD*	*df*	*t value*	*p value*
Intrinsic Motivation	Boys	55	63.16	10.65	156	1.16	p=0.25
	Girls	103	60.89	12.27			
Extrinsic Motivation	Boys	55	69.95	12.34	156	2.01*	p<0.05
	Girls	103	65.96	11.61			
Amotivation	Boys	55	25.29	7.11	156	0.11	p=0.91
	Girls	103	25.42	6.72			
Motivation for Learning Mathematics	Boys	55	158.40	26.89	156	1.37	p=0.17
	Girls	103	152.27	26.89			

* *Significant at 0.05 level*

significance (t(156) = 1.16, $p = 0.25$) on intrinsic motivation of students to learn mathematics, despite boys (M = 63.16, SD = 10.65) attaining higher scores than girls (M = 60.89, SD = 12.27). The mean and standard deviation of extrinsic motivation of students to learn mathematics for boys is M = 69.95, SD = 12.34 and for girls is M = 65.96, SD = 11.61 and they significantly differ at 0.05 level of significance (t(156) = 2.01, $p < 0.05$). The 55 boys' (M = 25.29, SD = 7.11) amotivation compared to the 103 girls (M = 25.42, SD = 6.72) demonstrated no significant difference between each other (t(156) = 0.11, $p = 0.91$). On comparing the total motivation score of boys (M = 158.40, SD = 26.89) and girls (M = 152.27, SD = 26.89) in learning mathematics it is found there is no significant difference between the two groups (t(156) = 1.37, $p = 0.17$). This means that there is no significant difference between boys and girls in their intrinsic motivation, amotivation and motivation for learning mathematics except for extrinsic motivation.

DISCUSSION

The main findings derived from the analysis and interpretation of the data collected is that gender does not influence the motivation to learn mathematics among secondary school students. The following results of the research endorse significant conclusions.

- The relationship between gender and intrinsic motivation for learning mathematics is negligible and not significant at 0.05 level of significance.
- The relationship between gender and amotivation is negligible and not significant at 0.05 level of significance.
- The relationship between gender and motivation for learning mathematics is negligible and not significant at 0.05 level of significance.
- The relationship between gender and extrinsic motivation for learning mathematics is negligible and significant at 0.05 level of significance.
- There is no significant difference between boys and girls for the variable intrinsic motivation for learning mathematics at 0.05 level of significance.
- There is no significant difference between boys and girls for the variable amotivation for learning mathematics at 0.05 level of significance.
- There is no significant difference between boys and girls for the variable motivation for learning mathematics at 0.05 level of significance.
- There is a significant difference between boys and girls for the variable extrinsic motivation for learning mathematics at 0.05 level of significance.

The value of point biserial correlation between gender and intrinsic motivation, amotivation, and motivation for learning mathematics is negligible and not significant at 0.05 level of significance. The relationship between gender and extrinsic motivation for learning mathematics is negligible and significant at 0.05 level of significance. Hence, hypothesis H_1 is partially accepted. The independent sample t-test reveals that motivation to learn mathematics does not differ significantly with gender and the difference is very small, and also, there is no significant difference between boys and girls, with an exception for extrinsic motivation. Hence, hypothesis H_2 is partially accepted.

The present study finds that students' motivation to learn mathematics does not depend on gender, consistent with the study by Arthur et al. (2017).

Some studies contradict this, wherein girls find mathematics more difficult and lack confidence and motivation than boys. According to prior studies, girls report lower levels of individual engagement and perceived mathematics competence (Rodríguez et al. 2020; Guo et al. 2015; Ganley and Lubienski 2016; Else-Quest et al. 2010; Frenzel et al. 2010). Many studies found a strong link between motivation and learning, but only minor, domain-specific gender variations in learning motivation (Parker 2007). According to Kissau (2006), age or grade is related to gender differences in school motivation, and the differences can vary depending on the motivating component evaluated. Depending on the issue, they discovered that young boys enjoy and excel at mathematics and sports, whereas young girls have higher ability beliefs in music and writing than boys.

This research reveals that both boys and girls are intrinsically motivated to learn mathematics. Students of any gender seek pleasure in learning mathematics and are very satisfied with it. This result is contradictory that the males' motivational pattern was more favourable than the girls' perceived competence and intrinsic enthusiasm for mathematics (Guo et al. 2015; Ganley and Lubienski 2016). Gender difference is found in their extrinsic motivation with boys being more extrinsically motivated to learn mathematics. Boys learn mathematics due to outside factors like rewards and feedback and not by self-driven force, as their extrinsic motivation profile is more significant than girls. It is in line with the research, which shows that boys are more extrinsically motivated than girls. Gender differences in mathematics self-concept, self-efficacy, and curiosity have been validated in research, even in primary school, implying that boys have more vital motivational profiles in mathematics than girls (Kurtz-Costes et al. 2008).

CONCLUSION

The investigation of gender variations in mathematics motivation throughout the early levels of education is of particular interest. In this way, the full potential of students could be realised, and measures are adopted to remove any imbalance in the motivation of students to learn mathematics, a foundation stone for many courses of future study. The psychometric features of motivation to study mathematics should be investigated in future studies. Emotional management, particularly anxiety management, may be critical for improving maths motivation of students. This can result in a better gender balance in future courses, identified as a vital filter for highly qualified and well-paid professions.

RECOMMENDATIONS

The study reveals that boys are more extrinsically motivated than girls, which means teachers can adopt many intervention strategies to motivate them to learn mathematics. Regardless of learning objectives, improving student motivation is a top priority for meaningful educational change. So the prime aim should be the discovery and development of instruction methodologies and intervention programmes to enhance the motivation of both boys and girls, connected with the mathematics learning process. It is challenging to measure the influence of gender on motivation for learning mathematics, as many other factors contribute to it. So, it is recommended to explore more factors contributing to the interactions between gender and motivation for learning mathematics. This research could serve as a foundation for future research on the impact of gender on other dimensions of motivational aspects of secondary school students in learning mathematics in Kerala.

LIMITATIONS

The study's outcomes show that gender does not influence mathematics motivation, which supports some studies' findings but contradicts others' conclusions. As a result, further research needs to determine the impact of gender on motivation to learn mathematics, with larger samples from various learning environments. Multiple elements influence secondary school pupils' motivation to learn mathematics, and these factors can differ depending on gender. As a result, more research on the impact of gender on motivation and other aspects of learning is essential. The present study reveals considerable minimisation of gender prejudice and gaps in today's educational system. So, suppose there are gender variations in motivation for studying mathematics. In that case, it is critical to investigate the reasons for these discrepancies and devise tools and strategies to address them. Gender disparities in education, in the learning of any topic, must be avoided at all costs, especially in the study of science and mathematics, which are topics that form the bedrock of any nation's progress.

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