Perceptions of Self-Efficacy and Anxiety in Mathematics: A Study of Secondary School Students in Pakistan

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ARTICLE INFO	ABSTRACT
	The relationship between students' self-efficacy in mathematics and their anxiety is a critical area of research, as it has significant implications for educational outcomes and student well-being. This study aimed to investigate the correlation between mathematics self-efficacy and anxiety among secondary school students. A correlational research design was employed, with the target population consisting of all male and female students enrolled in public and private schools in the Khanewal district. A stratified random sampling technique was used to select a sample of 1,386 students. Data were collected using a questionnaire that included two scales: the Mathematics Self-Efficacy Scale and the Anxiety Scale. Out of the 1,386 distributed questionnaires, 1,072 were returned, resulting in a response rate of 77%. The data were analyzed using descriptive statistics and Pearson's correlation method. Descriptive analyses revealed that students generally perceived their mathematics self-efficacy positively, while they reported higher levels of mathematics anxiety. Pearson's correlation analysis (two-tailed) indicated a weak negative relationship between mathematics self-efficacy and mathematics anxiety. These findings suggest that enhancing students' mathematics self-efficacy may lead to a reduction in their mathematics anxiety.

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1.   Introduction

With the rapid technological progression, mathematics has become increasingly essential in both daily and professional life (Anderson, 2022; Smith, 2023). It is not only critical for academic achievement but also plays a vital role in enhancing problem-solving skills and logical reasoning, which are indispensable for various life situations (Brown, 2021). The standards of excellence in our social and personal lives are closely linked to our proficiency in mathematics, underscoring the importance of mathematical literacy for overall success (Garcia, 2023). Despite its significance in nearly every aspect of life, a substantial number of individuals struggle to attain a sufficient understanding of mathematics due to various factors, including anxiety, lack of motivation, and inadequate teaching methods (Khan, 2020; Williams, 2024). Previous literature Igcasama, Amante, Benigay, Mabanag, Monilar, and Kilag (2023); Ompad Jr, Kilag, Luzares, Tipontipon, dela Cruz, and Velasquez (2024) supports the notion that students' math self-efficacy significantly influences their learning outcomes. For instance, a meta-analysis by Ompad Jr et al. (2024) identified a consistent positive correlation between students' self-efficacy beliefs in mathematics and their academic performance, indicating that higher self-efficacy is associated with better learning experiences and outcomes. Similarly, Igcasama et al. (2023) found that students with strong self-efficacy in mathematics were more confident in their ability to succeed, even when faced with challenges and setbacks. These findings highlight the critical role of self-efficacy in fostering resilience and academic success in mathematics. Likewise, pupils' poor self-

efficacy contributes to their failure to external events and circumstances disregarding their inherent qualities and talents. They do not take on any difficult assignments. As a result, when given a task, they are unable to finish it quickly and effectively, thus they procrastinate till giving up. They don't persevere in the face of adversity and show little dedication to any objectives (Hayat, Shateri, Amini, & Shokrpour, 2020). Students' self-efficacy for mathematics is accelerated by their self-assurance and self-evaluation of math-related tasks. Because of their trust in their mathematical abilities, individuals, therefore, think that they can solve any math problem they come across or get stuck on (Yildiz & Özdemir, 2019). Under the aforementioned sources or causes of efficacy, the cycle of success is completed and the technique of interpreting and judging achieved and desired results is referred to as mastery experiences, which offers a learner a sense of performance completion. These experiences help students evaluate their own performance and set goals in light of these interpretations, and if they do so incorrectly, they may feel inferiority complexes due to their lack of skills. It makes people depressed, adds to their bad mood, and makes them feel like failures. At this point, encouraging words from their parents and teachers give them self-efficacy (Doménech-Betoret, Abellán-Roselló, & Gómez-Artiga, 2017).

As regards Mathematics anxiety, Annisa and Ifdil (2016) declare that it is an uncomfortable feeling resulting from an individual's unbalanced emotive conditions which might involve worry, fear, panic, anxiety, etc. An unwanted task might lead any individual to such type of conditions or feelings (Annisa & Ifdil, 2016). One causing factor for student Mathematics anxiety in view of Gafoor and Kurukkan (2015) may be students' self-perception that it is very difficult to learn or solve mathematical problems. The fact that math related anxieties directly impact the students' promptness in learning mathematics (Ayyala, Taylor, & Callahan, 2020; Guita & Tan, 2018) increases the significance of the problem under study. Likewise, many other previous scholars (i.e., (Huang, Zhang, & Hudson, 2019; Lewis, 2020) also found that extent of students' anxiety in math learning have profound negative impact on students' learning motivation, students' positive attitudes towards mathematics, their academic performance and decision making abilities. Regarding students' perception of Math difficulty, several previous studies suggested that teachers' should mainly focus on provision of mathematical sense-making to students' as well as maintaining discipline (Li & Schoenfeld, 2019) instead of teaching math contents and practices (i.e., (Fritz, Haase, & Rasanen, 2019). Highlighting the issue of Mathematics anxiety Fan, Hambleton, and Zhang (2019) proclaimed that higher levels of math anxiety have negative association with students' achievement and more anxious students found to be performed poorly in mathematics. In addition, McMullan, Jones, and Lea (2012) found that mathematics anxiety also negatively affects other achievement related variables as students' self-efficacy and their learning behavior. Writing in the same vein, Paechter, Macher, Martskvishvili, Wimmer, and Papousek (2017) analyzed psychology students' perception of mathematics anxiety and found negative links between students' stat-math anxiety and their learning behavior.

The feelings of anxiety appear when someone feels himself/herself in predominantly frightening mental state. Students' feel anxious about learning mathematics because of their understanding that math contents, especially at the beginning of the class, are inappropriate,. This negative perception of students about math contents lead students' towards difficulty in understanding math contents as well as difficulty in putting proper focus on math learning. This unfocused students' behavior, in view of Putri, Muqodas, Wahyudy, and Nuraeni (2020) is one of the major causes of mathematical anxiety along with various other hindrances experienced by math students (Afrianti & Prabawanto, 2020). Resultantly, mathematical anxiety potentially put negative influence on student level of self-esteem and their academic performance (Cropp, 2017). The same is applied to secondary school students. The anxiety level of secondary school students regarding math learning might be higher based on their earlier experience in lower grades about this subject (Suarjana, Nanci Riastini, & Yudha Pustika, 2017). Writing in the same vein, Shishigu (2018) declared that Mathematical anxiety might affect not only students' academic performance but also their daily routines and even anxiety contributes in worsening students' feelings of stress. Shishigu (2018) further emphasized that continuity of this condition might eventually generate various academic and psychological issues. Mathematics anxiety found to have drastic impacts especially on students in early classes and grades and extremely affect students' working memories (Aosi, Metrianis, & Rifma, 2019). Similarly, this issue of anxiety that adolescents face while learning math might negatively affect their achievement in math as well

as their future job prospects. Zhou et al. (2020) also supported this view and proclaimed that students' with higher level of mathematical anxiety performed poorly in maintaining relationships with their teachers, being self-efficacious and in their ability to solve mathematical problems. Additionally,Alves, Rodrigues, Rocha, and Coutinho (2016) also asserted that math anxiety impedes students' academic achievement with severe negative consequences. Alves et al. (2016) further highlighted that students with mathematics anxiety, usually, hesitate in getting admission in math related courses. They also avoid to attend such courses which involve major mathematical component and such attitude towards math courses, consequently, affect students' future career opportunities (Alves et al., 2016). Furthermore, Ramirez, Chang, Maloney, Levine, and Beilock (2016) also found negative association between these two variable i.e., math anxiety and achievement. They further claimed that mathematical anxiety, generally, leads students especially at secondary school level, towards math avoidance attitude and this attitude might influence students' problem solving ability negatively.

Review of literature puts forward that empirical evidence analyzing the relationship between students' mathematics self-efficacy and anxiety is still rare particularly in the Pakistani context. For example, according to Mohamed and Yunus (2017), students benefit greatly from higher levels of self-efficacy since it gives them the confidence they need to succeed in their line of work and accomplish tasks. They have an optimistic outlook and are confident in their skills to complete any assignment because they have high levels of self-efficacy. Their self-efficacy beliefs drive them to become adept planners for the successful achievement of their goal, regardless of how difficult it is and whether there are any unfavorable circumstances ahead. They exceed expectations in a creative and original way (Ahmad & Safaria, 2013). The impetus for this study arises from the pivotal role that mathematics occupies within both educational and professional realms, alongside the mounting concerns regarding students' performance and engagement in mathematics, particularly in developing nations such as Pakistan. Mathematics self-efficacy— defined as a student's confidence in their capability to successfully execute mathematical tasks— has been consistently identified as a crucial determinant of academic achievement and persistence in the subject (Bandura, 1997; Pajares & Miller, 1995). In contrast, mathematics anxiety, characterized by apprehension and fear that hinder mathematical performance, is a well-established obstacle to effective learning and achievement in mathematics (Ashcraft & Krause, 2007). The intersection of these two constructs—self-efficacy and anxiety—holds significant implications for students' educational trajectories. However, this nexus remains underexplored within the context of secondary education in Pakistan. Given the critical influence of these factors on student outcomes, it is imperative to investigate the relationship between mathematics self-efficacy and anxiety to inform interventions aimed at enhancing students' mathematical performance and overall academic success. This study, therefore, aims to address this research gap by exploring the perceptions of mathematics self-efficacy and anxiety among Pakistani secondary school students and examining the interplay between these constructs.

2. The Current Study

The central objective of this study was to examine the intricate relationship between mathematics self-efficacy and mathematics anxiety among secondary school students in Pakistan. Specifically, the study sought to explore how students' perceptions of their mathematical abilities—referred to as mathematics self-efficacy—are associated with their experiences of anxiety when engaging with mathematical tasks. By delving into students' beliefs about their competence in mathematics, this research aimed to elucidate the extent to which these perceptions influence their anxiety levels and, consequently, their overall performance and engagement in the subject. The investigation was structured around the following research questions, which guided the inquiry into the dynamic interplay between self-efficacy and anxiety within the educational context of Pakistan:

1. What are secondary school students' perceptions of their mathematics self-efficacy?
2. How do secondary school students perceive their mathematics anxiety?
3. is there any relationship between secondary school students' perceived mathematics self-efficacy score and their perceived levels of mathematics anxiety?

3. Material and Methods
3.1. Research Design and Participants

Co-relational research design was used in this study. All the 22140 (male and female students) enrolled in public schools along with 4201 (male and female students) in privately-

managed schools of district Khanewal served as the population for this study. Sample for this study (1386 students) was selected using stratified sampling technique. The Krejcie and Morgan (1970) formula determined the study sample. Out of 1386 sample students 742 (372 male and 370 female) were from public schools and 644 students (323 male and 321 female) were studying in private schools of district Khanewal.

3.2. Instrumentation and Data Collection

This study used one questionnaire to collect data comprising i.e., demographic section and a questionnaire to assess students' perceived level of self-efficacy in Math as well as their perceived level of Math anxiety (MSEAQ). Original, designer and developer of this questionnaire May (2009) who designed MSEAQ to measure secondary school students' perceived level of self-efficacy and anxiety in learning mathematics. This questionnaire i.e., MSEAQ assesses each of the two constructs as a sub-scale of the questionnaire. Mathematics self-efficacy refers to an individual's confidence about completing a variety of mathematical tasks such as understand concepts and solve mathematical problems and generally, it is linked with students' motivation. As regards Mathematics anxiety, it is related to students' feeling tense or anxious when solving mathematical problems and working with numbers. The MSEAQ comprised 29-item with 02 subscales/categories i.e., mathematics self-efficacy (14 items) and mathematics anxiety (15 items). MSEAQ is a self-report measure of self-efficacy and anxiety. The total score is calculated by finding the sum of the all the items in each sub-scale. Higher score indicates students' more self-efficacy and/or more anxiety. Each statement of MSEAQ questionnaire was measured using a Likert five point scale from 1 to 5 such as: 1=Never; 2= Seldom; 3= Sometimes; 4= often; and 5= usually. Cronbach's Alpha reliability of both the sub-scales (i.e., self-efficacy and anxiety) was found to be .79 and .71 respectively. These reliability values support the MSEAQ as a reliable tool.

A team of experts translated the MSEAQ items from English to Urdu, the national language in Pakistan. Subsequently, the translated things were back-translated in accordance with the rules set forth by the International Test Commission. The translation-back-translation technique was conducted by a team of experts consisting of three educational practitioners who possess extensive understanding of the theoretical framework that underlies this questionnaire and its topics. Additionally, it is worth noting that all members of the expert team possessed a high level of proficiency in both the English language and the target language, Urdu. The final version of the questionnaire was delivered to all the 1386 sample secondary school students. Finally, 1072 sample students (77%) responded.

4. Data Analysis and Results

Researchers applied the descriptive statistical techniques (i.e., Percentage, Mean & SD) to analyze students' responses about mathematics self-efficacy and anxiety scales. Furthermore, Pearson's R correlation was performed to establish strength of relationship between students' mathematics self-efficacy and anxiety. Table 1 to Table 3 along with Figures exhibit the results.

Table 1: Descriptive analysis of students' perception of mathematics self-efficacy

Sr. no.	Statement	Never %	Sometmes%	Usually%	M	SD
1	Confidence to ask questions	37.7	21.7	40.6	3.08	1.46
2	Belief of doing a mathematics test.	32.7	32.1	35.2	3.13	1.18
3	Belief of completing all the assignments	32.6	26.1	41.3	3.21	1.29
4	Belief of being good at mathematics.	27.1	22.6	50.2	3.34	1.30
5	Belief of having ability to use math in future.	32.1	24.0	43.9	3.23	1.33
6	Belief of understanding content in math.	30.2	23.8	46.0	3.29	1.33
7	Belief of getting 'A' grade in math course.	34.2	22.4	43.4	3.17	1.31
8	Belief of learning well in math course.	31.3	24.0	44.7	3.23	1.30
9	Confidence when taking a test.	33.1	24.3	42.6	3.16	1.30
10	Belief of doing well in mathematics.	36.2	20.7	43.1	3.12	1.40
11	Belief of doing well in future courses.	34.9	24.2	40.9	3.12	1.32
12	Belief of doing well	33.1	24.8	42.1	3.14	1.30

13	Belief of thinking like a mathematician	37.9	18.3	43.8	3.09	1.44
14	Confidence using math outside school	42.3	20.6	37.1	2.91	1.44
Overall self-efficacy					3.16	1.34

Table 1 shows the results of descriptive statistics calculated to assess students' perception of mathematics self-efficacy. Figure 1 also displays the mean values based same results in the form of Bar Graph followed by the interpretation of the both i.e., Table 1 and Figure 1.

Figure 1: Bar chart of the means showing students' mathematics self-efficacy
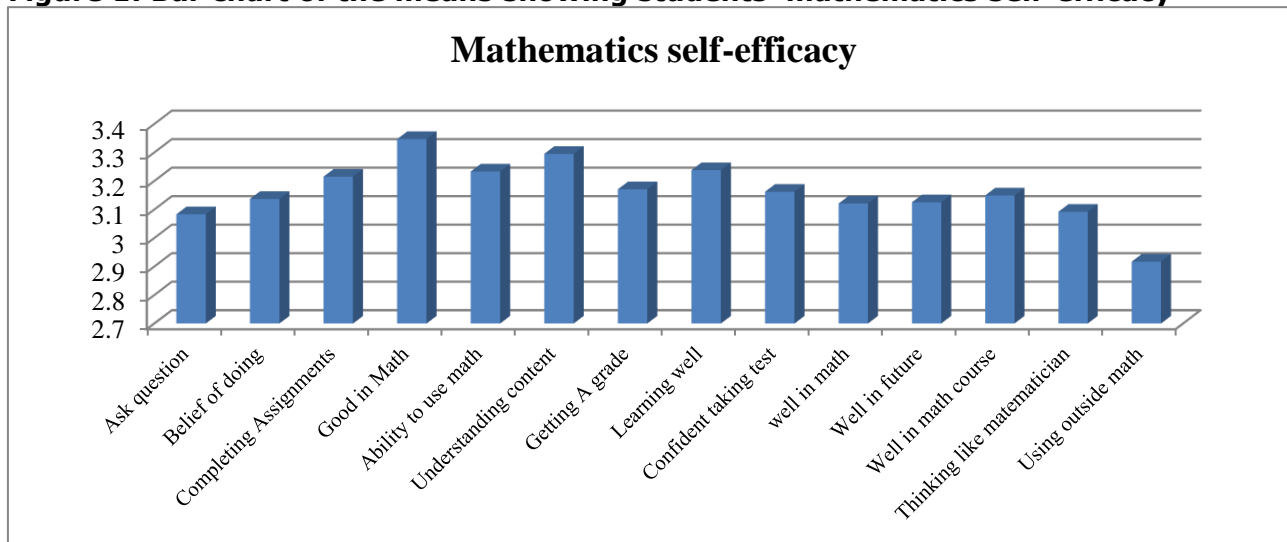

Table 1 and Figure 1 revealed that the range of mean scores (i.e., 2.91 to 3.34) on all the fourteen items included in this subscale related to mathematics self-efficacy. Item fourteen i.e., 'confidence using math outside school' had the lowest mean value (i.e., 2.91) while item four 'belief of being good at mathematics' with mean score 3.34 considered as highest among all the fourteen items of this subscale related to mathematics self-efficacy. Similarly, analysis in Table 1 also depicted mean values for the other twelve items of this factor. Analysis in Table 1 and Figure 1 further exhibit that majority thirteen items were with mean score above mid-point (i.e., 3.00). This result statistically put forward that majority of students believed that they have moderate mathematics self-efficacy. The mean value (2.91) on one item i.e., confidence using math outside school' is indicative of lower level of students' perceived mathematics self-efficacy in this area. The overall mean value of 3.16 also shows that students moderately positive response in this area related to mathematics self-efficacy. Overall, it can be concluded that majority of students were agreed with the most of the statements in this area related to mathematics self-efficacy.

Table 2: Descriptive analysis of students' perception of mathematics anxiety

Sr. no.	Statement	Never %	Sometimes%	Usually %	Mean	SD
1	Tension in preparing a mathematics test.	50.4	21.7	27.9	2.68	1.38
2	Nervousness in using mathematics outside school.	46.4	28.7	24.9	2.68	1.24
3	Worry about inability to use mathematics in future .	42.7	28.6	28.6	2.74	1.27
4	Worry of not getting good grades in mathematics.	43.8	24.8	31.4	2.81	1.31
5	Worry of not doing good in mathematics test.	45.7	22.7	31.6	2.79	1.34
6	Stress when listening mathematics instructions in class .	45.0	21.4	33.7	2.82	1.40
7	Nervousness in asking questions in class.	43.1	24.9	32.0	2.82	1.35
8	Stress of mathematics homework.	47.4	20.6	32.0	2.72	1.39
9	Worry about short of knowledge to take future courses.	45.2	24.2	30.6	2.76	1.32

10	Worry about inability of completing assignment in math.	43.0	23.9	33.1	2.83	1.33
11	Worry about not understanding mathematics.	44.9	23.4	31.8	2.78	1.35
12	Worry about not having grade 'A' in mathematics course .	44.8	24.5	30.7	2.77	1.32
13	Worry about inability of learning mathematics course.	45.3	23.0	31.6	2.80	1.32
14	Nervousness in taking mathematics test.	44.1	24.4	31.5	2.83	1.33
15	Fear of giving incorrect answer to mathematics question.	42.1	20.6	37.3	2.93	1.45
Overall anxiety					2.78	1.34

Table 2 shows the results of descriptive statistics calculated to assess students' perception of mathematics anxiety. Figure 2 also displays the mean values based same results in the form of Bar Graph followed by the interpretation of the both i.e., Table 2 and Figure 2.

Figure 2: Bar chart of the means presenting of students' perception of mathematics anxiety
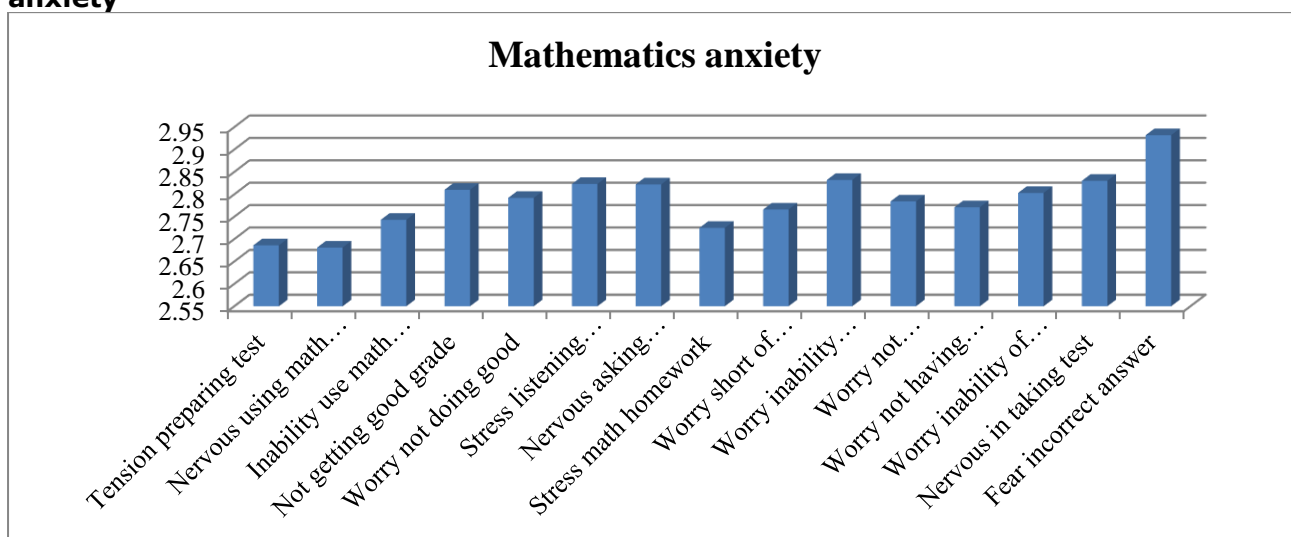

Table 2 and Figure 2 revealed that the range of mean scores (i.e., 2.68 to 2.93) on all the fifteen items included in this subscale related to mathematics anxiety. Item one i.e., 'tension in preparing a mathematics test' had the lowest mean value (i.e., 2.68) while item fifteen 'fear of giving incorrect answer to mathematics question' with mean score 2.93 considered as highest among all the fifteen items of this subscale related to mathematics anxiety. Similarly, analysis in Table 2 also depicted mean values for the other thirteen items of this factor. Analysis in Table 2 and Figure 2 further exhibit that majority all items were with mean score below mid-point (i.e., 3.00). The mean value (2.68) on one item i.e., tension in preparing a mathematics test' is indicative of lower level of students' perceived mathematics anxiety in this area. The overall mean value of 2.78 also shows students lower level response (below 3.00) in this area related to mathematics anxiety. Overall, it can be concluded that majority of students were not agreed with the most of the statements in this area related to mathematics anxiety. This result statistically put forward that majority of students believed that they have lower mathematics anxiety.

Table 3: Relationship between students' mathematics self-efficacy and anxiety

Variables		MS	MA
Mathematics self-efficacy (MS)	Pearson correlation	1	-.296**
	Sig.(2-tailed)		.000
Mathematics anxiety (MA)	Pearson correlation	-.296**	1
	Sig.(2-tailed)	.000	

**Correlation is significant at the 0.01 level (2-tailed)

Table 3 shows the results of Pearson Correlation (2-tailed) performed to analyze extent of association between students' mathematics self-efficacy and their mathematics anxiety.

Findings revealed that 'r' value for mathematics self-efficacy and mathematics anxiety is -.296 which means both the variables has weakly negative correlation with each other. These findings in Table 3 support the assertion that students' higher level of self-efficacy in mathematics is a major contributing factor for decreasing their mathematics anxiety. This result further suggests that secondary school students' mathematics anxiety may be mediated by improving their mathematics self-efficacy, which in turn might improve students' math achievement. This means that increase in students' mathematics self-efficacy level decreases their mathematics anxiety level. It can, therefore, be concluded from the coefficient values of 'r' that students' mathematics self-efficacy and mathematics anxiety found to be negatively associated.

5. Discussion

The current co-relational study was designed to analyze the relationship between students' mathematics self-efficacy and anxiety at secondary level. The study mainly focused to find out that whether mathematics self-efficacy can influence the students' mathematics anxiety. The current study concluded that mathematics self-efficacy and mathematics anxiety have weakly negative correlation with each other. A number of previous studies also found self-efficacy as a strong indicator of academic performance (Agustiani, Cahyad, & Musa, 2016; Honicke & Broadbent, 2016; Igcasama et al., 2023; Nasa, 2014). Alternatively, there are some other studies that dispute this relationship (Cho & Shen, 2013; Fan, Hambleton, & Zhang, 2019; Gębka, 2014; Guita & Tan, 2018; Jung, 2013; Ramirez et al., 2016). Some studies found similar negative correlation between these two variables (Huang, Zhang, & Hudson, 2019; Lewis, 2020; May, 2009). Though, many researchers Bandura (1986); Heslin (2006); Mahanta (2012); Ompad Jr et al. (2024); Oxford and Vordick (2006) found a strong positive correlation between mathematics self-efficacy and anxiety while a few found no relationship (Stevens et al., 2004; Woodrow, 2011). This study also resulted that mathematics self-efficacy and anxiety has weakly negative correlation with each other.

6. Conclusions and Recommendations

This study analyzed the relationship between secondary school students' self-perceived level of mathematics self-efficacy and anxiety. On the basis of study findings, following three main conclusions were drawn. First, it was concluded that majority of students thought they possess high mathematics self-efficacy. Second, it was concluded that majority of students believed that they have lower mathematics anxiety. Third, it was concluded that mathematics self-efficacy and mathematics anxiety have weakly negative correlation with each other. Although, this study tried to analyze the link between mathematics self-efficacy and math anxiety but to the researchers' understanding and knowledge, influence of individual differences on students' perception of these variable has rarely been investigated in interplay with each other. This study, therefore, recommends that more research is needed on such interaction. Explicitly, further investigation may be done to ascertain the strength of relationship between related variables i.e., student effort, math achievement, self-efficacy, and various forms of anxiety. Finally, this study also recommends that institutions might schedule monthly workshops and seminars to keep students motivated, boost their confidence, and to further enhance their level of self-efficacy.

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