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ANTECEDENTS OF THE THEORY OF PLANNED BEHAVIOR AS CORRELATES OF MATH ANXIETY AMONG STUDENTS IN RURAL SECONDARY SCHOOLS IN WESTERN UGANDA

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Abstract:
Mathematical abilities have been linked to positive outcomes and well-being in adults, although secondary school students in Western Uganda still exhibit math anxiety. Thus, the purpose of the study was to investigate the correlation between the antecedents of the theory of planned behavior (TPB) and math anxiety among students in rural secondary schools in Western Uganda, Ntungamo District, Ruhaama County. Using a quantitative approach, data were collected from a random sample of 578 students using a self-administered questionnaire. Data at the bivariate and multivariate levels were analyzed using Pearson's Linear Correlation Coefficient and multiple regression analysis respectively. Considering the three antecedents of TPB namely perceived behavioral control, attitude and subjective norms, the study at the bivariate level found that all the three antecedents of TPB positively significantly correlated with math anxiety, thus supporting all the three study hypotheses. At the multivariate level, while all the three TPB antecedents correlated with math anxiety, the correlation between attitude and math anxiety was not statistically significant. Further, subjective norms were the strongest predictor of math anxiety in this particular context. The implication is that interventions with parental views and perceived usefulness of mathematics among students should be dealt with in order to lower the levels of math anxiety among students in rural secondary schools in Western Uganda.

Keywords: attitude, math anxiety, theory of planned behavior (TPB), perceived behavioral control, subjective norms, Uganda

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1. Introduction

Mathematics is necessary for creativity, without which, modern key technologies and systems would be nonexistent. In fact, without mathematics, the entire universe would most likely remain a complete mystery to its inhabitants. For, mathematical skills are not only essential for academics, but also for the contemporary society (Skagerlund, Ostergren, Vastfjall, & Traff, 2019). Mathematical skills play a fundamental role in scientific thought, the course of industrialization and technological advancements (Rubinstein & Tannock, 2010) among much more, making it hard to live a normal life in the 21st century without making use of mathematics of some sort (Sevindir, Yazici, & Yazici, 2014). Owing to its pervasive, direct and fundamental role in life, a deficiency in mathematical skills is a significant barrier to facets of life (Dogan & Yurtcu, 2015; Bekdemir, 2010).

Although strong mathematical abilities have been linked to positive life outcomes and well-being in adults (Skagerlund, et al., 2019; Wilson, 2014), students still exhibit anxious tendencies when confronted by mathematics (Maloney, Waechter, Risko, & Fugelsang, 2012), thus impeding their mathematical skills. While there could be several other factors that harmfully affect students' forecasts of achieving passable mathematical skills, math anxiety is one (Wahid, Yusof, & Razak, 2014). Math anxiety has been defined as the "*feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations*" (Richardson & Suinn, 1972, p. 551). Thus, Hill, Mammarella, Devine, Caviola, Passolunghi, Szűcs (2015), maintain that math anxiety affects cognitive, affective and physical behaviors, and consequently psychologically related to problem-solving difficulties that are as a result of distressing past experiences. According to Hannula (2012), affect explains an array of facets of the human mind that go beyond cognition, for instance beliefs or the experience of feelings and emotions. The early affective research was instigated by social psychologists in the 1970s (Hannula, 2014) and concentrated on studies of math anxiety and attitude and these kinds of studies continue to date (Ingram, 2017).

Math anxiety has been found to have several undesirable outcomes (Bai, 2011) among students. For example, it affects how students behave and feel (Adimora, Nwokenna, Omeje, & Eze, 2015), causes low self-esteem (Sevindir, et al., 2014), loss of confidence (Stoehr, 2016), negative thinking (Filippatou, Pantazi, & Triandafillidis, 2016), and disappointments leading to an inability to complete learning tasks (Lyons & Beilock, 2011). Further, math anxiety also makes it easy for students to forget mathematical concepts (Young, Wu & Menon, 2012). According to Jameson (2013), highly mathematics anxious students report no enjoyment of mathematics, view mathematics as less useful compared to other subjects, have a negative attitude towards the teachers, have little motivation and low self-efficacy.

Consequently, mathematics anxious students have long-term bearings such as avoidance of courses and careers involving mathematics hence, affecting their adult and social lives (Luttenberger, Wimmer, & Paechter, 2018). Brunye, Mahoney, Giles, Rapp, Taylor, and Kanarek (2013) support the above view by opining that "*students with high [math] anxiety avoid mathematics exposure in both daily life …. and formal education coursework…., ultimately resulting in lower exposure to mathematics, reduced practice using mathematics principles, and reduced workforce in mathematics competence*" (p. 2).

Buckley (2013) posits that the causes of math anxiety include students failing to admit to their personal difficulties with and lack of interest in mathematics. Corollary, students who do not concede that mathematics is hard to them are likely going to fail it because failure to admit to problems can be an obstacle towards working hard to achieve higher grades. Paechter, Macher, Martskvishvili, Wimmer, and Papousek (2017) argue that persistent poor performance in mathematics leads to math anxiety. In addition, failure to understand mathematical concepts leads to negative emotions towards mathematics and low motivation (Arslan, Deringol-Karatas, Yavuz, & Erbay, 2015) and accordingly diminishes the attitude towards mathematics, leading to loss of hope as some students start tagging mathematics as hard, terrible, among others. Bandura (1982) contends that success builds robust belief and retrospectively failure undermines it, hence failure at first time may lead to successive failure since students are discouraged. Krinzinger, Kaufmann, and Willmes (2009) support this analogy by asserting that emotional factors influence cognitive abilities. Thus, it would be right to argue that persistent failure in mathematics will lead to rather continued failure of such a student unless guided otherwise.

The performance expectations of parents also cause math anxiety. According to Mutodi and Ngirande (2014), mathematics anxious parents tend to make their children anxious as well. They further add that students' prior negative experiences at home or school cause math anxiety as these two form for students a background in mathematics. Corollary, a weak foundation cannot lead to a robust building. On the same note, Wahid, Yusof, and Razak (2014) maintain that negative experiences with parents in viewing mathematics also affects the students' attitudes and beliefs. The involvement of parental and societal beliefs influence students' perceptions in mathematics. On their part, Abbasi, Samadzadeh, and Shahbazzadegan (2013) assert that environmental factors have a high effect on human personality development. Among these environmental factors is culture, that is, the way how things are done and perceived. Culture has a detrimental effect on learning of mathematics since the cultures formed in schools, homes, and communities in general form perceptions, beliefs, and attitudes of the students.

Mutodi and Ngirande (2014) assert that a teacher is the primary cause of math anxiety. They noted that when a teacher is anxious about mathematics, yet charged with teaching students the subject, their anxiety will have consequences on the students' learning and will subsequently affect their performance for the reason that the teacher's expectations might at times be low. When teachers have a bad attitude about mathematics and lack confidence in their pedagogical practices, this will trigger anxiety among students (Zakaria, Zain, Ahmad, & Erlina, 2012). Bekdemir (2010) noted that teachers also cause math anxiety as a result of their teaching approaches that they faced within the past. Additionally, most teachers teach the way they were taught (Batiibwe, 2018). Several researchers have tried to establish relationships between the numerous predictors of math anxiety and math anxiety itself. For example, Abbasi et al. (2013) found a significant negative relationship between the students' math anxiety and their self-esteem; a significant relationship between math anxiety and the teacher's personality characteristics; a substantial difference between math anxiety of male and female students; and no significant association between math anxiety and educational levels.

Brunyé, et al. (2013) realized that participants with high math anxiety underperformed relative to those with low math anxiety. Çatliolu, Birgin, Costu, and Gürbüz (2009) found the degree of math anxiety among elementary school teacher trainees to be small and their gender differences to be significant. They also discovered significant differences between math anxiety and class, perceived ability, and perceived success levels. Mutodi and Ngirande (2014) found higher math anxiety levels among females than males. Olmez and Ozel (2012) found significant differences between math anxiety and perceived enjoyment of mathematics; and perceived appreciation of the mathematics teacher and mathematics achievement. They also found lower anxiety scores obtained among female students than male students and those students who liked their mathematics teachers had significantly lower math anxiety.

Sepehrianazar and Babaee (2014) found that parenting styles had a direct effect on math anxiety. Sevindir, et al., (2014) found that while students whose mothers' educational level was uneducated stated more negative responses than others, those whose fathers had a lower level of education stated more positive responses. They further found that students with lower grades gave more negatives responses as compared to the students with higher grades who felt less anxious. Wahid, et al., (2014) found that psychological factors scored highest about math anxiety followed by environmental and assessment factors respectively. They also discovered that students' performance much depended on math anxiety revealing that the higher the math anxiety, the lower the score in mathematics performance.

From literature, the predictors of math anxiety can be broadly categorized as those related to the students themselves (Ashkenazi & Danan, 2017) like emotions, attitude, level of confidence, performance, age, gender, motivation, self-esteem, self-efficacy, self-concept; those that are related to teachers, for example assessment, teaching methods (Batiibwe, 2018); and the environment related factors such as the family background, community, cultures, and peers (Kvedere, 2014). Although the predictors of math anxiety have been presented by the various scholars as well as their relationships with math anxiety itself, Luttenberger, et al., (2018) argue that "*to understand how math anxiety takes effect, it has to be regarded as a variable within an ensemble of interacting variables*" (p. 311). According to them, they proposed three antecedents that facilitate the development of math anxiety namely environmental factors, societal stereotypes and personal factors. With reference to Luttenberger, et al.'s submission, this study regarded math anxiety as a variable within an ensemble of antecedents of the theory of planned behavior (TPB). Considering math anxiety as feelings, Ajzen (1991) maintains that attitude toward behavior, subjective norms, and perceived behavioral control, collectively influence behavioral intention, which then directly influences behavior. Thus, attitude toward behavior, subjective norms, and perceived behavioral control are the three constructs of TPB.

Behavioral intention (BI) is defined as a person's "*subjective probability that he or she will engage in a given behavior*" (Committee on Communication for Behavior Change in the 21st Century, 2002, p. 31). Ajzen (1991) argued that since BI is the most proximate predictor of behavior, it reflects how hard a person is willing to try, and how motivated he or she is, to perform the behavior. While Ajzen further defined attitude toward performing the behavior as a positive, negative or mixed evaluation of an object that is expressed at some level of intensity, he defined subjective norms as perceptions of what important others think about the behavior. Ajzen introduced the construct of perceived behavioral control in TPB as a determinant of both behavioral intention and of the behavior itself. Perceived behavioral control according to Ajzen refers to a person's perception of their ability to perform a given behavior.

Consequently, on a conceptual basis, perceived behavioral control is similar to self-efficacy since both constructs refer to the measure of the extent to which a person believes that their behavior in question is under control. Although, operationally perceived behavioral control is every so often assessed by the ease or difficulty of the behavior, while self-efficacy is operationalized by a person's confidence in being able to carry out the behavior in the face of explanatory settings (Committee on Communication for Behavior Change in the 21st Century, 2002). Meanwhile, self-esteem as defined by Du, King and Chi (2017) is confidence in one's own abilities or worth. Thus, the purpose of this study was to investigate the correlation between TPB constructs and math anxiety among students in rural secondary schools in Western Uganda. In terms of TPB, this study operationalized perceived behavioral control as students' self-esteem and students' mathematics self-efficacy; subjective norms as perceived usefulness of mathematics and parental views towards mathematics and attitude as the extent students have a favorable or unfavorable evaluation of their perceptions towards their mathematics teachers and the help that they get from their mathematics teacher. Thus, the study sought:

1) To ascertain whether or not a relationship between math anxiety and perceived behavioral control existed among secondary school students in Western Uganda
2) To find out whether or not a relationship between math anxiety and attitude existed among secondary school students in Western Uganda
3) To examine whether or not a relationship between math anxiety and subjective norms existed among secondary school students in Western Uganda

This research sought validity or otherwise of the following hypotheses:

H$_1$: There was a statistically significant relationship between math anxiety and perceived behavioral control among secondary school students in Western Uganda.

H_2: There was a statistically significant relationship between math anxiety and attitude among secondary school students in Western Uganda.

H_3: There was a statistically significant relationship between math anxiety and subjective norms among secondary school students in Western Uganda.

2. Literature Review

Several researchers (e.g. Abbasi et al., 2013; Filippatou et al., 2016; Luttenberger et al., 2018; Paechter et al. 2017; Skagerlund et. al., 2019) have investigated math anxiety among different level learners. For example, Abbasi et al. (2013) studied the relationship between math anxiety among high school students and their self-esteem and teachers' personality characteristics. They categorically chose 480 students and 60 mathematics teachers in accordance with their characteristics. Having collected data through the use of self-esteem, math anxiety and personality questionnaires, they analyzed them using one-way ANOVA, Scheffe post hoc test, the t-test, the correlation coefficient and descriptive statistics. They found a negative significant relationship between the students' math anxiety and their self-esteem; a significant relationship between the students' math anxiety and their teachers' personality characteristics; and no significant relationship between the students' math anxiety and their education levels. Further, Abbasi et al. found a significant difference between the math anxiety of humanities and natural science students as well as a significant difference between the math anxiety of male and female students.

Filippatou et al. (2016) investigated whether teaching mathematics with the use of manipulatives could help Grade 5 elementary school pupils reduce math stress and hence whether this teaching approach could contribute to a better understanding of fractions concepts as well as creating positive feelings about mathematics. They used a quasi-experimental design pre and post with two groups of eleven-year old children. The experimental and control groups each comprised 24 children, thus a total of 48 children participated in the study. Before the intervention, both groups had the same level of mathematics knowledge of fractions. They then implemented an educational programme using manipulatives in the experimental group for 12 teaching hours while the control group followed traditional teaching. In both groups, before and after teaching, research materials included an informal mathematics achievement test, the anxiety rating scale for mathematics and semi-structured pupil interviews exploring misunderstanding of fractions and their feelings about mathematics. Further, during the implementation phase of the programme in the experimental group, Filippatou et al. carried out observations alongside with a class teacher and a non-participant observer. Their results indicated that Grade 5 elementary school pupils exhibited high test anxiety in mathematics before the intervention, thus, they found a statistically significant reduction of test anxiety as well as of global math anxiety after the intervention. Furthermore, through achievement tests and error analysis, they found that after the intervention, pupils had statistically significant improvement of their understanding of fractions and that pupils had improved their attitude towards mathematics and increased self-confidence in mathematics activities.

Luttenberger et al. (2018) provided a spotlight on math anxiety by (1) describing the phenomenon of math anxiety, including information on its prevalence and on how it differs from other forms of anxiety (2) explaining which variables or antecedents influence the occurrence of math anxiety, which variables interact with it, and the educational outcome of math anxiety (3) introducing instruments for the measurement of math anxiety in different age groups and (4) describing possible means to prevent or reduce math anxiety. From their review, Luttenberger et al. noted that individuals may suffer from specific forms of test and performance anxiety that are connected to a knowledge domain but the most prominent of these is math anxiety, which is a widespread problem for all ages across the globe. They further observed that the antecedents that facilitate the development of math anxiety concern (1) environmental factors such as teachers; and parents' attitudes towards their students' and children's ability in mathematics (2) societal stereotypes such as on females' mathematics abilities or (3) personal factors such as traits or gender. Thus, they contend that a first step lies in the correct diagnosis of math anxiety and that questionnaires for its assessment exist for all age groups, starting at primary education level. According to Luttenberger et al., in order to prevent or reduce math anxiety, help can be offered on different levels by educational institutions, by teachers and a change in instructional approaches, by parents or by the affected person.

Paechter et al. (2017) investigated whether statistics anxiety is a genuine form of anxiety that impairs students' achievements or whether learners mainly transfer previous experiences in mathematics and their anxiety in mathematics to statistics. Thus, they investigated the relationship between mathematics anxiety and statistics anxiety, their relationship to learning behaviors and to performance in a statistics examination using a sample of 225 undergraduate psychology students, of which 164 were women, while 61 were men. They recorded their data at three points in time. At the beginning of term, they assessed the students' math anxiety, general proneness to anxiety, school grades and demographics. Two weeks before the end of term, the students completed questionnaires on statistics anxiety and their learning behavior. At the end of term, Paechter et al. recorded examination scores. Using descriptive statistics, correlation coefficient and structural equation modeling, they found that math anxiety and statistics anxiety correlated highly but the comparison of different structural equation models showed that they had genuine and even antagonistic contributions to learning behaviors and performance in the examination. They also found math anxiety to be positively related to performance and that via statistics anxiety, math anxiety also had a negative contribution to performance. According to their findings, statistics anxiety contributed indirectly and negatively to performance and a direct negative impact on performance. Thus, the results of their study spoke for shared but also unique components of statistics anxiety and math anxiety.

Skagerlund et al. (2019) sought to find out how mathematics anxiety impaired mathematical abilities by investigating the link between math anxiety, working memory and number processing. Using structural equation modeling, Skagerlund et al. contrasted the different ways in which math anxiety has been suggested to interfere with mathematics abilities. Their models indicated that math anxiety may affect mathematics performance through three pathways namely (1) indirectly through working memory ability, giving support for the 'affective drop' hypothesis of math anxiety's role in mathematical performance, (2) indirectly through symbolic number processing, corroborating the notion of domain-specific mechanisms pertaining to number, and (3) a direct effect of math anxiety on mathematics performance. Further, they found that the pathways vary in terms of their relative strength depending on what type of mathematical problems are being solved. Their findings shed light on the mechanisms by which math anxiety may interfere with mathematical performance.

From the five articles reviewed for this study, one major gap emerges. Although all the studies have discussed math anxiety with concepts of anxiety such as self-efficacy, gender-related differences, mathematics performance, test anxiety, mathematics achievement among others, none of them has drawn concepts from a theory or theoretical/ conceptual framework, which gap this study sealed.

3. Methodology

3.1 Research Design

Being positivist in nature, the study employed a cross-sectional correlational survey research design. The study was a survey in that it involved large numbers of respondents to enable generalization of findings (Bakkabulindi, 2015). The study adapted a cross-sectional survey design because it collected data to make inferences about secondary school students in Western Uganda who are similar in other characteristics such as geographical location but different in a key factor of interest namely math anxiety, at one given point of time once and for all (Creswell, Klassen, Clark & Smith, 2011). The study employed a correlational research design due to the primary interest in determining non-causal relationships among variables and as such this design helped in establishing the relationships between constructs of TPB and math anxiety.

3.2 Sample

Uganda's secondary school system has two levels namely the ordinary level (O level) and advanced level (A level). O level has a duration of four years, after which candidates sit for their end of level national examinations termed Uganda Certificate of Education (UCE) examinations. After their O level, students join the A level which is two years long. At the end of two years, these students sit for their national examinations termed Uganda Advanced Certificate of Education (UACE) examinations, which actually guarantee their university entry. Uganda has 134 districts which are grouped into four administrative regions namely central, eastern, northern and western regions of which western Uganda has 26 districts. Mathematics performance of students from western Uganda is not at its best (Kizza, 2020) and although there are several factors responsible for this status quo such as poor teaching methods, inadequate science and mathematics teachers and math anxiety (Kiwanuka, Damme, Noortgate, Anumendem & Namusisi, 2015), this study focused on exploring math anxiety. Thus, quantitative data were collected from two purposively sampled rural secondary schools in Western Uganda, Ntungamo District - Ruhaama County. One of the schools was a public secondary school and the other a private owned secondary school, with both O and A levels of education. These schools were among those whose students were not normally performing highly in national examinations especially in basic sciences (Mathematics, Physics, Biology, and Chemistry) and had no differences in mathematics attainment. Simple random sampling was used to select a total of 578 students across both O and A levels from these schools.

3.3 Measures

A self-administered questionnaire (SAQ) was used to collect data from the respondents. The SAQ had three sections namely A, B and C. Section A contained the demographic profile of learners including gender, age, class, academic level, parents' level of education and respect for mathematics teacher and appreciation of their teaching. Section B was on math anxiety. This section had 14 items adopted from Bai, Wang, Pan and Frey (2009). Section C was on the constructs of TPB namely perceived behavioral control (PBC), attitude (AT) and subjective norms (SN) and had 41 items in total. The PBC construct of TPB had 15 items and was conceptualized as students' self-esteem and students' mathematics self-efficacy. While students' self-esteem had 10 items adopted from Rosenberg (1965), students' mathematics self-efficacy had five items adopted from Xing and Hari (2009).

The AT construct of TPB had 12 items and was conceptualized as students' perceptions of their mathematics teacher and the help that they got from their mathematics teacher. While students' perceptions of their mathematics teacher had six items adopted from Marchis (2011), help with mathematics teacher had six items adopted from University of London (2008). The SN construct of TPB had 14 items and was conceptualized as perceived usefulness of mathematics and parental views towards mathematics. While perceived usefulness of mathematics had three items adopted from Marchis (2011), parental views towards mathematics had 11 items adopted from University of London (2008). Students rated themselves on items in Sections B and C on a four point Likert scale ranging from 1 to 4 where 1 = strongly disagree (SD), 2 = disagree (D), 3 = agree (A), 4 = strongly agree (SA).

3.4 Data Analysis

Data were analyzed both descriptively and inferentially. Descriptive analysis involved computation of relative frequencies and descriptive statistics such as means on the numerical variables. At this stage, analyses were univariate; that is analyzing one variable at a time. For inferential statistics, correlation and regression analysis were used in the testing of hypothesis (Ali & Bhaskar, 2016). Inferential data analysis involved testing hypotheses in two ways namely bivariate and multivariate levels. At the bivariate level, math anxiety was related to the respective background variables using student's sample t test or ANOVA. Furthermore, at this level, hypotheses of the study were tested using Pearson's Linear Correlation Coefficient by correlating the respective numerical aggregate index of each of the TPB constructs to an equally numerical aggregate index of math anxiety. At multivariate level, multiple regression was used to test the three hypotheses to rank the TPB constructs in terms of the strengths of their relationship with math anxiety.

4. Results

4.1 Demographic Characteristics of the Respondents

In the study, the sample size was 578 students from two rural secondary schools in Western Uganda, Ntungamo District, Ruhaama County. Data on the background of the students were collected to help in determining whether the data collected were appropriate to the study population. The distribution of the students by gender, age, class, academic level, parents' level of education and respect for their mathematics teacher and appreciation of their teaching is illustrated in Table 1.

Table 1: Classification of Respondents

Description	Category	Count	Percent
Gender	Female	260	45.0
	Male	318	55.0
Age	10-14	34	5.9
	15-19	352	60.9
	20 years and above	192	33.2
Class	S.1	24	4.2
	S.2	124	21.5
	S.3	238	41.2
	S.4	56	9.7
	S.5	62	10.7
	S.6	74	12.8
Academic level	O level	422	73.0
	A level	156	27.0
Parents' level of Education	No education	58	10.0
	Primary level	226	39.1
	Secondary level	206	35.6
	University level	88	15.2
Respect for mathematics teacher and appreciation of their teaching	Yes	464	80.3
	No	114	19.7

Table 1 shows that the typical respondent was a male (55%), aged between 15 and 19 years (60.9%) in S.3 (41.2%), an O level student (73.0%), with parents whose highest level of education was primary (39.1%) and respected their mathematics teacher and appreciated their teaching (80.3%).

4.2 Variations of Mathematics Anxiety with Background Variables

In this subsection, the researchers were interested in finding out whether math anxiety varied with the respondents' background variables namely gender, age, class, academic level, parents' level of education and respect for the students' mathematics teacher and appreciation of their teaching. To find out how math anxiety varied with the respondents' gender, academic level and respect for students' mathematics teacher and appreciation of their teaching, student's sample t test was used, and the results are presented in Table 2.

Table 2: Student's t-test Results of Math Anxiety by Gender, Academic Level, and Respect for Students' Mathematics Teacher and Appreciation of their Teaching

	Category	Count	Mean	Standard Deviation	t-value	p-value
Gender	Female	260	2.71	0.47	-0.676	0.499
	Male	318	2.74	0.43		
Academic level	O level	422	2.76	0.46	3.041	0.003
	A level	156	2.64	0.40		
Respect for mathematics teacher and appreciation of their teaching	Yes	464	2.76	0.43	3.296	0.001
	No	114	2.60	0.49		

The results in Table 2 on gender show that males had the largest sample size (n = 318) with the highest mean of 2.74. Since its p-value of 0.499 was greater than $\alpha = 0.05$, then at the 5% level of significance, the t statistic (t = -0.676) was very small implying that the mean scores on math anxiety for males and females did not differ significantly and could be attributed to chance. Both the males and females had high mean scores indicating that they both had high math anxiety, irrespective of gender. Regarding academic level, O level students had the largest sample size (n = 422) with the highest mean of 2.76. Since its p-value of 0.003 was less than $\alpha = 0.05$, then at the 5% level of significance, the t statistic (t = 3.041) was big enough implying that the mean scores on math anxiety for O and A levels differed significantly and could not be attributed to chance. Thus, O level students had a higher mean score indicating higher math anxiety as compared to the A level students. On the issue of students' respect for their mathematics teacher and appreciation of their teaching, those who did had the largest sample size (n = 464) with the highest mean of 2.76. Since its p-value of 0.001 was less than $\alpha = 0.05$, then at the 5% level of significance, the t statistic (t = 3.296) was big enough implying that the mean scores on math anxiety for the two responses, yes or no, differed significantly and could not be attributed to chance. Hence, students who respected their mathematics teacher and appreciated their teaching tended to have higher math anxiety levels than those who did not.

To find out whether math anxiety varied with respondents' age, class and parents' level of education, one-way ANOVA was carried out to that effect and the results are presented in Table 3.

Table 3: ANOVA Results of Math Anxiety by Students' Class, Age, Parents' Level of Education

		Count	Mean	Standard Deviation	F	p-value
	10-14	34	2.66	0.36		
Students' age	15-19	352	2.77	0.39	4.033	0.018
	20 years and above	192	2.66	0.55		
	S.1	24	2.63	0.31		
Students' class	S.2	124	2.75	0.43		
	S.3	238	2.76	0.49	1.291	0.266
	S.4	56	2.75	0.47		
	S.5	62	2.68	0.42		
	S.6	74	2.64	0.37		
Parents' level	No education	58	2.84	0.48		
of Education	Primary level	226	2.70	0.39	1.615	0.185
	Secondary level	206	2.73	0.43		
	University level	88	2.73	0.60		

The results in Table 3 on students' age show that the students aged between 15 and 19 had the largest sample size (n = 352) with the highest mean of 2.77. Since its p-value of 0.018 was less than $\alpha = 0.05$, then at the 5% level of significance, the F statistic (F = 4.033) was big enough implying that at least two mean scores on math anxiety for the three age groups differed significantly and could not be attributed to chance. This means that the students between the age of 15 and 19 years had higher math anxiety as compared to the rest of the age groups, indicated by their higher mean score. Regarding students' class, Senior Three (S.3) students had the largest sample size (n = 238) with the highest mean of 2.76. Since its p-value of 0.266 was greater than $\alpha = 0.05$, then at the 5% level of significance, the F statistic (F = 1.291) was small implying that the mean scores on math anxiety for the six classes did not differ significantly and could be attributed to chance. This indicated that, irrespective of the class level, all students had high math anxiety, as revealed by the high mean scores.

On the issue of parents' level of education, although parents who had no education at all registered the highest mean of 2.84, students whose parents had attained only up to the primary level had the largest sample size (n = 226) with the lowest mean of 2.70. Since its p-value of 0.185 was greater than $\alpha = 0.05$, then at the 5% level of significance, the F statistic (F = 1.615) was small implying that the mean scores on math anxiety for the four parents' levels of education did not differ significantly and could be attributed to chance. Thus, irrespective of their parents' level of education, the students had high mathematics anxiety as indicated by the high mean scores.

4.3 Description of Mathematics Anxiety and TPB Constructs

Math anxiety among the secondary school students was measured using 14 quantitative items. The students were asked to rate themselves on math anxiety during their mathematics classes. Each of the 14 items was measured using the four-point Likert scale ranging from 1 to 4 where 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Agree (A), and 4 = Strongly Agree (SA). To establish an overall picture of how students rated themselves on math anxiety, an average index of math anxiety was computed for all the 14 items measuring math anxiety. TPB constructs were used to conceptualize the predictors of math anxiety namely perceived behavioral control (students' self-esteem and students' mathematics self-efficacy); attitude (students' perception towards their mathematics teacher and the help that students get from their mathematics teacher); and subjective norms (parental views towards mathematics and perceived usefulness of mathematics).

Students' self-esteem, students' mathematics self-efficacy, students' perception towards their mathematics teacher, teachers' help with mathematics, perceived usefulness of mathematics and the students' parental views towards mathematics each had 10, 5, 6, 6, 3 and 11 quantitative items respectively which required students to rate themselves in terms of TPB constructs during their mathematics classes. The responses were based on a four-point Likert scale ranging from 1 to 4 where 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Agree (A), and 4 = Strongly Agree (SA). To establish an overall picture of how students rated themselves on TPB constructs, an average index of each TPB construct was computed for all the 15, 12, and 14 items respectively measuring the TPB constructs. Table 4 gives the statistics generated namely means of the items on math anxiety and TPB constructs and their respective standard deviations.

Table 4: Descriptive Statistics of Math Anxiety and TPB Constructs

TPB Constructs	Mean	Standard Deviation
Mathematics Anxiety	2.73	1.12
Perceived Behavioral Control	2.79	0.94
Attitude	3.03	0.97
Subjective Norms	2.89	1.02

Table 4 shows that the responses to the items on math anxiety had a mean of 2.73. Considering the mean of 2.73 close to code 3 which corresponded to agree, the results suggested that the respondents had math anxiety. The responses to the items on perceived behavioral control had a mean of 2.79 which was close to code 3 that corresponded to agree. This result suggested that the respondents' perceived behavioral control contributed towards their math anxiety. The responses to the items on students' attitude had a mean of 3.03. Considering the mean of 3.03 close to code 3 which corresponded to agree, the results suggested that the respondents' attitude towards mathematics caused their math anxiety. The responses to the items on subjective norms had a mean of 2.89. The mean of 2.89 was close to code 3 which corresponded to agree, meant that students' math anxiety was caused by subjective norms. The standard deviation of math anxiety and TPB constructs in Table 4 suggested a minimal deviation from the means of the items on math anxiety and TPB constructs.

4.4 Testing Hypotheses

The study hypotheses were tested at two levels namely the bivariate and multivariate levels. At the bivariate level, the three hypotheses of the study were tested using Pearson's Linear Correlation Coefficient (PLCC). Table 5 gives the necessary correlation matrix.

Table 5: PLCC output for Math Anxiety and TPB Constructs

	Mathematics Anxiety	Perceived Behavioral Control	Attitude	Subjective Norms
Mathematics Anxiety	1			
	-			
Perceived Behavioral Control	0.172**	1		
	0.000	-		
Attitude	0.148**	0.166**	1	
	0.000	0.000	-	
Subjective Norms	0.275**	0.365**	0.184**	1
	0.000	0.000	0.000	-

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

According to Table 5, Pearson's Linear Correlation Coefficient (PLCC) was computed for math anxiety and perceived behavioral control and the results ($r = 0.172$, $p = 0.000$) indicated that there was a positive ($r > 0$) but quite weak correlation between math anxiety and perceived behavioral control. However, since its significance level ($p = 0.000$) was less than $\alpha = 0.05$ ($p < 0.05$), the null hypothesis to the effect that there was no statistically significant relationship between math anxiety and perceived behavioral control was rejected at the 5% level of significance, thus accepting H_1. This suggested that math anxiety and perceived behavioral control were significantly positively linearly correlated, although the correlation was quite weak. Thus, PLCC supported the first hypothesis, H_1. Pearson's Linear Correlation Coefficient (PLCC) was computed for math anxiety and attitude and the results ($r = 0.148$, $p = 0.001$) indicated that there was a positive ($r > 0$) but quite weak correlation between math anxiety and attitude. However, since its significance level ($p = 0.001$) was less than $\alpha = 0.05$ ($p < 0.05$), the null hypothesis to the effect that there was no statistically significant relationship between math anxiety and attitude was rejected at the 5% level of significance, thus accepting H_2. This suggested that math anxiety and attitude were significantly positively linearly correlated, although the correlation was quite weak. Thus, PLCC supported the second hypothesis, H_2.

Pearson's Linear Correlation Coefficient (PLCC) was computed for math anxiety and subjective norms and the results ($r = 0.275$, $p = 0.000$) indicated that there was a positive ($r > 0$) but quite weak correlation between math anxiety and subjective norms. However, since its significance level ($p = 0.000$) was less than $\alpha = 0.05$ ($p < 0.05$), the null hypothesis to the effect that there was no statistically significant relationship between math anxiety and subjective norms was rejected at the 5% level of significance, thus accepting H_3. This suggested that math anxiety and subjective norms were significantly positively linearly correlated, although the correlation was quite weak. Thus, PLCC supported the third hypothesis, H_3.

At the multivariate level, multiple regression analysis was used. Thus, using a multiple regression model, math anxiety (MA) was regressed on perceived behavioral control (PBC), attitude (AT), and subjective norms (SN). The following mathematical model was developed;

$$MA = \beta_1 PBC + \beta_2 AT + \beta_3 SN \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (i)$$

Where any beta was positive, it meant that MA was positively related to the corresponding constructs; and where any beta was negative, it meant that MA was negatively related to the corresponding constructs. Each of these betas was accompanied by a p-value which was used to determine whether a given beta was significant. The relevant statistics including the betas and their p-values that were generated by SPSS are given in Tables 6 and 7.

Table 6: ANOVA Results of Regression of MA on PBC, A and SN

F	p-value	Adjusted-R square
21.099	0.000	0.174

The adjusted R square was 0.174. When it is multiplied by 100, it gives 17.4%. This means that PBC, AT, and SN explained only 17.4% of the variations of MA. It can be seen from Table 6 that the high F (= 21.099) was accompanied by a p-value of 0.000 which was less than $\alpha = 0.05$ ($p < 0.05$). This meant that equation (i) was quite a good regression model and that the predictors, to an extent, significantly explained math anxiety among students. Table 7 gives the respective betas and their corresponding p-values.

Table 7: Multiple Regression Scores of MA on PBC, A and SN

TPB Constructs	Standardized Coefficients (β)	Significance (p)
Perceived Behavioral Control	0.093	0.018
Attitude	0.021	0.061
Subjective Norms	0.213	0.001

According to Table 7, perceived behavioral control was accompanied with a positive beta (= 0.093) suggesting a positive correlation between math anxiety and perceived behavioral control. Further, its p-value of 0.018 which was less than α (= 0.05) suggested that there was a significant positive correlation at the 5% significant level. Table 7 revealed that attitude was accompanied with a positive beta (= 0.021) suggesting a positive correlation between math anxiety and attitude. Furthermore, its p-value of 0.061 which was greater than α (= 0.05) suggested that there was no significant correlation at the 5% significant level. Subjective norms were accompanied with a positive beta (= 0.213) suggesting a positive correlation between math anxiety and subjective norms. Additionally, its p-value of 0.001 which was less than α (= 0.05) suggested a significant positive correlation at the 5% significant level. Thus, while using multiple regression analysis, the first hypothesis (H_1) and the third hypothesis (H_3) were accepted while the second hypothesis (H_2) was rejected. Of the three TPB constructs that were utilized in this study, subjective norms were the strongest predictor of math anxiety, followed by perceived behavioral control.

5. Discussion

The study intended to establish the relationship between TPB constructs and math anxiety among students in rural secondary schools in Western Uganda. In addition, the background variables of the students in terms of gender, age, class, academic level, parents' level of education and the students' respect for their mathematics teacher and appreciation for their teaching were collected. From data analysis, the mean scores on math anxiety for males and females did not differ significantly. This means that it does not matter what the student's gender is, but both males and females are in the same way affected by math anxiety. This finding is in accord with Olmez and Ozel (2012) and Catliolu, et al. (2009) but contradict the findings of Abbasi, et al. (2014) and Mutodi and Ngirande (2014) who found significant differences between females and males on math anxiety. Furthermore, the finding also contradicts with Wahid, et al. (2014) and Mutodi and Ngirande (2014) who observed that females had a higher level of math anxiety.

While there could be several reasons for the inconsistent results to this effect, we think that context played a part. Given that this study was in the context of a rural setting where performance in mathematics is reported to be consistently poor, this finding is not surprising because usually there are many factors that impede teaching and learning mathematics in rural schools like shortage of teachers. Math anxiety significantly differed between the three age groups namely 10-14, 15-19 and above 20. The students who are aged between 15 and 19 years exhibited the highest level of math anxiety. Mutodi and Ngirande's (2014) finding was in disagreement with this study's finding to the effect that according to them, students who were above 21 years showed a higher level of math anxiety.

This contradiction could be explained by the nature of the curriculum. For example, in Uganda, usually students aged on average above 18 years decide on what they will study at their A level. Chances are very minimal that they will choose subjects which they are anxious about. Thus, we could not expect higher levels of math anxiety at above 20 years of age. Averagely, A level students are between 18 and 19 years but the inclusion of 20 years in our sample was to cater for the students who enroll for school at mature age. Although S.3 students had the highest level of math anxiety, the differences between students' class and math anxiety were not significant. The least level of math anxiety was found among the S.1 students followed by those of S.5 and S.6. This takes us back to the earlier assertion about curriculum to the effect that S. 5 and S.6 study mathematics as a choice, thus the low levels of math anxiety as compared to the other classes.

The study also showed that math anxiety significantly differed between academic levels with students at O level having a higher level than those at A level. This might be because students at A level decide their course combination and thus, choosing mathematics is a personal choice, while those at O level do mathematics as a compulsory subsidiary subject and have no other choice than to do it if they are still in school. Math anxiety among the students did not significantly differ based on their parents' level of education. However, students whose parents had no education at all had a higher level of math anxiety. According to Luttenberger, et al. (2018), in circumstances where parents are also anxious, it is challenging for them to support the students in developing a positive self-confidence so as to prevent the development of math anxiety. In Sevindir, et al.'s (2014) context, they conceptualized parents as mothers and fathers and found that students whose mothers were uneducated were more anxious as compared to those whose fathers had a lower level of education. Regarding math anxiety differences among students who respect or do not respect their mathematics teacher and appreciate their teaching, the finding indicates a significant difference to the effect that those who respect their mathematics teacher and appreciate their teaching had a significantly higher level of math anxiety than those who do not respect their mathematics teacher and appreciate their teaching.

The high level of math anxiety among students who respect their mathematics teacher and appreciate their teaching could be attributed to their fear to disappoint their teacher in terms of knowledge retention and achievement. Meanwhile, this finding contradicts that of Olmez and Ozel (2012) who found no significant difference in the math anxiety of students who did or did not love their mathematics teacher. At the bivariate level, the findings of this study show that there was a significant positive relationship between perceived behavioral control, attitude, subjective norms and math anxiety. This means that students' self-esteem, students' mathematics self-efficacy, perception of their mathematics teacher, the help that students get from their mathematics teacher, perceived usefulness of mathematics, parental views towards mathematics are predictors of math anxiety. This finding is in agreement with Wahid, et al. (2014) who observed that psychological factors such as self-esteem, mathematics self-efficacy, students' perceptions and attitudes affect math anxiety.

At the multivariate level, the study found that while only subjective norms and perceived behavioral control had a significant correlation with math anxiety, subjective norms was the strongest predictor of math anxiety. Meanwhile, according to Wahid, et al., psychological factors were the strongest predictors of math anxiety followed by environmental and assessment factors. In our context, subjective norms was conceptualized as perceived usefulness of mathematics and parental views towards mathematics. This suggests that the students are not sure of how useful mathematics is and will be in their social and adult life. This could probably be because teachers have not opted for instructional approaches that augment students' interest and motivation

(Batiibwe, 2018). For example, by relating mathematics to students' lives and to their daily life circumstances (Luttenberger, et al., 2018).

Although at the multivariate level the correlation between attitude and math anxiety was not significant, it cannot be concluded that attitude is not a strong predictor of math anxiety. Rather, our conceptualization of attitude in this study, which was, students' perceptions of their mathematics teacher and the help that they get from their teacher could either be looked at in a much more broad sense or further broken down to more detailed indicators. However, overall TPB constructs are collectively predictors of math anxiety as revealed by the adjusted R square in Table 6. Lastly, according to the adjusted R square, the TPB constructs explained only 17.4% of the variations in math anxiety, implying that there are several other factors that could explain the variations in students' math anxiety that this study did not consider.

6. Conclusion

The purpose of this study was to establish the relationship between TPB constructs namely perceived behavioral control, attitude and subjective norms and math anxiety among secondary school students in Western Uganda. Although perceived behavioral control, attitude and subjective norms explained the variations in math anxiety, the strongest of these was subjective norms. The implication is that interventions with parental views and perceived usefulness of mathematics among students should be dealt with in order to lower the levels of math anxiety among students in rural secondary schools in Western Uganda.

6.1 Limitations of the Study

The study was carried out in only one of the four regions in Uganda and therefore findings cannot be generalized to all the regions. Further, although the sample was relatively big, it was a composition from only two schools in the entire western regions. The study was purely quantitative in nature, yet the qualitative approach could have given in-depth understanding of the phenomenon at hand, especially on matters regarding perceived behavioral control, attitude and subjective norms.

6.2 Recommendations

Basing on the limitations of this study, similar studies need to be replicated in the remaining three regions of Uganda. Further still, in such studies, it could be better that more schools and students are included in the sample for representative generalization. Future studies could employ a mixed methods approach to tap as much information as possible pertaining to students' math anxiety because qualitative data provides in-depth explanations that could supplement the quantitative data.

Declarations

The authors declare no conflict of interests in this study.

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List of Abbreviations

A	Agree
AT	Attitude
A Level	Advanced Level
ANOVA	Analysis of Variance
BI	Behavioral Intention
D	Disagree
MA	Math Anxiety
O Level	Ordinary Level
PBC	Perceived Behavioral Control
PLCC	Pearson's Linear Correlation Coefficient
SA	Strongly Agree
SAQ	Self-Administered Questionnaire
SD	Strongly Disagree
SN	Subjective Norms
TPB	Theory of Planned Behavior

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Appendix: Self-Administered Questionnaire on Predictors of Mathematics Anxiety in Secondary Schools in Western Uganda

Section A: Demographic Variables

Please answer the following demographic questions by placing a tick against your choice.

1. Gender
   Female…….
   Male…….
2. Age
   10-14 years……..
   15-19 years……..
   20 years and above…….
3. Class
   S.1…..
   S.2…..
   S.3…..
   S.4…..
   S.5…..
   S.6….
4. Level
   O………
   A……….
   Parents level of education
   No education…….
   Primary Level…….
   Secondary Level…….
   University Level…….
5. Respect for your mathematics teacher and appreciation of their teaching.
   Yes……
   No…….

Section B: Mathematics Anxiety

Please rate the following statements in terms of how much you agree or disagree with them. 1 = Strongly Disagree, 2 = Disagree, 3 = Agree and 4 = Strongly Agree

No	Statement	1	2	3	4
1	I find mathematics interesting				
2	I get uptight during mathematics tests				
3	I think that I will use mathematics in the future				
4	My mind goes blank and I am unable to think clearly when doing my mathematics test				
5	Mathematics relates to my life				
6	I worry about my ability to solve mathematics problems				
7	I get a sinking feeling when I try to do mathematics problems				
8	I find mathematics challenging				
9	Mathematics makes me feel nervous				
10	I would like to take more mathematics classes				
11	Mathematics makes me feel uneasy				
12	Mathematics is one of my favorite subjects				
13	I enjoy learning mathematics				
14	Mathematics makes me feel confused				

Section C: Antecedents of the Theory of Planned Behavior (TPB)
Please rate the following statements in terms of how much you agree or disagree with them. 1 = Strongly Disagree, 2 = Disagree, 3 = Agree and 4 = Strongly Agree

No	Statement	1	2	3	4
	Perceived Behavioral Control (PBC)				
	Self-Esteem				
1	I feel that I am a person of worth, at least on an equal plane with others				
2	I feel that I have a number of good qualities				
3	All in all, I am inclined to feel that I am a failure				
4	I am able to do things as well as most other people				
5	I feel I do not have much to be proud of				
6	I take a positive attitude toward myself				
7	On the whole, I am satisfied with myself				
8	I wish I could have more respect for myself				
9	I certainly feel useless at times				
10	At times I think I am no good at all				
	Mathematics Self-Efficacy				
11	I am confident that I can do an excellent job on my mathematics tests				
12	I am certain I can understand the most difficult material presented in mathematics texts				
13	I am confident I can understand the most difficult material presented by my mathematics teacher				
14	I am confident I can do an excellent job on my mathematics assignments				
15	I am certain I can master the skills being taught in my mathematics class				

	Attitude (AT)				
	Your Mathematics Teacher				
16	My teacher explains mathematics enthusiastically				
17	My teacher likes mathematics				
18	My teacher is a good mathematician				
19	My mathematics teacher is one of my favorite teachers				
20	My teacher can arouse my interest for mathematics				
21	My teacher encourages me if I have difficulties with mathematics				
	Help with Mathematics				
22	I need help with mathematics				
23	I do extra mathematics at home (i.e. work not set by teachers)				
	Do any of these people ever help you with your mathematics work?				
24	Someone in my family				
25	My friend(s)				
26	A private tutor				
27	My mathematics teacher				
	Subjective Norms (SN)				
	Utility of Mathematics				
28	Mathematics does not have any connection with the real life				
29	There is a link between mathematics and everyday life				
30	I will use mathematics in my life				
	Your Family's Views				
31	My parents/ guardians understand me				
32	I get along well with my parents/ guardians				
33	I prefer not to talk to my parents/ guardians about issues that concern me				
34	My parents/ guardians are disappointed with what I do				
	Someone in my family:				
35	Wants me to be the best in my class in mathematics				
36	Wants me to talk to them about my mathematics work				
37	Thinks that you have to be born with a mathematics talent to do well at it				
38	Thinks that I should continue with mathematics after my UCE/ UACE				
39	Thinks that anyone can do mathematics if they try hard enough				
	If my general standard of mathematics work slipped, my family would:				
40	Take away privileges or ground me				
41	Threaten to punish me				

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