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Mathematics anxiety among pre-service accounting teachers

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Pre-service accounting teachers perform a variety of calculations in accounting courses, for example, they calculate and compare company financial ratios, calculate dividends, interests, and variances. Mathematics is thus a crucial tool for performing accounting calculations. This paper reports on a study designed in order to investigate pre-service accounting teachers' mathematics anxiety with respect to accounting. The Fennema-Sherman Mathematics Anxiety Scale (F-SMAS), with established reliability and validity, was applied. A cross-sectional data set containing demographic details and attitudes towards mathematics anxiety was collected and quantitative responses of 255 first-, second-, and third-year pre-service teachers were analysed. In addition, semi-structured interviews with 18 pre-service accounting teachers, 6 from each level, were conducted. A sequential explanatory mixed methods design was employed. Data was analysed using the Statistical Package for Social Sciences for quantitative data, and semi-structured interviews were transcribed and analysed qualitatively. The study revealed that the Fennema-Sherman Mathematics Anxiety Scale score is slightly above neutral. Qualitative results reveal that even mathematically competent students are not free from mathematics anxiety. Based on these findings it was concluded that mathematics anxiety affects and influences the way students learn and perform accounting calculations.

Keywords: accounting; accounting calculations; mathematics anxiety; pre-service accounting teachers

Introduction

Pre-service accounting teachers perform a variety of calculations in accounting courses or modules, for example, they calculate and compare company financial ratios, calculate interim and final dividends, provisional and final taxation, dividends, interests, profits or losses, and variances. Pre-service accounting teachers are scored and credited for performing calculations on tests and examinations. Therefore, pre-service accounting teachers are expected to have mathematical expertise. Mathematics is thus crucial for the learning of accounting. It has been claimed that Mathematics is a subject that causes anxiety in many students (Pia, 2015). In South Africa, learners who experience challenges in Mathematics opt for Mathematical Literacy, a subject in Grades 10–12, Further Education and Training (FET) phase, which is a watered-down version of Mathematics in high school. These students usually need support in some areas of Mathematics at tertiary level, especially algebra, because it is not covered in the mathematical literacy syllabus. Grade 12 Mathematics or Mathematical Literacy is an entry requirement for a Bachelor of Education (BEd) accounting degree at the University of KwaZulu-Natal (UKZN), which is the setting for this study. As an accounting lecturer, I have observed students who appear to be capable in mathematics but are so apprehensive about it, that they are rendered helpless when it comes to independently performing accounting tasks, tests, or examinations. Negative attitudes and mathematics anxiety are identified as barriers to learning mathematics and attending courses or choosing jobs/careers that require Mathematics (Birgin, Baloğlu, Çatlıoğlu & Gürbüz, 2010). The dismal mathematical competence of South African high school learners is reflected in the World Economic Forum Global Competitiveness Report 2012/2013 that ranks South Africa last out of 148 countries in mathematics and science education (Schwab & Sala-i-Martín, 2012). South Africa finds itself with shortages in scientifically oriented professions and failure in Mathematics has been a major contributing factor (Mji & Mwambakana, 2008). Chantyl Mulder, a senior executive of the South African Institute of Chartered Accountants, emphasises that mathematics is the key to a prosperous and fulfilling future and that the South African emerging economy is crying out for the skills, which require learners to study Mathematics, not Mathematical Literacy (The South African Institute of Chartered Accountants [SAICA], 2010). Therefore, research into this issue in a developing country like South Africa is important for informing educational contexts in developed countries, where immigration has presented new challenges for those education systems (Mkhize & Maistry, 2017). A major factor that might impact a student's attitude towards accounting, is mathematics anxiety (Joyce, Hassall, Arquero-Montano & Donoso-Anes, 2006). Mathematics anxiety is considered a crucial dimension of attitudes towards mathematics (Fennema & Sherman, 1976). The purpose of this study is to investigate pre-service accounting teachers' mathematics anxiety as it relates to the study of accounting. The research questions for this study were formulated as follows:
1. What is the level of pre-service accounting teachers' mathematics anxiety?
2. What is the relationship between mathematics anxiety and pre-service accounting teachers' demographic variables?

Literature Review

Richardson and Suinn (1972:551) define mathematics anxiety as "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." According to Fennema and Sherman (1976), mathematics anxiety denotes feelings of anxiety, dread, nervousness, and associated bodily symptoms related to doing mathematics. The feelings of anxiety can lead to fear, distress, shame, tension, frustration, indifference, helplessness, mental disorganisation, inability to breath, and loss of ability to concentrate (Gresham, 2007). Mathematics anxiety generally manifests itself in the form of a feeling of tension, apprehension or fear and leads to low self-efficacy in doing mathematics (Ashcraft & Moore, 2009). Mathematics anxiety is at play once a student feels discomfort when asked to perform mathematical tasks.

Haladyna, Shaughnessy and Shaughnessy (1983) differentiate as follows between cognitive mathematics anxiety and affective or somatic mathematics anxiety: cognitive anxiety signifies feelings of low anxiety, worry, poor concentration in decision-making, a sense of confusion, or defeatist self-talk, and affective or somatic anxiety signifies feelings of nervousness, tension, unpleasant, and psychological reactions to testing situations.

Blazer (2011), Peker (2009), Trujillo and Hadfield (1999), and Woodard (2004) categorise internal and external factors that contribute to mathematics anxiety into three areas:

- Environmental factors (external): negative student experiences in the classroom and at home, such as influence of myths, actions of teachers, and attitude of parents, unintelligible textbooks, emphasis on drill and memorisation of formulas without understanding, and poor mathematics teachers.
- Intellectual factors (internal): lack of student self-efficacy (confidence in mathematical ability), poor attitude and lack of persistence, being taught through mismatched learning styles, lack of perceived usefulness of mathematics, inability to understand mathematics concepts, self-doubt, and dyslexia.
- Personality factors (internal): shyness, perfectionism, inability to handle frustration, low self-esteem, viewing mathematics as a male domain, and intimidation.

Newstead (1998) found that mathematics anxiety may be a function of teaching methodologies utilised to teach basic mathematical skills that involve the mechanical, explain-practice-memorise teaching paradigm, and stress memorisation rather than understanding and reasoning. Chewing (2002) points out that mathematics anxiety is not an intellectual problem, but an emotional problem that students can overcome.

Gresham (2007) states that effective mathematics instruction not only prevents the development of mathematics anxiety, but can also reduce it. Mji and Mwambakana (2008) identified first-year students who self-reported mathematics anxiety and sought to determine whether this was a factor in their studies. In a sample of 204 first-year mathematics students in engineering, information technology and natural sciences, a majority of students admitted to have heightened levels of mathematics anxiety. It is suggested that lecturers could use investigations such as this one to identify and isolate highly anxious mathematics students, and that mathematically anxious students could receive remedial psychological assistance or that, at least, lecturers might revise their presentation methods to address these students' needs. A study by Joyce et al. (2006) conducted in the United Kingdom and Spain, on maths anxiety as a barrier to numeracy skills in accounting and business education at the commencement of students' courses in higher education, showed that students preparing to undertake a degree in business studies recorded significantly higher scores for mathematics anxiety than did the accounting students. They noted further that the population statistics indicated that the accounting students were predominantly male and had sound numerate/scientific educational backgrounds.

Yenilmez, Girginer and Uzun (2007:1) found no significant relationship between mathematics anxiety and gender, however some connections were found with other demographic variables. They also found that the finance discipline students had a higher level of mathematics anxiety than the others. Durrani and Tariq (2009:000787) found that "undergraduates showing high levels of mathematics anxiety tended to have negative attitudes toward developing numeracy skills, and that students possessing higher pre-university mathematics qualifications tended to exhibit lower levels of maths anxiety and greater confidence, motivation, enjoyment and competence." Das and Das (2013) point out that since the competency of problem-solving is crucial for the teaching and learning of mathematics, it should be regarded in a positive light to reduce mathematics anxiety. The authors also state that teachers can play an important part in creating a teaching and learning environment by presenting mathematics topics in an activity-oriented way to reduce or block mathematics anxiety. If learners regard mathematics as fun, they will be free of anxiety and enjoy doing mathematics.

The theoretical framework underpinning the study is self-efficacy: the degree to which the student believes that he/she is capable of performing specific tasks (Fast, Lewis, Bryant, Bocian, Cardullo, Rettig & Hammond, 2010). Scarpello (2005:13–14) found that

> the effect of mathematics anxiety on mathematics efficacy is that as mathematics anxiety increases, mathematics self-efficacy decreases, and vice versa. The two constructs are inseparable and influence each other and both directly influence course and career choice. High levels of mathematics anxiety and low self-efficacy can lead the student to avoid mathematics-related careers or high-level mathematics courses in high school and this may in turn affect the student's career choice. Students' interests may be strong enough to counter the adverse effect of mathematics anxiety and low mathematics efficacy on their career choices. It is however possible that students' career

choices may be negatively affected by mathematics anxiety and low mathematics related self-efficacy.

According to Blazer (2011), studies have shown that some students who perform poorly on assessments actually have a full understanding of the concepts being tested, although their mathematics anxiety interferes with their ability to solve mathematical problems. Researchers believe that strategies to reduce or prevent mathematics anxiety will improve the mathematics achievement of many students. Blazer (2011:2–6) summarises strategies that teachers, parents, and students can employ to reduce or prevent mathematics anxiety.

Teachers who use strategies for reducing students' mathematics anxiety:

- develop strong skills and a positive attitude towards mathematics (relate mathematics to real life);
- encourage critical thinking; encourage active learning; accommodate students' varied learning styles;
- put less emphasis on correct answers and conceptual speed;
- organise students into cooperative learning groups;
- provide support and encouragement to their students;
- avoid putting students in embarrassing situations;
- never use mathematics as a punishment;
- use manipulatives and technology in the classroom;
- dispel harmful but popular misconceptions;
- use various assessments.

Parents who use strategies for reducing children's mathematics anxiety:

- do not express negative attitudes about mathematics;
- have realistic expectations;
- provide support and encouragement to their children;
- monitor children's mathematics progress;
- demonstrate positive applications for mathematics.

In order to use strategies for reducing mathematics anxiety, students may:

- practise mathematics every day;
- use good learning techniques;
- study according to their own learning styles;
- not rely solely on memory;
- keep in mind the memory of past successes;
- ask for help;
- practise relaxation techniques.

Rameli, Abdullah, Mislan, Tajuddin, Vân, Rosdi and Chai (2013) concur with the above. Their study concluded that mathematics anxiety could potentially disturb the learning process and that all stakeholders, including teachers, parents, and students, therefore need to look for alternatives to overcome mathematics anxiety.

Integration of mathematics in accounting learning

Integrated study is described as study "in which learners broadly explore knowledge in various subjects related to certain aspects of their environment" (Humphreys, Post & Ellis, 1981:11). An interdisciplinary integrated approach is when teachers integrate the subdisciplines within a subject area. Teachers arrange the curriculum around common knowledge or learnings throughout disciplines and break apart or chunk together the common knowledge or learnings embedded in the disciplines to emphasise interdisciplinary skills and concepts (Drake & Burns, 2004).

In the integrated curriculum priorities that overlap multiple disciplines are examined for common skills, concepts, and attitudes. The advantage of the integrated curriculum is that it encourages students or learners to see interconnectedness and interrelationships among disciplines. Learners become motivated as they see the connections. The disadvantage of the integrated curriculum is that it requires interdepartmental teams with common planning and teaching time. An integrated curriculum has many positive effects: it assists students to apply skills; multiple perspectives produce a more integrated knowledge base, which in turn speeds up retrieval of information; it fosters the depth and breadth of learning; promotes students' positive attitudes toward learning; and gives more time for curriculum exploration (Lake, 1994).

Mathematics is an inseparable component of accounting, as codified by Italian mathematician, Luca Pacioli, in his book introducing the concept of double-entry bookkeeping (Ellerman, 2007). In a study on using mathematics to teach accounting principles, Warsono, Darmawan and Ridha (2009) report that many crucial topics relating to accounting principles could be explained mathematically and that students can understand them easily. Ellerman (2007) also argues that the development of accounting is influenced by three interrelated pillars: (i) Mathematics, which should be firmly founded and upon which accounting may build; (ii) Generally Accepted Accounting Practice (GAAP), which serves to ensure that the development of accounting is understood and accepted by the users; and (iii) engineering skills, which provide a space for users to develop the kind of accounting that is most suited to their needs.

Mwakapenda and Dhlamini (2010) investigated the extent to which teachers make connections between mathematical concepts and other disciplines. They found that the types of connections teachers make are directly linked to teachers' specialisation disciplines. The study also found that in some cases it was impractical, however desirable, to ask of teachers to make connections with disciplines beyond the areas of their specialisation. This resulted in anxiety for students learning mathematics in classrooms where opportunities for making connections between mathematics and other subjects were available, but not used. Likewise, Dorier (2014) reports that in most cases teachers know very little about other subjects, let alone how they are related to their own disciplines. Mathematics teachers do not want to get involved in applications that are too specific, while physics or economics teachers refer learners back to their mathematics teachers for explanations on the use of mathematics in their fields. As a result, learners regard Mathematics and other subjects as disconnected. A study by Davison, Miller and Metheny (1995) indicates that the inclusion of science accounting in a mathematics curriculum, and vice versa, is one way to provide this continuity between schooling and the rest of learners' lives. Students should regard mathematics and the science of accounting as relevant components of their world. Therefore, Mathematics should not be regarded as a discipline studied and applied for the sake of Mathematics, but rather because it helps to make sense of parts of our world. Doing mathematics and doing accounting creates a new way for learners to view the world, and it develops depth (not only breadth) in a mathematics curriculum.

Theoretical Framework

Social cognitive theory highlights the idea that much of human learning occurs in a social environment through observing others, whereby people acquire knowledge of rules, skills, strategies, beliefs, and attitudes (Bandura, 1986). Environmental factors like modelling and persuasion by family members, friends, and teachers also affect students' behaviour. An environment that is learner-friendly and supports responsive behaviour fosters learners' intellectual development. Teachers can have a major influence on learners by using verbal persuasion and emotional arousal to improve learners' self-efficacy (Moodley, 2011).

Bandura (1997:3) describes self-efficacy belief as "the belief or perception that one is capable of organising and executing the actions necessary to succeed at a given task or activity." Mathematics-related self-efficacy is thus the degree to which a learner believes that he/she is capable (competent and effective) of performing a mathematical task or activity (Bandura, 1986). Mathematics self-efficacy deals with cognitive assessment of learners' mathematics competence (Bandura, 1977). Individuals with high self-efficacy are confident, effective, attempt tasks, tend to persist in exhibiting new behaviour, and thus have greater opportunities for receiving feedback about acquired skills. Individuals with low self-efficacy apply minimum effort and, in many cases, give up easily (Sizoo, Jozkowkia, Malhotra & Shapero, 2008; Tollefson, 2000). Learners with low mathematics self-efficacy may regard themselves as incompetent and ineffective in mathematical tasks and unable to think mathematically (Hellum-Alexander, 2010). Teachers may first present problems that learners understand clearly and can solve easily because learners' self-efficacy beliefs may be enhanced. Thereafter teachers may introduce learners to more difficult problems (Erdoğan, Kesici & Şahin, 2011).

Social cognitive theory outlines four sources of information from which efficacy expectations are learnt and that individuals use to judge their own efficacy.

The first source of self-efficacy is performance outcome, or mastery experience, or enactive attainment: individuals' own past experiences influence the ability to perform a given task (successive mastery of tasks helps students to develop and refine skills). If a student believes that he/she was successful in a mathematics task, self-efficacy increases (Harvey, 2012). Britner and Pajares (2006) found that only mastery experiences significantly predicted science self-efficacy. In their study, girls reported stronger science self-efficacy than boys.

The second source of self-efficacy is vicarious experience: individuals can develop high or low self-efficacy vicariously by observing the performances of others (e.g., watching peers succeed at a task). Noble (2011:188) suggests that prior successes can elevate efficacy while prior failures can lower it. He found "that enactive attainment and vicarious experiences were influential sources for African-American male students' self-efficacy beliefs and were supported by family, friends and peers. Vicarious experience was more influential than enactive attainment for these students." This result contradicts Bandura's (1986) assertion that enactive attainment has the most important influence on self-efficacy.

The third source of self-efficacy is verbal persuasion, which may be positive or negative. In their study Zeldin and Pajares (2000) found that verbal persuasion was an essential source of self-efficacy for women who entered mathematical, scientific, and technological careers. These female students were persuaded by their family, teachers, peers, and supervisors. Bandura (1986) found that verbal persuasion did not influence self-efficacy more than an individual's own experiences and vicarious experiences. The results indicate no statistically significant difference between boys and girls in terms of their science self-efficacy levels. With regard to sources of science self-efficacy, mastery experience was found to be the leading source for both boys and girls. Additionally, verbal persuasion and emotional arousal were found to be significant predictors of students' science self-efficacy for both genders. On the other hand, vicarious experience did not significantly predict students' self-efficacy. Findings, in general, support Bandura's theoretical contention regarding sources of self-efficacy (Kiran & Sungur, 2011).

The fourth source of self-efficacy is physiological feedback or emotional arousal. Bandura (1977:198) describes emotional arousal as "one more source of information about performance, for example, assessment of your anxiety when contemplating a dinner speech provides some information about how well you will perform it." Repeated practice reduces emotional arousal; for example, lack of anxiety may be a signal that one possesses skills, meaning that lower levels of mathematics anxiety are related to the highest levels of self-efficacy (Bandura, 1986; Harvey, 2012).

Methodology

The following section provides a description of the methodology adopted to conduct the study.

Research Design, Sampling, Instrument and Analysis

A mixed methods research approach was followed in this study. A sequential explanatory design mixed methods design (Quant $\rightarrow$ qual) was used, which included a sequential collection of both quantitative and qualitative data to provide answers to research questions.

Sequential mixed methods sampling was used. Information from the first sample was used to draw the second sample. In phase one, a cross-sectional data set containing demographic details and their relation to mathematics anxiety was collected. Quantitative responses (255) of first- (179), second- (85), and third-year (35) pre-service accounting teachers were analysed. In phase two, a purposeful choice sample for interviews (18 participants, six from each year of study) was selected from a quantitative sample.

In this study, the Fennema-Sherman Mathematics Anxiety Scale, as the quantitative research instrument based on a five-point Likert scale was used with very minor wording changes to suit the South African context. The following changes were made: Math to Maths/Mathematics, and Grades to Marks/Scores. The mathematics anxiety scale contained 12 items, of which six measured positive attitudes and six measured negative attitudes toward mathematics. The 12 items are under four categories: thinking about maths (four items), taking maths tests (three items), learning maths lessons (two items), and solving maths problems (three items). The following were possible responses: strongly agree, agree, not sure, disagree, and strongly disagree. Each of the Likert responses was given a value of 5 to 1 respectively, for the positively and negatively stated questions. The minimum possible score was 12 and the maximum possible score was 60. Higher scores indicate lower mathematics anxiety. According to Dogbey (2010:67), "the wide use of F-SMAS, is being established, and the strong reliability it engenders in many studies makes piloting the instrument unnecessary. Piloting is most useful when new instruments are devised."

The interview schedule was constructed from the Fennema-Sherman Mathematics Attitude Scale and from literature identified and discussed in the literature review. Creswell (2008:161) advises that researchers should use attitudinal measures when measuring feelings towards educational topics such as in assessing positive or negative attitudes towards mathematics. In constructing the interview schedule, I took note of various factors that influence the reliability, validity, and practicality of a measurement scale, as indicated by Cooper and Schindler (2008:303–309).

Rating scale

Participants score an object or indicant without making a direct comparison to another object or attitude (e.g. a 5-point rating scale). Cohen, Manion and Morrison (2007) note that rating scales are useful for tapping attitudes, perceptions and opinions of responses (Figure 1).

Watching and listening to a teacher in an accounting class performing an algebraic equation or applying a formula on the chalkboard makes me feel happy. Do you agree with this statement?

Not applicable	Strongly agree	Agree	Undecided	Disagree	Strongly disagree

Explain: ____

Figure 1 Example of a Likert-scale question used in a survey via interview

The responses required of participants to explain or give reasons for their choices in answer to the semi-structured questions. According to Ivankova, Creswell and Plano Clark (2007), interview participants share their views about experiences with the phenomenon.

Multiple-response (checklist) question and ranking scale

This is a form of multiple-choice questions in which respondents are instructed to check all response options that apply. Multiple-response questions are also called checklist questions, because a list of all relevant items is provided for respondent to check off. The *N* column indicates how many respondents (counts) mentioned each location and these counts are placed in rank order. The respondents choose words that are applicable to them when they perform mathematical accounting calculations (Figure 2).

Choose words from cards that are applicable to you when performing accounting calculations and arrange in rank order. You can choose more than one.	Rank order (*N* or Count)
Scared	
Challenging	
Panic	
Anxious	
Calm	
Comfortable	
Uneasy	
Confused	
Impatient	
Useful	
Confident	
Other (specify):	

Figure 2 Example of (multiple-choice and ranking-scale) question used in a survey via interview

Sorting

Participants sort cards (representing concepts or constructs). Cards might contain photos or images or verbal statements. In this study participants were presented with accounting scenarios (Figure 3).

Scenario: Imagine during a test, you are tackling the first accounting adjustment involving mathematical calculation and you are immediately lost.
In light of the given scenario, answer the following questions:
What happens to you if you can't perform a mathematical accounting calculation?
What strategies do you employ?

Figure 3 Accounting scenario

The pre-test of the survey via interview was conducted by asking colleagues and supervisors at the university to read and respond to the questions regarding clarity and wording of questions. The purpose of the pilot study was to clarify the wording of questions and check the suitability of the survey via interviews to best obtain accurate information. The interviewer piloted the survey with two pre-service accounting teachers to check whether interviewees understood the questions. The Statistical Package for Social Sciences (SPSS) version 21.0 (SPSS Inc., Chicago, Illinios, USA) was used for all statistical analyses. The interview data was qualitatively analysed.

Validity, Reliability and Trustworthiness

Cronbach's coefficient alpha is a popular reliability test used for establishing the internal consistency of a multi-item measurement (Sekaran, 2003). A reliability coefficient less than 0.50 is unacceptable, between 0.5 and 0.60 is regarded as significant, and above 0.70 is regarded as good. For this study, the Cronbach's alpha was computed to determine reliability, and Factor Analysis was computed to test validity. The reliability was confirmed by determining the Cronbach's Alpha for the scale of .912 (reported F-SMAS Cronbach's Alpha of .89). The criteria used by Krefting (1991) were used for judging the overall trustworthiness of a qualitative research. A summary of the strategies and the criteria used to establish trustworthiness is as follows: credibility (interview technique) – voice recordings of interviews; transferability (dense descriptions) – verbatim quotes from interviews; dependability (dependability audit) – interview transcripts; and confirmability (confirmability audit) – transcripts checked and participants' written responses checked. Member checks and peer confirmation of interpretations were done to ensure trustworthiness of the study.

Ethical Considerations

The research complied with ethical considerations for dealing with research participants. Ethical clearance was obtained from the Human Research Ethics Committee of the University of KwaZulu-Natal. According to Cooper and Schindler (2006), research ethics ensure that no one is harmed or suffers adverse consequences from research activities. The respondents were told that no identifying information was to be disclosed on the questionnaire, and for this reason the questionnaire was conducted anonymously. Participants were told that fictitious names would be used. Participants were also assured that their participation or nonparticipation would not affect their marks or disadvantage them in any way, even though I was their accounting lecturer. This gave respondents the assurance of confidentiality and anonymity.

Results

Demographic Profile of Pre-service Accounting Teachers

The information on the demographic profile of pre-service accounting teachers was collected to present their profiles and to provide a basis for analysis of important aspects. Students were predominantly African and Zulu-speaking. More than half of the students were first-year students, which skews the data towards them. There were slightly more female than male students. Most students came from rural areas, followed by those from townships, and had Zulu as their mother tongue, while more or less an equal number of them studied Mathematics and Mathematical Literacy.

Two sources of data were utilised to identify levels of mathematics anxiety: the Fennema-Sherman Mathematics Anxiety Scale survey instrument and the interview instrument.

Fennema-Sherman Mathematics Anxiety Scale Results

The mean score on mathematics anxiety was M = 36.97 (SD = 11.489), which represents slightly moderate agreement with the composite statement, "I am not anxious about doing mathematics." This mean does, however, conceal wide differences in individual scores, which cover the full range of 12 to 60 for the mathematics anxiety scale. A mean greater than 36 ($M > 36.00$) represents agreement with the composite statement. A mean equal to 36 ($M = 36.00$) represents neutrality (neither agree nor disagree) with the composite statement, and a mean less than 36 ($M < 36.00$) represents disagreement with the composite statement (Table 1).

Table 1 Minimum, maximum, and mean scores and standard deviations for mathematics anxiety scale responses

	N	Minimum	Maximum	*M*	*SD*
Mathematics anxiety	255	12	60	36.97	11.489

Some interesting insights became apparent when the individual items (Table 2) were considered, and the data was disaggregated by gender, age, race, mother tongue, mathematics schooling background, year of study, and location of schooling (Table 3). The italicised items were reverse coded to provide an overall score that indicates agreement with positively worded items. The category column has been inserted to show the four categories for the 12 items of the mathematics anxiety scale and were not provided to students during the data collection. No significant differences were found on mathematics anxiety across demographic variables ($p > .050$) (Table 3).

The Relationship between Levels of Mathematics Anxiety and Variables

Table 2 Number of students selecting each level of agreement on mathematics anxiety

F-SMAS item in the mathematics anxiety domain (N = 255)	Category	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
		n	*n*	*n*	*n*	*n*
Maths does not scare me at all.	Thinking	34	71	36	63	51
It wouldn't bother me at all to take more maths courses.	Learning	31	63	52	61	48
I don't usually worry about being able to solve maths problems.	Solving	24	84	41	63	43
I almost never get nervous during a maths test.	Test	27	51	20	93	64
I am usually calm during maths tests.	Test	22	68	33	78	54
I am usually calm in maths class.	Learning	40	97	33	54	31
Maths usually makes me feel uncomfortable and nervous.	Thinking	46	52	16	82	59
Maths makes me feel uncomfortable, restless, irritable, and impatient.	Thinking	36	51	24	87	57
I get a sick feeling when I think of trying to do maths problems.	Solving	29	44	20	92	70
My mind goes blank and I am unable to think clearly when working with maths problems.	Solving	33	34	26	92	70
A maths test would scare me.	Test	27	89	32	64	43
Maths makes me feel uneasy, confused, and nervous.	Thinking	39	55	31	79	51

Table 3 Comparison: mathematics anxiety with demographic variables using means, *t*-test, and analysis of variance (ANOVA)

				t-test			ANOVA	
Variables	Sub-groups	*N*	*M*	*t*	*df*	*p*	*f*	*p*
Gender	Male	105	37.46	.567	253	.571		
	Female	150	36.63					
Age (years)	18–20 years	165	37.02	.104	253	.917		
	21 years and above	90	36.87					
Race group	African	225	36.91	-.219	253	.827		
	Indian	30	37.40					
Mother tongue	English	32	37.84	.460	253	.646		
	Zulu	223	36.84					
Grade 12 mathematics	Mathematics	146	38.18	1.956	253	.052		
	Mathematical Literacy	109	35.35					
Accounting module	First year	143	37.90				1.126	.326
	Second year	77	35.55					
	Third year	35	36.29					
Areas/location of school	Rural area	134	37.06				.616	.541
	Township area	72	35.92					
	Suburban area	49	38.27					

Note. $p < 0.050$.

In the following subsection, I present the interview results that highlight the responses on mathematics anxiety.

Interview Results on Mathematics Anxiety

What happens if you can't perform an accounting calculation?

The results indicate that a degree of mathematics anxiety exists when pre-service accounting teachers cannot perform an accounting calculation. Terms used when participants self-reported emotional feelings of mathematics anxiety when they were unable to perform an accounting calculation were "scared," "confused," "lost," "frustrated," "nervous," "sad," "worried," "anxious," "panic," "impatient," "demotivated," "discouraged," and "lose confidence." Such feelings are reflected in the responses presented below.

> *I just panic, I spend most of my time trying to understand what is required from me, which is time consuming. This results in me not finishing my tests within allocated time* (Kazi).

The response shows a high level of anxiety, frustration, and emotional imbalance. All feelings have consequences for progress and for being able to break through this block. The high level of anxiety, "I spend most of my time trying to understand," drains time resources available for a normal examination test – the time resources available for trying to understand. It creates a psychological block and hinders understanding.

> *I would get very nervous, be lost and be scared for the rest of the paper. I might even forget simple calculations or transactions* (Vender).

Anxiety fuels fear (and vice versa) and for the duration of the test paper these heightened levels of anxiety can intensify.

> *I become frustrated and less interested because I know that even if I put an extra effort I will still get the answer wrong. So automatically I feel sad and worried* (Khoba).

The student shows a defeatist attitude: "*if I put extra effort I will get the answer wrong*," the student's motivation level to continue declines: "*I become frustrated and less interested*." It is important to avoid inculcating this anxiety in students and to encourage them to shift from this kind of attitude. Feelings such as being depressed – "sad and worried" – have a negative impact on the student's character.

What strategies do you employ if you can't perform an accounting calculation?

Most participants reported that the strategy that they employ in a test situation is to skip the question involving challenging accounting adjustments or transactions requiring mathematical calculations, and later return to these questions after completing all others. Some participants indicated that, in a classwork situation, they consult classmates or the teacher for assistance. This is reflected in the responses below.

> *I read the adjustment again and if I can't get a solution I skip it maybe along the way I may recall how can I tackle that adjustment* (Sibo).

The response shows that the participant employed a strategy of temporary avoidance with the hope that there might be a later breakthrough. This is not a bad strategy, but one cannot keep on avoiding several consecutive questions.

> *I leave the question for last and carry on with the questions that I know and when I'm done with everything I go back to it and have enough time to think clearly and do the question* (Narri).

The student needs enough time to complete difficult questions.

> *In a classwork situation I consult my classmates or teacher to explain to me how to go about tackling the adjustment* (Phindi).

The response shows that the student regards peers and the teacher as resources, although teachers and peers should not show other students how to do the problems, but they should teach the students the skills to do the problem. Assistance should go beyond telling one how to get the answer. The teach-a-man-to-fish principle should be applied.

The students were asked to choose words applicable to them when they perform accounting calculations (Table 4).

Table 4 Multiple response and ranking order of words chosen as applicable when performing accounting calculations

	Ranking order (*N* or Count)
Challenging	1 (14)
Panic	2 (11)
Anxious	3 (10)
Uneasy	4 (9)
Confused	4 (9)
Scared	5 (8)
Impatient	5 (8)
Comfortable	6 (7)
Confident	7 (5)
Useful	8 (4)
Calm	9 (4)

"Challenging," "panic," "anxious," "confused," "uneasy," "scared," and "impatient" were ranked highest by participants, with "comfortable," "confident," "useful," and "calm" all ranked lower. The ranking order shows that for most students, and even for students majoring in mathematics, accounting calculations were a source of frustration, discouragement, and anxiety rather than satisfaction. When participants found the accounting problems challenging, they panicked, or became impatient, confused, anxious, frustrated, or uneasy. Participants who were comfortable with the accounting problems found them useful and were confident and calm.

Considering the fact that I never did pure mathematics I sometimes feel comfortable if have been taught well and mastered the calculations, but I can't deny that sometimes I do panic if I am lost (Kazi).

The participant (Kazi) indicated that even though she had not done pure mathematics at school, if she had a good lecturer at university, the good teacher could assist her. Under the guidance of a good teacher or mentor she could come to terms with the calculations, although she panicked when she felt lost.

I hated mathematics whenever I saw it never understood. It was the worst subject at school. I did mathematics because they want it at university. If I knew I am going to be a teacher I was going to take Mathematical Literacy. (Mara)

The participant (Mara) indicated that he had "*hated mathematics*." This means that the hatred did not start in Matric (Grade 12), but earlier, when he was small. He had had a bad teacher: "*It was the worst subject*." Attending mathematics class had been a nightmare for 12 years as he did not want to be there. Over time these bad feelings became entrenched, and it is very hard to change someone's mindset.

Watching and listening to the teacher in an accounting class performing a calculation presents a space for personal reflection (Figure 4)

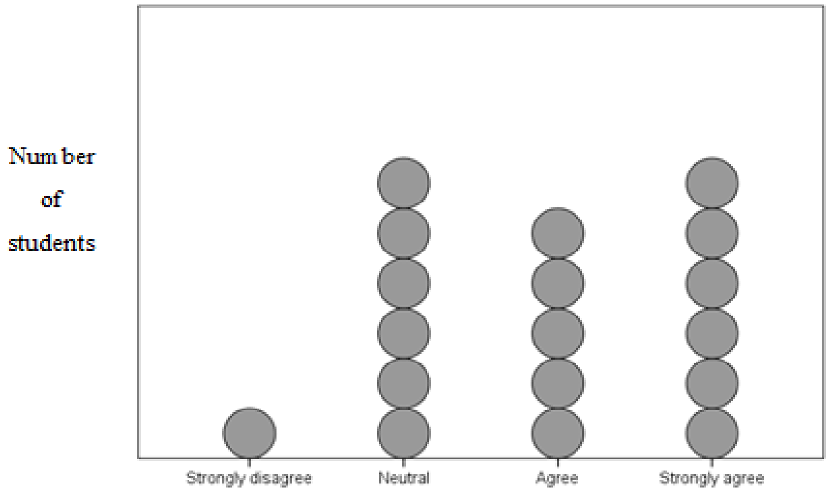

Figure 4 Watching and listening to the teacher in an accounting class performing a calculation presents a space for personal reflection

The overall results indicate that most participants agreed with the statement, while a minority did not, for which they gave the reasons below.

I feel happy because that is when I pick up information and tips for my understanding of the calculation. I have already attempted the calculation before, when the teacher performs it I am then able to correct my mistakes (Asiya).

When the teacher models the process or steps, the students are likely to learn from the process and reflect on it.

> *... get lost in the middle of the calculations ... get frustrated ... mathematical calculations, it is as if you are challenging the teacher ... decide to keep quiet even if they do not understand* (Phindi).

Students sometimes believe that asking a teacher to explain can be misinterpreted by the teacher, as if students are challenging the teacher's mathematics competence. However, if they want clarification and get a sense that their question is being misconstrued, they resolve to be quiet. Teachers need to distinguish between questions that indicate misunderstanding and questions that are testing the teacher's competence.

Class environment when teacher performs accounting calculation

Participants were asked to describe the class environment when a teacher performed accounting calculations. The participants' responded as follows:

> *It was evident that top achievers in mathematics assisted the accounting teacher to explain the accounting calculations to the learners better. Students with problems or challenges in mathematics will find it difficult in class. Some learners who were OK, were top achievers would manage and help other students. Top achievers will always help the teacher to show an easier method.* (Bima)

To alleviate mathematics anxiety, teachers could use top achievers in mathematics or more mathematics-competent students as a resource in the classroom.

> *... many students looked tensed ... were scared ... not confident to ask in front of everyone* (Narri).

Fear of asking questions lowers self-esteem and personal self-belief.

> *... classroom is filled with different feelings ... biggest problem facing teaching and learning atmosphere is the lack of knowledge, theory, given to learners so that they understand what is it that they are dealing with before trying to know how to deal with it.* (Wandi)

The response indicates that the participant identified a serious issue in teaching and learning, saying that understanding theory was crucial, and that a theoretical foundation should be established before trying to apply it. If theoretical knowledge is strong, there is less anxiety in application.

Discussion

Students' mathematics anxiety is slightly above neutral and affects students' confidence in doing accounting calculations. Eighty-seven students agreed with the following statement: "Mathematics makes me feel uncomfortable, restless, irritable, and impatient." This result was supported by results from the interviews, where all participants self-reported feelings of mathematics anxiety when they were unable to perform a mathematical accounting calculation – expressed in terms like "scared," "lose confidence," "confused," "lost," "frustrated," "nervous," "anxious," "panic," "impatient," "demotivated," and "discouraged." This finding is consistent with findings by Ashcraft and Moore (2009), and Gresham (2007) where participants similarly admitted to high levels of mathematics anxiety when unable to perform a mathematical calculation for accounting. One hundred and sixteen students agreed that "[a] maths test would scare me." It was found that a high level of mathematics anxiety created time constraints, which created a psychological block, hindered understanding, and exacerbate anxiety for the remainder of the accounting examination or test. For some participants the inability leads to a defeatist attitude with decreased motivation to continue with the task. This finding tallies with the findings of Durrani and Tariq (2009) and Mji and Mwambakana (2008).

Responses like "challenging," "panic," "anxious," "confused," "impatient," "scared," and "uneasy" were ranked higher than terms like "comfortable," "confident," "useful," and "calm," which were ranked lower by participants. The ranking order shows that, for most students, and even students majoring in mathematics, mathematical accounting calculations are a source of frustration, discouragement, and anxiety rather than of satisfaction. This places a significant responsibility on accounting teachers and lecturers to create a classroom atmosphere that is comforting, encouraging, and motivating for students so that they do not feel challenged, anxious, confused, and impatient. Lecturers should focus on two aspects – the mathematical accounting calculation and the state of mind, because if students get into a negative state of mind, almost all learning done through mathematical accounting calculation is nullified. Das and Das (2013) found that mathematics anxiety is a contributing factor to poor performance in terms of solving mathematical problems. Therefore, teachers can play an instrumental role in fostering an environment of teaching and learning by presenting mathematics topics in an activity-oriented way to lessen or prevent mathematics anxiety. Bandura (1997) points out that teachers must be aware that when emotional arousal increases, mathematics self-efficacy decreases. Family behaviour can also positively or negatively influence the level of students' mathematics anxiety. Therefore, parents, teachers, and students must be aware of strategies suggested by Blazer (2011) and Rameli et al. (2013) for reducing mathematics anxiety.

A student who obtained a distinction in Mathematical Literacy indicated that under the guidance of a good lecturer, teacher, or mentor, a student can come to terms with mathematical accounting calculations. The view expressed by this student agrees with research by Walton (2009), who found that students who passed Grade 12 Mathematical Literacy, would probably need support in algebra in order to cope with the mathematical content. For one participant, who said, "*I hate mathematics –*

whenever I saw it I never understood,” the hatred began when he was young, not in Grade 12. This participant felt bad in mathematics class and the negative feeling became entrenched over the years. One hundred and six participants disagreed with the statement that “I don’t usually worry about being able to solve maths problems.” Lecturers should be able to identify those students who have high anxiety when solving maths problems and should learn how to unlock students who have piled on negative attitudes towards mathematics for 12 years to motivate them to adopt positive attitudes towards mathematics so that they may become better accounting teachers.

Most of the participants agreed that watching and listening to a teacher performing a calculation in an accounting class presents a space for personal reflection. One major reason given was that when the teacher modelled the process or steps, the students were likely to learn from the process and reflect it in their own approach. This finding corresponds with Bandura’s (1997) finding that individuals can develop high or low self-efficacy vicariously by observing the performances of others. Only six participants were neutral regarding to the statement, “Watching and listening to the teachers in an accounting class performing a calculation presents a space for personal reflection.” A reason given by participants was that when one asked a teacher to explain the process or steps the question could be misinterpreted by the teacher as challenging the teacher’s mathematics competence. Students who simply require clarification decide to remain quiet when they get a sense that the teacher is misinterpreting the question. Teachers must be able to recognise genuine questions and not misinterpret them as testing their mathematical competence.

The participants reflected a need for teachers to use the classroom environment as a resource for motivation. This result supports findings by Daniels and Arapostathis (2005). To alleviate mathematics anxiety and increase the motivation level of students, teachers could use top achievers in mathematics as a resource to show easier mathematical accounting calculation methods. These top students benefit by having their abilities affirmed and by learning that they can become a resource for other learners.

One participant indicated that students in her class were uncomfortable and “*not confident to ask questions in front of other learners*.” This fear of asking questions lowered students’ self-esteem and personal self-belief. Another participant identified a serious issue regarding teaching and learning: she felt that it was crucial to understand a theory and set a theoretical foundation before applying it. Consequently, if the students’ theoretical knowledge was solid, less anxiety in the application of theoretical knowledge would exist.

Conclusion

The mathematics anxiety mean scores are slightly above neutral. Among the expressions used by students who reported feelings of mathematics anxiety when they were unable to perform a mathematical accounting calculation were “scared,” “lose confidence,” “confused,” “lost,” “frustrated,” “nervous,” “anxious,” “panic,” “impatient,” “demotivated,” and “discouraged.” Students also disclosed that when they were unable to perform a mathematical accounting calculation, their motivation level declined. The results show that when students are comfortable with mathematical accounting calculations, they become comfortable, confident, useful, and calm. This study found that mathematics anxiety affects and influences the way students do mathematical accounting calculations and the way they learn accounting calculations.

Lecturers should put more effort into improving students’ attitudes towards mathematics because anxiety levels, which were slightly above neutral, affected students’ confidence in doing accounting calculations.

Fifty per cent of the students reported that some of the teachers did not integrate mathematics with accounting. In- and pre-service accounting and mathematics teachers’ workshops should be conducted for them to integrate accounting calculations in classrooms.

In terms of implications for teacher education, one needs to teach pre-service teachers coping skills. When one encounters something difficult or challenging, how does one cope or how does one step back in a meta-cognitive way? The pre-service teacher must set a direction for himself or herself. If one can recognise the situations that make one anxious, one can check and control that anxiety. One must also be able to recognise students who suffer from anxiousness and work with them to develop ways of addressing it. One needs to pay attention to this aspect in one’s classes, as my research indicates that, although lecturers are not always aware of this, many students in their classes suffer from this kind of anxiety. One can incorporate examination techniques and study skills, build self-esteem, develop self-belief and self-control, and develop other soft skills that may otherwise be overlooked in accounting.

In teacher education programmes lecturers should develop competencies and skills such as resilience, endurance, and appreciation of effort, and teach students skills and techniques to identify clues and cues to unravel problems. If one does not teach students how to analyse the problem, how to take it apart, how to look for clues, and how to link things together, these high-level analytical skills will not be learnt. One needs to tell them to try to see the links and connections in the data, in order to try and get to the answer when experiencing problems in assembling data. One needs to teach pre-service teachers this skill in a more overt and explicit way. The constructivist notion that "content is important," is not as important as teaching learners how to think and how to reflect on how they learn. If one can teach someone that, one has taught a skill for life. Pre-service teachers will be learning how to learn.

The implication for teacher education is that one needs to infuse these kinds of skills. This approach places a significant responsibility on accounting lecturers to focus not only on calculations, but also to pay attention to the state of mind. No matter how well one does with the calculation, if pre-service accounting teachers get stuck in a negative state of mind, almost all the potential of learning from calculations is lost. It is about working on two aspects of the student's learning: looking at state of mind as well as the calculation, however, this is lacking in teacher education. To improve the confidence of students with high mathematics anxiety (especially in accounting education), lecturers should focus on techniques to overcome their mathematics anxiety while teaching accounting calculations. The study results show that even students with low mathematics anxiety are not free from anxiety. Although they are confident or enthusiastic in mathematics, they have negative attitudes about other areas of mathematics that affect their learning in accounting.

Accounting lecturers should identify those students who have high mathematical anxiety and who show a defeatist attitude in the accounting classes. Remedial psychological assistance could be suggested to these students, or lecturers could reconsider their methods of presentation to try to bring about changes in these students' attitudes. Accounting lecturers should also create or construct a module or course on accounting education methods so that all pre-service accounting teachers who lack confidence, and are highly anxious about mathematics, will have a chance of reducing mathematics anxiety, and to develop confidence and positive attitudes towards mathematics.

Notes

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