Investigating Math Self-Efficacy and Math Anxiety Regarding Gender, A-Level Math Entry Grade and Mathematics Achievement

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Abstract
Although mathematics is perceived as an indispensable pre-cursor to success in modern society, many students still grapple with a genuine fear of mathematics and feel anxious when engaging in mathematical tasks. One of the affective factors that can affect math anxiety is learners' belief in their own ability which is termed self-efficacy. In this study we aimed to investigate how math anxiety and math self-efficacy varied across gender, A-level math entry grade and recent mathematics score and how math anxiety and math self-efficacy related in the context of students in Mayuge District, Uganda. We collected data from 60 advanced level (A-level) mathematics students from two secondary schools in Mayuge District. Their study of mathematics was not compulsory but rather by choice. The participants filled a Mathematics Self-Efficacy and Anxiety Questionnaire (MSEAQ). Data were analyzed using descriptive statistics, independent sample t tests, one-way ANOVA, Pearson's Linear Correlation Coefficient (PLCC) and linear regression. Descriptive statistics indicated a high level of math self-efficacy and a low level of math anxiety among the students. Independent sample t tests revealed no gender differences in math self-efficacy and math anxiety and ANOVA suggested no differences in math self-efficacy and math anxiety for the A-level math entry grades and recent mathematics scores. PLCC revealed a strong significant negative linear correlation between math self-efficacy and math anxiety with $r = -0.782$. Meanwhile, regression analysis suggested that math self-efficacy explained 60% of math anxiety among A-level students in Mayuge District. A recommendation was made.
Keywords: Entry Grade, Gender, Math Achievement, Math Anxiety, Math Self-Efficacy
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1. Introduction

Although mathematics is perceived as an indispensable pre-cursor to success in modern society, it is every so often regarded as one of the most difficult subjects at school. Many learners still grapple with a genuine fear of mathematics and feel anxious when engaging in mathematical tasks (Maloney, Waechter, & Fugelsang, 2012). Richardson and Suinn (1972) defined math anxiety as a feeling of "tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide array of ordinary life and academic situations" (p. 551). Khatoon and Mahmood (2010) revealed that math anxiety occurs almost at all levels of education and concerns with negative views that develop in society. Thus, learning mathematics depends on the learners' point of view (Siswanti & Djalal, 2017). According to Ashcraft and Kirk (2001) "anxiety reaction involves attention to a preoccupation with intrusive thoughts or worry" (p. 236). Math anxiety causes students to avoid mathematics, mathematics classes, and mathematics related courses (Ashcraft, 2002). Gleason (2008) maintains that math anxiety also causes learners difficulty to learn and apply mathematical concepts, turning into a dislike and avoidance of the subject. However, there are cognitive factors that contribute to the difficulty or ease that learners experience in doing mathematics tests or courses and performing mathematics-related tasks (Olango, 2016). Consequently, in addition to cognitive domains, affective domains play a crucial role in performing mathematical tasks and these also affect mathematics learning, performance and interest in pursuing STEM majors and careers (PISA, 2012).

One of the affective factors that can affect math anxiety is learners' belief in their own ability which is termed self-efficacy (Tudy, 2014). Self-efficacy, which is defined as "beliefs in one's capabilities to organize and execute the course of action required to produce given attainments" (Bandura, 1997, p. 3) has consistently been shown to be low in highly math anxious individuals. Bandura (1992) argues that self-efficacy beliefs and individuals' beliefs about their competencies evolve during early childhood as the children encounter different experiences, obstacles, new tasks or difficult situations. Thus, Jameson and Fusco (2014) hypothesized that self-efficacy plays a role in the development of math anxiety, as individuals high in math anxiety tend to be low in this construct as well. Although mathematics is regarded as a cognitive discipline, the affective dimension should not be ignored, thus understanding the nature of motivational and emotional constructs and their relationships with demographic characteristics and mathematics achievement should be a major research concern. According to

Soleymani and Rekabdar (2016), the said constructs are important in understanding learners' mathematics achievement. In consideration of the foresaid, there has been a major shift to study contributions of affective variables such as math self-efficacy, math anxiety and dispositions on cognitive skills (Schunk & Mullen, 2012) for the reason that learners' mathematics related career pathways are likely to be swayed by their emotions, feelings and self-beliefs toward mathematics. This means in essence that beliefs about mathematics exhibit significant impact on a learner's decision to like or dislike mathematics or mathematics related fields (Vukovic, Roberts, & Green, 2013) or force learners away from careers that require yet modest mathematics capabilities (Hafner, 2008). In terms of school mathematics, self-efficacy influences the learners' effort, persistence and feelings towards mathematics.

However, few studies have addressed the effect of emotional factors on math anxiety such as math self-efficacy (Vukovic *et al*., 2013). For example, Hackett (1985) established that self-efficacy in mathematics is a strong predictor of math anxiety unlike the impact of, say, prior mathematics experiences and gender. In fact, Siswanti and Djalal (2017) showed that math self-efficacy contributed 46.3% to math anxiety while 53.7% emanated from other factors. Although Pajares and Miller (1994) found that the level of mathematics performance was activated by math self-efficacy beliefs, Lee (2009), in contrast, posed a broader study in which math self-concept, math self-efficacy and math anxiety were separate elements and empirically distinct from each other. Moreover, Lee conducted his study both within individual countries and between countries. Meanwhile, Ashcraft, Kirk and Hopko (1998) revealed that math anxiety is related to decreased self-confidence in learning mathematics, and on their part, Krinzinger, Kaufmann and Willmes (2009) revealed no relationship between the two. Furthermore, while Galla and Wood (2012) explained that the relationship between math self-efficacy and math anxiety is moderated by an individual's confidence in their ability to control their emotions, Ashcraft and Krause (2007) identified an inverse relationship between math anxiety and performance.

In the meantime, although this inverse relationship is fairly sensical since as anxiety results in self-doubt and it becomes difficult to have confidence in one's abilities, it appears from literature that there are variations in findings on math anxiety, math self-efficacy and mathematics achievement. This seems to suggest that these vary across situations and contexts. Given this background, in this research we aimed to investigate how math anxiety and math self-efficacy varied across gender, A-level math entry grade and recent mathematics score and how math anxiety and math self-efficacy related in the context of A-level mathematics students in Mayuge District, Uganda. In particular, we sought to answer the following research questions:

(i) How does math self-efficacy differ by students' gender, A-level math entry grade and recent mathematics score?
(ii) How does math anxiety differ by students' gender, A-level math entry grade and recent mathematics score?
(iii) How does math self-efficacy relate with math anxiety?

Thus, the following hypotheses were tested:

(i) Math self-efficacy does not differ by students' gender, A-level math entry grade and recent mathematics score.
(ii) Math anxiety does not differ by students' gender, A-level math entry grade and recent mathematics score.
(iii) Math anxiety has no relationship with math self-efficacy.

In terms of theory, this study anchored on Bandura's (1977) sources of self-efficacy and Bandura's 1986 Social Cognitive Theory (SCT). Bandura (1977) proposed four sources of self-efficacy namely mastery experiences, vicarious experiences, social persuasions and physiological or affective states. According to him, mastery experiences include a person's interpretations of their past performances and are supported as the most powerful source of self-efficacy (Usher & Pajares, 2009). While vicarious experiences involve a person's interpretation of their performance in comparison to the performance of another individual and whether they conclude it to be a success or failure, social persuasions are encouragements that a person receives from influential sources including peers, teachers and parents. Meanwhile, physiological or affective states involve symptoms such as stress and anxiety that are stimulated as a result of a specific event or grouping of events. Together, these four categories have been widely accepted as enveloping all observed means of influence on self-efficacy. From Bandura's work, it's very clear that anxiety is a source of self-efficacy. On its part, SCT posits that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behavior. SCT views human beings as cognitive, self-regulatory and self-reflective and hence self-efficacy is a major component on this theory. Further, SCT takes into account a person's past experiences, which factor into whether behavioral action will occur. These past experiences influence reinforcements, expectations, and expectancies, all of which shape whether a person will engage in a specific behavior and the reasons why a person engages in that behavior. Therefore, according to Bandura's SCT, students' judgment of their capability to perform academic tasks or self-efficacy beliefs predicts their capability to accomplish such tasks. In other words, unless students believe that they can produce desired outcomes they have little incentive to act.

2. Literature Review

Scholars, such as Ampofo (2019), Jameson and Fusco (2014), Macmull and Ashkenazi (2019), Olango (2016), Recber, Isiksal and Koç (2018), Siswanti and Djalal (2017) and Szczygieł1 (2020), have studied math anxiety, math self-efficacy and mathematics achievement. For example, Ampofo (2019) sought to explore the relationship between pre-service teachers' perceived self-efficacy in teaching mathematics and their achievement in mathematics. His descriptive study involved 40 students of Kibi College of Education, Ghana, who completed a mathematics self-efficacy scale questionnaire and a mathematics achievement test. Ampofo analyzed his data using independent sample t-test and Pearson's product-moment correlation coefficient and found a strong positive relationship between the pre-service teachers' self-efficacy in mathematics and their achievement in mathematics. In their study, Jameson and Fusco (2014) compared adult learners to traditional undergraduate students in a medium-size state university in the United States in terms of their math anxiety, math self-concept and math self-efficacy. They collected data from 226 undergraduate students, where 60 were traditional students whereas 166 adult learners, using the abbreviated math anxiety scale, mathematics self-efficacy scale and the math subscale of a self-description questionnaire. After analyzing their data using multivariate analysis, that is Hotelling's T, item analysis, one-way analysis of variance and Pearson's correlation analysis, they found that adult learners self-reported lower levels of self-efficacy and higher levels of math anxiety than their traditional peers.

Macmull and Ashkenazi (2019) examined the direct and indirect influences of parenting styles, math self-efficacy and the participants' sex on math anxiety. They collected data from 204 participants whose native language was Hebrew and were born in Israel. The participants completed a survey about demographics, math anxiety, parenting style of the child's mother and math self-efficacy. Having used Pearson's sample correlation coefficient, regression and path analyses, they found that the authoritative parenting style had both a direct positive correlation and an indirect negative correlation on math anxiety. Further, Macmull and Ashkenazi indicated that there were strong correlations between the authoritarian parenting style and math anxiety and that math anxiety levels, as well as the negative effects of self-efficacy on the level of math anxiety, were higher in females compared to the males.

The purpose of Olango's (2016) study was to determine the direct and indirect effects of math anxiety on achievement in mathematics of first year science and engineering students. He obtained data from a descriptive survey of 245 students from five departments of two faculties of Hawassa University, Ethiopia, enrolled for a BSc degree programme. Olango used different instruments to collect data which included standard scales of math self-efficacy and math anxiety. Having used independent samples t-test and path analyses to analyze his data, he found that the level of prevalence of math anxiety among the gender groups was high for test-and task-related anxieties and moderate for course-related anxiety. He found no significant gender difference in math anxiety although the gender difference was significant in only mathematics capability and engagement in math self-efficacy. All the anxiety factors namely math test anxiety, numerical task-related anxiety and math course-related anxiety and only two of the self-efficacy factors namely mathematics problem solving capability self-efficacy and engagement in mathematical tasks self-efficacy had significant direct effects on mathematics achievement. Further, the mathematics test anxiety had significant indirect effect, as well, on mathematics capability self-efficacy.

Recber *et al*. (2018) investigated the relationship among seventh grade students' math self-efficacy, math anxiety, attitudes towards mathematics and mathematics achievement regarding gender and school type. They collected their data from 934 seventh grade students with an average age of 12 from 13 elementary schools, seven of which were public and six private, in Ankara, Turkey using math self-efficacy, math anxiety and math attitude scales. Recber *et al*. performed two-way ANOVA and multiple regression analysis in order to analyze their collected data. They found that there was a significant main effect of gender on mean math self-efficacy, attitude and anxiety scores and mathematics achievement. However, the school type did not have significant main effect on mean math self-efficacy, math anxiety and mathematics achievement scores but had a significant effect on attitude scores. Their findings further supported that math self-efficacy, anxiety, attitude, gender and school type significantly predicted the achievement scores of seventh grade students.

Siswanti and Djalal (2017) aimed at determining the influence of math self-efficacy on math anxiety when students were encountered with mathematics as a subject. Seventy five students of grades seven, eight and nine of YDM learning guidance course in Makassar, Indonesia participated in their study by completing the math self-efficacy and math anxiety scales. Having analyzed their data by way of a simple linear regression test, Siswanti and Djalal found that there was a significant effect of math self-efficacy on math anxiety of junior high school students in YDM learning guidance Makassar. In fact, according to them, math self-efficacy contributed 46.3% to math anxiety in their context.

Szczygieł1 (2020) investigated the relationship between math anxiety in parents and teachers and math anxiety and math achievement in first- to third-grade children. Her study was conducted in nine public elementary schools in Krakow, Poland, among early school children, their parents, and teachers. Two hundred and forty-one pupils, 176 mothers, 51 fathers and 30 early school education women teachers took part in the study. Szczygieł1 collected data using the math anxiety questionnaire for adults, math anxiety questionnaire for children and math achievement tasks and analyzed those using descriptive statistics and hierarchical regression. Her results indicated that math anxiety in fathers (but not mothers and teachers) was associated with math anxiety in first-grade children and third-grade girls. Math anxiety in mothers and teachers (but not fathers) explained the level of math achievement in third-grade children. Further, Szczygieł1's research results indicated the importance of adults in shaping pupils' math anxiety and math achievement, but these relationships varied depending on gender and the grade year. Her obtained outcomes generally suggested that adults' math anxiety is not a social source of children's math anxiety, but it can be considered a source of low math achievement among children in the final grade of early school education.

From the literature reviewed it is clear that although scholars have studied math self-efficacy, math anxiety and achievement, the relationship between math anxiety and math self-efficacy, as well as its strength, have been ignored. Instead, studies have established how math anxiety and math self-efficacy are related to variables such as school type (Recber, *et al*., 2018), gender (Olango, 2016; Recber, *et al*., 2018), parenting styles (Macmull & Ashkenazi, 2019; Szczygieł1, 2020) and mathematics achievement (Ampofo 2019; Olango, 2016; Recber, *et al*., 2018; Szczygiell, 2020). Although Macmull and Ashkenazi (2019), Olango (2016) and Siswanti and Djalal (2017) studied how math self-efficacy affected math anxiety, they never established the strength of the relationship between these. Math self-efficacy and math anxiety in relation to gender have been studied but findings pose contradictions. For example, while Olango (2016) established no significant gender differences in math anxiety, Macmull and Ashkenazi (2019) found higher levels of math anxiety in females compared to the males. Meanwhile, Szczygieł1 (2020) found that learners' math anxiety varied depending on gender. On account of the gaps from literature, this study becomes relevant.

3. Method

3.1. Research Design

The quantitative research paradigm was employed in this study since data were collected and analyzed using positivist methods (Creswell, 2003) to establish the relationship between math anxiety and math self-efficacy, as well as that between these and each of gender, A-level math entry grade and recent mathematics score. The study employed a cross-sectional correlational survey design. Best and Kahn (1993) assert that a survey involves large numbers of respondents to enable generalization of findings, for large samples are more likely to be representative of their populations (Bakkabulindi, 2015). The cross-sectional survey was adapted because data were collected at one given point in time once and for all (Creswell, Klassen, Clark & Smith, 2011). The study design was correlational because we were interested in establishing a relationship between the study variables, math self-efficacy and math anxiety.

3.2. Study Population and Sample

All the 46 secondary schools in Mayuge District constituted the population for this study. Mayuge District was chosen because its students have been reported to be among those whose mathematics achievement is lowest. Of the 46, the four best science performing schools, which were purposively sampled under the guidance of the District Education Officer, were involved in this study. These included Busoga Secondary School, Waitambogwe Secondary School, Bunya Secondary School and Delta High School. Our target population was A-level students who offered mathematics as one of their subjects. Our assumption was that at A-level, mathematics is offered by choice and so we wanted to find out if they chose so, would they still have issues in math anxiety and math self-efficacy that could possibly affect their mathematics achievement? Unfortunately, after our schools' selection we found out that only Waitambogwe and Bunya Secondary Schools had students at A-level. Moreover, the total population of these was 60 and so by way of census sampling (Erba, Ternes, Bobkowski, Logan, & Liu, 2018) all of them participated in this study. Table 3.1 shows the distribution of the students.

Table 3.1: Population and Sample Size

Name of School	Target Population	Sample Size
Waitambogwe Secondary School	35	35
Bunya Secondary School	25	25
Total	60	60

3.3. Instrument

The primary instrument for collecting data in this study was the Mathematics Self-Efficacy and Anxiety Questionnaire (MSEAQ). The MSEAQ comprised 29 self-opinion items, 14 of which were on math self-efficacy and 15 on math anxiety. The questionnaire was adapted from May (2009). The reliability test of the instrument gave a Cronbach alpha value of 0.93 for the math self-efficacy items and 0.75 for the math anxiety items. According to Tavakol and Dennick (2011), a reliable instrument has a reliability coefficient of 0.7 and above, so the instrument was reliable in our context. The targeted sample of 60 A-level secondary school students in Mayuge District filled the instrument, all of whom returned the questionnaires, implying a response rate of 100%. Data on the background of the respondents were collected and this included the respondents' gender, age, A-level math entry grade, recent mathematics score, other learning subjects, university courses, school, and mathematics continuity at the university. This information was assumed to be valuable to this study because it helped in determining whether the data collected were appropriate to the study population. Results in Table 3.2 reveal that a typical respondent was a male aged 19, had a 2nd A-level math entry grade, scored between 61% and 80% on their recent mathematics examination, whose other subjects were economics and geography and aspired to become an accountant or teacher in future.

Table 3.2: Classification of Respondents

Variable	Categories	Frequency(N)	Percentage (%)
Gender	Female	17	29.8
	Male	40	70.2
Age	17	07	12.1
	18	13	22.4
	19	24	41.4
	20	09	15.5
	21	05	08.6
A-level Math Entry Grade	First	09	16.1
	Second	34	60.7
	Third	13	23.2
	Forth	00	00.0
	Fifth	00	00.0
Recent Mathematics Score	0-20	00	00.0
	21-40	05	33.3
	41-60	04	26.7
	61-80	06	40.0
	81-100	00	00.0
Other Subjects	Physics and Chemistry	04	07.1
	Biology, Chemistry and Agriculture	02	03.6
	Economics and Geography	15	26.8
	Biology and Chemistry	13	23.2
	Economics and History	01	01.8
	Economics and Divinity	01	01.8
	Chemistry and Agriculture	01	01.8
	History, Economics and Geography	05	08.9
	Geography, Economics and Agriculture	02	03.6
	Physics, Chemistry and Biology	01	01.8
	Divinity, Economics and Geography	01	01.8
	History, Divinity and Geography	02	03.6
	Physics and Economics	04	07.1
	Biology, Chemistry and Geography	01	01.8
	Economics and Fine Art	03	05.4
University Courses	Engineering	08	13.8
	Teaching	12	20.7
	Medicine and Surgery	09	15.5
	I do not know	02	03.4
	Accountant	12	20.7
	Law	02	03.4
	Pharmacy	03	05.2
	Land Survey	01	01.7
	Industrial Chemistry	01	01.7
	Statistics	03	05.2
	Architecture	01	01.7
	Mathematics	01	01.7
	Physical Education/ Sports Science	01	01.7
	Dental Surgery	01	01.7
Name of School	Waitambogwe Secondary School	35	58.3
	Bunya Secondary School	25	41.7
Mathematics Continuity at University	Yes	43	74.1
	No	13	22.4
	Not Sure	02	03.4

3.4. Data Analysis
The quantitative data collected from A-level secondary school students were processed and analyzed. Using Statistical Package for Social Sciences (SPSS Version 21), descriptive and correlation and regression analyses were performed. Mean scores were calculated for each statement of math self-efficacy and math anxiety. The study required to establish the relationship between math self-efficacy and math anxiety, and thus, relative frequencies and descriptive statistics such as means on the numerical variables of each construct were used. The mean values of all the math self-efficacy and math anxiety items were averaged to get the overall index on math self-efficacy and math anxiety respectively. Further, frequency tables particularly for the background variables were generated and at this level, the analyses were univariate. At the bivariate level, students' math self-efficacy and math anxiety were related to gender, A-level math entry grade and recent mathematics score using student sample t test or ANOVA in order to justify the observed mean differences in the overall math self-efficacy and math anxiety items. Further, at the bivariate level, the relationship between math self-efficacy and math anxiety was established using Pearson's linear Correlation Coefficient. At the multivariate level, simple linear regression was performed.

4. Results
4.1. Description of Students' Math Self-Efficacy
The students' math self-efficacy was measured using a Mathematics Self-Efficacy and Anxiety Questionnaire (MSEAQ) which had 14 self-opinion items on math self-efficacy. Respondents were asked to rate themselves on their math self-efficacy and each of these 14 items as indicated in Table 3.3 on math self-efficacy was measured using the five-point Likert scale where 1= Strongly Disagree (SD), 2 = Disagree (D), 3 = Undecided (U), 4 = Agree (A), and 5 = Strongly Agree (SA). Table 3.3 gives the descriptive results namely frequencies, percentages, means, standard deviations (SDv) and overall rating of each of all the 14 items on students' math self-efficacy.

Table 3.3: Respondents' Rating on Math Self-Efficacy

No	Item	SD Count (%)	D Count (%)	U Count (%)	A Count (%)	SA Count (%)	Mean	SDv	Overall Rating
1	I feel confident enough to ask questions in my mathematics class	02 (03.3)	01 (01.7)	00 (00.0)	18 (30.0)	39 (65.0)	4.62	0.652	Strongly Agree
4	I believe I can do well on a mathematics test	04 (06.7)	00 (00.0)	00 (00.0)	14 (23.3)	42 (70.0)	4.56	0.990	Strongly Agree
7	I believe I can complete all the assignments in a mathematics course	04 (06.8)	03 (05.1)	04 (06.8)	11 (18.6)	37 (62.7)	4.24	1.182	Agree
9	I believe that I am the kind of person who is good at mathematics	04 (07.0)	01 (01.8)	06 (10.5)	19 (33.3)	27 (47.4)	4.38	0.888	Agree
10	I believe I will be able to use mathematics in my future career when needed	05 (08.6)	00 (00.0)	01 (01.7)	14 (24.1)	38 (65.5)	4.74	0.511	Strongly Agree
12	I believe I can understand the content in a mathematics course	02 (03.5)	03 (05.3)	04 (07.0)	15 (26.3)	33 (57.9)	4.24	0.987	Agree
13	I believe that I can get an "A" when I am in a mathematics paper	09 (15.0)	02 (03.3)	02 (03.3)	13 (21.7)	34 (56.7)	4.24	1.182	Agree
16	I believe I can learn well in a mathematics class	03 (05.2)	03 (05.2)	03 (05.2)	11 (19.0)	38 (65.5)	4.44	1.050	Agree
19	I feel confident when taking a mathematics test	05 (08.3)	01 (01.7)	02 (03.3)	10 (16.7)	42 (70.0)	4.44	1.260	Agree
20	I believe I am the kind of person who can do mathematics	06 (10.0)	01 (01.7)	00 (00.0)	12 (20.0)	41 (68.3)	4.41	1.234	Agree
21	I feel that I will be able to do well in future mathematics courses	05 (08.5)	01 (01.7)	03 (05.1)	11 (18.6)	39 (66.1)	4.59	0.892	Strongly Agree

No	Item	SD Count (%)	D Count (%)	U Count (%)	A Count (%)	SA Count (%)	Mean	SDv	Overall Rating
23	I believe that I can do the mathematics in a mathematics course	00 (00.0)	01 (01.8)	08 (14.0)	16 (28.1)	32 (56.1)	4.44	0.705	Agree
28	I believe I can think like a mathematician	04 (06.7)	01 (01.7)	02 (03.3)	14 (23.3)	39 (65.0)	4.56	1.021	Strongly Agree
29	I feel confident when using mathematics outside of school	03 (05.0)	00 (00.0)	01 (01.7)	12 (20.0)	44 (73.3)	4.68	0.806	Strongly Agree
	Overall						4.35		Agree

Table 3.3 shows that the overall mean on students' math self-efficacy was 4.35. This mean corresponds to code 4 on the five-point Likert scale which stands for agree. This means that the students agreed to have math self-efficacy. The results in this table also reveal that the students were generally confident about and believed in their math self-efficacy. Particularly, almost all students strongly agreed to feel confident to ask questions in mathematics classes, when using mathematics outside of school and that they would be able to do well in future mathematics courses. They also believed that they could do well on mathematics tests, would be able to use mathematics in their future career when needed and could think like mathematicians.

4.2. Description of Students' Math Anxiety

The students' math anxiety was measured using a Mathematics Self-Efficacy and Anxiety Questionnaire (MSEAQ) which had 15 self-opinion items on math anxiety. Respondents were asked to rate themselves on their math anxiety and each of these 15 items as indicated in Table 3.4 on math anxiety was measured using the five-point Likert scale where 1= Strongly Disagree (SD), 2 = Disagree (D), 3 = Undecided (U), 4 = Agree (A), and 5 = Strongly Agree (SA). Tables 3.4 gives the descriptive results namely frequencies, percentages, means, standard deviations (SDv) and overall rating of each of all the 15 items on students' math anxiety.

Table 3.4: Respondents' Rating on Math Anxiety

No	Item	SD Count (%)	D Count (%)	U Count (%)	A Count (%)	SA Count (%)	Mean	SDv	Overall Rating
2	I get tense when I prepare for a mathematics test	22 (37.9)	13 (22.4)	04 (06.9)	12 (20.7)	07 (12.1)	2.59	1.480	Undecided
3	I get nervous when I have to use mathematics outside of school	21 (38.2)	18 (32.7)	04 (07.3)	05 (09.1)	07 (12.7)	2.21	1.431	Disagree
5	I worry that I will not be able to use mathematics in my future career when needed	34 (59.6)	11 (19.3)	06 (10.5)	03 (05.3)	03 (05.3)	1.62	1.101	Disagree
6	I worry that I will not be able to get a good grade in my mathematics course	42 (70.0)	09 (15.0)	02 (03.3)	03 (05.0)	04 (06.7)	1.56	0.960	Disagree
8	I worry that I will not be able to do well on mathematics tests	36 (60.0)	12 (20.0)	05 (08.3)	04 (06.7)	03 (05.0)	1.65	1.070	Disagree
11	I feel stressed when listening to mathematics teachers in class	38 (63.3)	16 (26.7)	02 (03.3)	03 (05.0)	01 (01.7)	1.47	0.825	Disagree
14	I get nervous when asking questions in class	26 (44.8)	14 (24.1)	05 (08.6)	06 (10.3)	07 (12.1)	2.24	1.539	Disagree
15	Working on mathematics homework is stressful for me	31 (52.5)	12 (20.3)	01 (01.7)	05 (08.5)	10 (16.9)	1.91	1.505	Disagree
17	I worry that I do not know enough mathematics to do well in future mathematics courses	25 (42.4)	14 (23.7)	05 (08.5)	09 (15.3)	06 (10.2)	2.18	1.403	Disagree
18	I worry that I will not be able to complete every assignment in a mathematics paper	28 (46.7)	17 (28.3)	02 (03.3)	10 (16.7)	03 (5.0)	2.06	1.324	Disagree

No	Item	SD Count (%)	D Count (%)	U Count (%)	A Count (%)	SA Count (%)	Mean	SDv	Overall Rating
22	I worry I will not be able to understand the mathematics	36 (63.2)	12 (21.1)	04 (07.0)	04 (07.0)	01 (01.8)	1.53	0.961	Disagree
24	I worry that I will not be able to get an "A" in my mathematics course	34 (57.6)	15 (25.4)	03 (05.1)	04 (06.8)	03 (05.1)	1.74	1.109	Disagree
25	I worry that I will not be able to learn well in my mathematics class	35 (58.3)	11 (18.3)	06 (10.0)	06 (10.0)	02 (03.3)	1.79	1.298	Disagree
26	I get nervous when taking a mathematics test	29 (48.3)	15 (25.0)	04 (06.7)	06 (10.0)	06 (10.0)	2.12	1.472	Disagree
27	I am afraid to give an incorrect answer during my mathematics class	18 (31.0)	11 (19.0)	05 (08.6)	13 (22.4)	11 (19.0)	2.59	1.598	Undecided
	Overall						2.12		Disagree

Table 3.4 shows that the overall mean on students' math anxiety was 2.12. This mean corresponds to code 2 on the five-point Likert scale which stands for disagree. This means that the students disagreed to have math anxiety. In other words, they were not anxious about mathematics on the whole. Although this was the case, the results in this table reveal that the students were undecided about if they got tense when they prepared for mathematics tests and if they were afraid to give an incorrect answer during their mathematics classes. This might suggest that sometimes they are tense and afraid, yet at other times not.

4.3. Objective One: Variations of Students' Math Self-Efficacy with Gender, A-level Math Entry Grade and Recent Mathematics Score

The first objective of this study was to establish how math self-efficacy differed by students' gender, A-level math entry grade and recent mathematics score. Corollary, the first objective of the study was to the effect that math self-efficacy did not differ by students' gender, A-level math entry grade and recent mathematics score. Thus, in this section we give the variations of students' math self-efficacy with gender, A-level math entry grade and recent mathematics score/ achievement.

4.3.1. Students' Math Self-Efficacy by Gender

In this subsection we were interested in finding out whether students' math self-efficacy varied with their gender and to establish this, an independent sample t test was used and the results are presented in Table 3.5.

Table 3.5: Independent Sample t Test on Students' Math Self-Efficacy by Gender

Gender	Frequency	Mean	SD	t	p
Female	15	4.24	1.009	-0.643	0.523
Male	32	4.41	0.742		

Results in Table 3.5 show that males (n = 32) were more than the females (n = 15). Further, the table reveals that on average, the males (mean = 4.41) rated themselves higher on their math self-efficacy than the females (mean = 4.24). However, basing on the p-value ($p = 0.523$) which was greater than $\alpha = 0.05$ ($p > 0.05$) at the 5% level of significance, the t-statistic ($t = -0.643$) was so small suggesting that the mean scores in Table 3.5 on students' math self-efficacy by males and females did not differ significantly and therefore the difference in sample means on students' math self-efficacy could be attributed to chance.

4.3.2. Students' Math Self-Efficacy by A-level Math Entry Grade

In this subsection we were interested in finding out whether students' math self-efficacy varied with their A-level math entry grade and to find this, Sir. Ronald Fisher's Analysis of Variance (ANOVA) was carried out to that effect and the results are presented in Table 3.6

Table 3.6: ANOVA Results on Students' Math Self-Efficacy by A-level Math Entry Grade

Entry Grade	Frequency	Mean	SD	F	p
First	06	4.85	0.139	1.582	0.217
Second	30	4.21	0.947		
Third	10	4.44	0.609		

The results in Table 3.6 indicate that students with the second A-level math entry grade had the largest sample size (n = 30). Further, while students with a first A-level math entry grade had the highest mean (mean = 4.85), those with a second grade had the least mean (mean = 4.21). However, since the p-value ($p = 0.217$) was greater than $\alpha = 0.05$ ($p > 0.05$), then at the 5% level of significance, the F-statistic ($F = 1.582$) was so small implying that at least two mean scores in Table 3.6 on students' math self-efficacy for the three grades did not differ significantly and thus, the differences in the sample means in Table 3.6 could be attributed to chance.

4.3.3. Students' Math Self-Efficacy by Recent Mathematics Score

In this subsection we were interested in finding out whether students' math self-efficacy varied with their recent mathematics score and we carried out ANOVA to that effect. The results are presented in Table 3.7.

Table 3.7: ANOVA Results on Students' Math Self-Efficacy by Recent Mathematics Score

Recent Exam Score	Frequency	Mean	SD	F	p
21-40	03	4.52	0.648	2.476	0.146
41-60	03	3.74	0.991		
61-80	05	4.74	0.292		

The results in Table 3.7 indicate that students whose recent mathematics score was 61-80 had the largest sample size (n = 5). Further, while students with a recent mathematics score of 61-80 had the highest mean (mean = 4.74), those with 41-60 had the least mean (mean = 3.74). However, since the p-value (p = 0.146) was greater than α = 0.05 (p > 0.05), then at the 5% level of significance, the F-statistic (F = 2.476) was so small implying that at least two mean scores in Table 3.7 on students' math self-efficacy for the three categories of recent mathematics scores did not differ significantly and thus, the differences in the sample means in Table 3.7 could be attributed to chance. It should also be noted that these statistics were computed on only 11 responses as 49 students declined to reveal their recent mathematics score.

4.4. Objective Two: Variations of Students' Math Anxiety with Gender, A-level Math Entry Grade and Recent Mathematics Score

The second objective of this study was to establish how math anxiety differed by students' gender, A-level math entry grade and recent mathematics score. Consequently, the second objective of the study was to the effect that math anxiety did not differ by students' gender, A-level math entry grade and recent mathematics score. Thus, in this section we give the variations of students' math anxiety with gender, A-level math entry grade and recent mathematics score/ achievement.

4.4.1. Students' Math Anxiety by Gender

In this subsection we were interested in finding out whether students' math anxiety varied with their gender and we executed an independent sample t test to establish this. The results are presented in Table 3.8.

Table 3.8: Independent Sample t Test on Students' Math Anxiety by Gender

Gender	Frequency	Mean	SD	t	p
Female	12	1.94	0.837	-0.870	0.390
Male	28	2.13	0.540		

Results in Table 3.8 show that males (n = 28) were more than the females (n = 12). Further, the table reveals that on average, the males (mean = 2.13) rated themselves higher on their math anxiety than the females (mean =1.94). However, basing on the p-value (p = 0.390) which was greater than α = 0.05 (p > 0.05) at the 5% level of significance, the t-statistic (t = -0.870) was so small suggesting that the mean scores in Table 3.8 on students' math anxiety by males and females did not differ significantly and therefore the difference in sample means in Table 3.8 on students' math anxiety could be attributed to chance.

4.4.2. Students' Math Anxiety by A-level Math Entry Grade

In this subsection we were interested in finding out whether students' math anxiety varied with their A-level math entry grade. We performed ANOVA to that effect and the results are presented in Table 3.9.

Table 3.9: ANOVA Results on Students' Math Anxiety by A-level Math Entry Grade

Entry Grade	Frequency	Mean	SD	F	p
First	05	2.01	0.583	0.325	0.724
Second	24	2.06	0.728		
Third	10	2.24	0.463		

The results in Table 3.9 indicate that students with a second A-level math entry grade had the largest sample size (n = 24). Further, while students with a third A-level math entry grade had the highest mean (mean = 2.24), those with a first grade had the least mean (mean = 2.01). However, since the p-value (p = 0.724) was greater than α = 0.05 (p > 0.05), then at the 5% level of significance, the F-statistic (F = 0.325) was so small implying that at least two mean scores in Table 3.9 on students' math anxiety for the three grades did not differ significantly and thus, the differences in the sample means in Table 3.9 could be attributed to chance.

4.4.3. Students' Math Anxiety by Recent Mathematics Score

In this subsection we were interested in finding out whether students' math anxiety varied with their recent mathematics score and we carried out ANOVA to that effect. The results are presented in Table 3.10.

Table 3.10: ANOVA Results on Students' Math Anxiety by Recent Mathematics Score

Recent Exam Score	Frequency	Mean	SD	F	p
21-40	02	2.54	0.455	1.577	0.282
41-60	03	2.17	0.352		
61-80	04	1.84	0.520		

The results in Table 3.10 indicate that students whose recent mathematics score was 61-80 had the largest sample size (n = 4). Further, while students with a recent mathematics score of 21-40 had the highest mean (mean = 2.54), those with 61-80 had the least mean (mean = 1.84). However, since the p-value ($p = 0.282$) was greater than $\alpha = 0.05$ ($p > 0.05$), then at the 5% level of significance, the F-statistic ($F = 1.577$) was so small implying that at least two mean scores in

Table 3.10 on students' math anxiety for the three categories of recent mathematics scores did not differ significantly and thus, the differences in the sample means in Table 3.10 could be attributed to chance. It should also be noted that these statistics were computed on only nine responses as 51 students declined to reveal their recent mathematics score.

4.5. Objective Three: Relationship between Math Self-Efficacy and Math Anxiety

The third objective of this study was to establish whether math self-efficacy and math anxiety were related. To this end, the third hypothesis was to the effect that math self-efficacy and math anxiety had no relationship. Thus, the third hypothesis was tested at two levels namely bivariate and multivariate. At the bivariate level, we used Pearson's Linear Correlation Coefficient (PLCC) and Table 3.11 gives the necessary correlation matrix.

Table 3.11: PLCC output for Math Self-Efficacy and Math Anxiety

	Maths Self-Efficacy	Maths Anxiety
Maths Self-Efficacy	1	-0.782**
		0.000
Maths Anxiety		1

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

According to Table 3.11, PLCC was computed for math self-efficacy and math anxiety and the results ($r = -0.782$, $p = 0.000$) indicated that there was a strong negative linear correlation ($r < 0$) between math self-efficacy and math anxiety. However, since its significant level ($p = 0.000$) was far less than $\alpha = 0.05$ ($p < 0.05$), the null hypothesis to the effect that there was no statistically significant relationship between math self-efficacy and math anxiety was rejected at the 5% level of significance. This suggested that math self-efficacy and math anxiety were strongly significantly negatively linearly correlated. Thus, the higher the math self-efficacy, the lower the math anxiety and the reverse holds. In other words, PLCC did not support the third hypothesis.

At the multivariate level, we used a simple linear regression model such that the dependent variable, math anxiety was regressed on the independent variable, math self-efficacy using SPSS. Supposing that MSE stands for math self-efficacy and MA for math anxiety, a mathematical model was developed of the form:

$MA = \beta_1$ MSE………………………………………………………………………… (3.1).

The value of β_1 was found to be -0.782 and this implied that math anxiety was negatively related to math self-efficacy. The beta was accompanied by a significant or p-value of 0.000 which means that the beta was significant and that there is a significant negative correlation between math anxiety and math self-efficacy given that the p-value is far less than 0.05 ($p < 0.05$) at the 5% level. The adjusted R square is 0.600 and this implies that math self-efficacy explains 60% of math anxiety. Meanwhile, Fisher's ratio (F) is equal to 50.532 followed with a significance value, $p = 0.000$. Basing on these results, the F is high and given that it is accompanied by a significant value of 0.000 that is less than $\alpha = 0.05$, it is a good regression model. Thus, regression analysis supported the third research hypothesis. Table 3.12 gives the ANOVA results of regression of math anxiety on math self-efficacy.

Table 3.12: ANOVA Results on Regression of Math Anxiety on Math Self-Efficacy

Model	Sum of Squares	df	Mean Square	F	Significance (p-value)
Regression	8.478	1	8.478	50.532	0.000
Residual	5.369	32	0.168		

5. Discussion

The study sought to establish the relationship between math self-efficacy and math anxiety and if these differed according to students' gender, A-level math entry grade and recent mathematics score/ achievement. The first objective of the study was to establish how math self-efficacy differed by gender, A-level math entry grade and recent mathematics score among A-level mathematics students in Mayuge District. The results show that the mean score on students' math self-efficacy was 4.35. Basing on the five-point Likert scale on which the students rated themselves on math self-efficacy items, this value corresponded to code 4 which was agree. This means that the students having agreed to possess math self-efficacy, they believed in their abilities to study mathematics. In terms of levels, we can say that they had a high level of math self-efficacy. Of course, this is not surprising because at this level, studying mathematics is by choice and for the fact that they chose to have it as one of their principal subjects, there are chances that they believed they were ready to take it up.

Further, the results show that the mean score on students' math anxiety was 2.12. Basing on the five-point Likert scale on which the students rated themselves on math anxiety items, this value corresponded to code 2 which was disagree. This means that the students having disagreed to possess math anxiety, they were not anxious or worried about studying mathematics. In terms of levels, we can say that they had a lower level of math anxiety. Similarly, this is not astounding for the similar reason as that given for the students' high level of math self-efficacy. Generally speaking, the mean scores on math self-efficacy and math anxiety indicate that students had a lower level of math anxiety owing that their level of math self-efficacy was high. This association is particularly true basing on Jameson and Fusco (2014) who found that adult learners self-reported lower levels of self-efficacy and higher levels of math anxiety, the vice versa of this study's finding.

Table 3.5 indicates that there are no gender differences in math self-efficacy between female and male students. In essence, irrespective of gender, the math self-efficacy level was high. This finding contradicts with Olango's (2016) study which found significant gender differences in math self-efficacy and Recber *et al* (2018) who found a significant effect of gender on mean math self-efficacy scores. Further, Table 3.6 also reported that there is no difference in math self-efficacy for at least two students' A-level math entry grades namely first, second or third grade. Although the grades were different, the students on average performed well in mathematics irrespective of their grades and possibly believed that they could study mathematics at this level, hence, a no difference in their math self-efficacy by grades. Table 3.7 reveals no difference in math self-efficacy for at least two categories of the students' recent mathematics score. This finding contradicts with Pajeres and Miller (1994) who found that the level of mathematics performance was activated by math self-efficacy beliefs.

Other contradictions were detected, for example, while Recber *et al* (2018) indicated that math self-efficacy significantly predicted mathematics achievement scores among seventh grade students, Olango (2016) found that math self-efficacy had significant direct effects on mathematics achievement among first year science and engineering students. Furthermore, Ampofo (2019) found a strong positive relationship between math self-efficacy and mathematics achievement. This contradiction is somewhat not surprising since this finding is based on only 11 responses. Forty nine students did not reveal their recent mathematics score, which we found very suspicious. We think the hidden scores were very low to the extent that the students lacked the confidence to state them. Thus, we cannot particularly rely on our finding to this effect and think in future studies students will be given a spot-on mathematics achievement test/ scale for us to examine that rather than relying on their recent mathematics scores. Nonetheless, Tables 3.5, 3.6 and 3.7 supported the first hypothesis to the effect that math self-efficacy did not differ by gender, A-level math entry grade and recent mathematics score.

The second objective of this study was to ascertain how math anxiety differed by gender, A-level math entry grade and mathematics achievement among A-level students in Mayuge District. Table 3.8 reveals that there were no gender differences in math anxiety. All the students had a lower level of math anxiety. Although Olango (2016) also found no gender differences in math anxiety in his study as is the case in this, Macmull and Ashkenazi (2019) found higher math anxiety levels in females compared to the males. Moreover, while Recber *et al* (2018) found a significant effect of gender on mean math anxiety scores, Szczygiełl (2020) indicated that children's math anxiety varied depending on gender. Table 3.9 further reveals no differences in math anxiety for at least two students' A-level math entry grades for the same reason as that discussed on math self-efficacy by A-level math entry grade. Table 3.10 indicated no differences in math anxiety for at least two categories of students' recent mathematics score. This finding is not in consonance with Ashcraft and Krause (2007) who identified an inverse relationship between math anxiety and performance. Moreover, while also Recber *et al* (2018) found that math anxiety significantly predicted mathematics achievement scores, Olango (2016) showed that math anxiety had significant direct effects on mathematics achievement. Yet again, Szczygiełl (2020) found that math anxiety in mothers and teachers explained the level of math achievement in third grade children. For this contradiction, we have already expressed our suspicions caused by majority non-responses by the students, particularly on this item of recent mathematics score. Consequently however, Tables 3.8, 3.9 and 3.10 supported the second hypothesis to the effect that math anxiety does not differ by gender, A-level math entry grade and recent mathematics score.

The third objective of this study was to determine how math self-efficacy relates with math anxiety in the context of A-level mathematics students in Mayuge District. Thus, the third hypothesis was tested at two levels namely bivariate and multivariate. At the bivariate level, Table 3.11 shows the correlation coefficient as -0.782 which indicates a strong negative relationship between math self-efficacy and math anxiety. By this value and given its significant value that is less than 0.05, it can be stated that math self-efficacy and math anxiety are significantly negatively linearly correlated and that higher levels of math self-efficacy denote lower levels of math anxiety and vice versa. This finding is in agreement with Hackett (1985). Further, this finding is in consonance with Macmull and Ashkenazi (2019) who found that math self-efficacy negatively affected the level of math anxiety and Olango (2016) who also observed that math anxiety had a significant indirect effect on math self-efficacy among students. Similarly, Siswanti and Djalal (2017) observed a significant effect of math self-efficacy on math anxiety of junior high school students and their finding concurred with the finding on this study's third hypothesis. In contrast, Lee (2009) found math self-efficacy and math anxiety to be separate constructs and empirically distinct from each other. This contrast seems to suggest that math self-efficacy and math anxiety vary according to contexts and situations. Meanwhile, at the multivariate level, we found that math self-efficacy explains 60% of math anxiety. In affirmation, also Siswanti and Djalal (2017) established that math self-efficacy contributed 46.3% to math anxiety. Both studies suggest math self-efficacy as a good predictor of math anxiety. However, there are other factors such as parenting style (Macmull & Ashkenazi, 2019) that could explain 40% of math anxiety but were beyond the scope of this study.

6. Conclusion

In this study we aimed to investigate how math anxiety and math self-efficacy varied across gender, A-level math entry grade and recent mathematics score and how math anxiety and math self-efficacy related in the context of A-level mathematics students in Mayuge District, Uganda. In particular, we sought to answer the following research questions: (i) how does math self-efficacy differ by students' gender, A-level math entry grade and recent mathematics score? (ii) How does math anxiety differ by students' gender, A-level math entry grade and recent mathematics score? (iii) How does math self-efficacy relate with math anxiety? Descriptive statistics revealed a high level of math self-efficacy and a low level of math anxiety among the students. Independent sample t tests revealed no gender differences in math self-efficacy and math anxiety and ANOVA suggested no differences in math self-efficacy and math anxiety for the A-level math entry grades and recent mathematics scores. PLCC revealed a strong significant negative linear correlation between math self-efficacy and math anxiety with $r = -0.782$. Meanwhile, regression analysis suggested that math self-efficacy explained 60% of math anxiety among A-level students in Mayuge District. Given that the A-level students had a high level of math self-efficacy and a low level of math anxiety and yet their recent mathematics score was still very low, there could be other reasons for this status quo that warrants further research. Thus, we recommend further studies on other factors such as parenting style, teachers' pedagogical practices and availability of teaching and learning resources that affect the students' mathematics scores.

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