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Pre-service accounting teachers' attitudes to mathematics

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Mathematics proficiency has an acknowledged impact on students' accounting grades. Success in this core business subject is dependent on students' mathematical aptitude, attitude and type of secondary schooling. Our study investigated accounting students' attitudes to mathematics on domains of the Fennema-Sherman Mathematics Attitudes Scales (F-SMAS) and identified demographic variables in overall attitudes to mathematics, which are pertinent to higher education pedagogy for accountancy. Eight of nine F-SMAS with established reliability and validity were used for the study. A cross-sectional data set containing demographic details and attitudes to mathematics were collected, and quantitative responses of 255 first-, second- and third-year pre-service teachers were analysed. The F-SMAS scores were strongly positive, except for mathematics anxiety, where the score was slightly above neutral. The distribution of scores showed that there are first- and second-year students who experience mathematics anxiety, and have low scores in other domains, while third-year students are less anxious. The results also revealed more positive overall attitude to mathematics from specific categories of students, who also more frequently indicated parents and teachers as sources of support and encouragement for mathematics studies.

Keywords: accounting; attitudes; mathematics; pre-service accounting teachers; teaching

Introduction

Accounting is a course taken by Bachelor of Education (B.Ed.) commerce pre-service accounting teachers at the University of KwaZulu-Natal. The accounting course exposes pre-service accounting teachers to recording of business transactions and analysing and interpreting of financial information. Pre-service accounting teachers perform a variety of calculations in an accounting course: for example, calculating and comparing company financial ratios, calculating dividends for the year, and calculating provisional taxation, weighted average price, etc. Pre-service accounting teachers are scored and credited for showing calculations or workings and recoding in the correct journal. Pre-service accounting teachers in an accounting class are thus expected to have mathematical competence and problem-solving skills.

In South Africa, Grade Nine learners who find mathematics challenging enroll for mathematical literacy in Grades 10 to 12. Either Mathematics or Mathematical Literacy at Grade 12 level is an entry requirement for a B.Ed. Accounting degree in the School of Education at the higher education institution (HEI) which is the setting for this study (UKZN, 2013). Jacobs (2006) notes that the experiences of students at tertiary level, particularly during the first year, are significantly informed by their experiences at school. This study assumes, therefore, that there is a special relationship between success in accounting and competence in mathematics, since, as Naidoo (2011) points out, in both mathematics and accounting there is either a right or a wrong answer, the calculation of which demands that students work at a quick pace on exercises or assessments, creating circumstances for much anxiety.

University lecturers around the world report lack of adequate mathematical knowledge and computational skills in beginning students (Fedoryshyn, O'Brien, Hintz & Bosner, 2010; Heck & Van Gastel, 2006; Stainbank, 2013). It is therefore not surprising that the relationship between competence and attitude to mathematics of students and the study of subjects that depend on certain levels of mathematics competence continues to be a focus of interest both locally and internationally. Research into this issue in emerging-economy contexts like South Africa is important, as it has much potential for also informing educational contexts in advanced economy contexts, where immigration has presented new challenges for those education systems too. Student diversity and unevenness in mathematics preparedness increasing affect first-world learning contexts. As such, mathematics anxiety issues are likely to pertain in classrooms worldwide, and insights into these issues and how they may impinge on the study of commercial subjects, whether in developing or advanced economies, will have wide pertinence for funders interested in developmental advancement of mathematics and commerce.

The research questions in our study were formulated as follows: what are accounting students' attitudes to mathematics on eight domains of the Fennema-Sherman Mathematics Attitudes Scales? What is the relationship between overall attitudes to mathematics (F-SMAS total) and demographic variables? How do attitudes towards mathematics relate to learning and achievement in accounting?

Literature Review

A study by Latief (2005) on throughput of University of Western Cape students who did at least one semester of third-year statistics, suggested that in all quantitative subjects where mathematical calculations and abstract thinking are required, pure mathematics must be a prerequisite. Consistent with this study, Stainbank (2013), researching the impact of National Senior Certificate (NSC) Mathematics on the performance of first-year commerce students – Bachelor of Commerce (BCom) Accounting or BCom General, found that the university courses in which performance was most strongly related to school mathematics performance were Accounting 101 (ACC101), Economics 101 (ECN101), Information Systems and Technology 101 (ISTN101), Management 101 (MGNT101), and Quantitative Methods 1 (MATH134). She concluded her study by suggesting that the entrance requirement should be raised. Research by Barnes, Dzansi, Wilkinson and Viljoen (2009) on factors influencing success or failure in first-year accounting at another South African HEI (Central University of Technology) found on the other hand that performance in Grade 12 mathematics did not significantly correlate with performance in Financial Accounting I ($p = 0.152 > 0.05$). They also found no significant relationship between age and performance in Financial Accounting I ($p = 0.240 > 0.05$), nor was significant difference found between the performance of female students and male students ($p = 0.69 > 0.05$). Notably, the issue of mathematics anxiety was not a specific focus in their study.

Attitude is defined as a learned predisposition or tendency on the part of an individual to respond positively/favourably or negatively/unfavourably to a particular object, person or idea/situation (Ajzen & Fishbein, 2000; Haladyna, Shaughnessy & Shaughnessy, 1983; McLeod, 1992). The term *attitude* is borrowed from social psychology and is often used in everyday speech to characterise feelings, emotions or behaviour (Abbas, 2011).

Research indicates that attitude has three components: (i) the cognitive component representing beliefs – what we think to be true; ideas, thoughts, or pieces of knowledge that come to mind when a person encounters the attitude object; for example, a person might think that a snake is a dangerous reptile; (ii) the affect component, representing moods, emotions, and sympathetic nervous system activity that a person experiences when encountering the attitude object; for example, the sight of a snake may evoke feelings of fear in the individual; and (iii) the behavioural component – the tendency to respond in a certain way (actual and intended behaviour) to the attitude object; for example, choosing to run away or scream on seeing a snake. These three components are interrelated and interconnected (Mensah, Okyere & Kuranchie, 2013).

Attitudes are veiled, not directly observable or measurable. Attitudes can be measured by sets of statements created and sorted as positive or negative. Attitudes are thus calculated from respondents' statements (Thurstone, 1928). Attitudes can also be measured using 5- to 11-point Likert scales, where respondents indicate agreement with groups of statements and reliability is calculated for individuals or groups by summation of scores (Likert, 1932).

For this article, the cognitive component refers to what pre-service accounting teachers think or believe about mathematics (e.g. its usefulness, its self-efficacy), the affect component refers to the range of emotions (feelings, beliefs, moods) that they experience in relation to mathematics (e.g. motivation, anxiety), and the behavioural component refers to their tendency to respond in a particular way to mathematics as result of their experiences with it in the classroom (learning habits).

The widely used Fennema-Sherman Mathematics Attitude Scale (F-SMAS) (Fennema & Sherman, 1976) which we apply here covers nine affect scales (dimensions) that measure specific attitudes related to mathematics learning: (i) attitude towards the success in mathematics scale; (ii) mother scale; (iii) father scale; (iv) teacher scale; (v) confidence in learning mathematics scale; (vi) mathematics anxiety scale; (vii) effectance motivation in mathematics scale; and (viii) mathematics usefulness scale. The introduction of the F-SMAS instrument accomplished two concurrent objectives: it was the first to assess as many as four components of student affect (attitude, confidence, anxiety, and value of mathematics), and it assisted in identifying gender issues in the field of mathematics. The five additional scales focused on student perception of mother, father, and teacher interest in maths – since attitudes are influenced by parents, friends, teachers, and other models (Jazdzewski, 2011:7) – and on the usefulness of mathematics (Chamberlin, 2010:174).

The F-SMAS is well-suited to our study because of the specificity of the detailed domains that are included. Over the last three decades there has been extensive use of the F-SMAS in the assessment of affect in any field to evaluate students of various groups, race backgrounds, and gender at academic grade levels ranging from school to tertiary level (Bramlett & Herron, 2009; Chamberlin, 2010; Forgasz, Leder & Kloosterman, 2004; Galbraith & Haines, 1998; Kloosterman & Stage, 1992; Martin, 2002; Tapia & Marsh, 2004), and the instrument continues to have significant influence in ongoing research (Wilson, 2011). In our study, the terminology was adapted where necessary to suit the South African context. Table 1 shows the definitions for the F-SMAS (1976) domains used in the study.

Table 1 Definitions for domains of the Fennema-Sherman Mathematics Attitudes Scales

Affect domain		Dimension description
i.	Attitude towards success in mathematics	Measures the degree to which students anticipate positive or negative consequences as a result of success in mathematics. They demonstrate their fear by anticipating negative consequences of success as well as by lack of acceptance or responsibility for success, for example, 'it was just luck.'
ii.	Mother's mathematics attitude	Measures students' perception of their mother's interest, encouragement and confidence in the student's ability.
iii.	Father's mathematics attitude	Measures students' perception of their father's interest, encouragement and confidence in the student's ability.
iv.	Teacher's mathematics attitude	Measures students' perceptions of their teacher's attitudes to them as learners of mathematics. Teacher's interest, encouragement, and confidence in the student's ability form part of this domain.
v.	Confidence in learning mathematics	Measures confidence in one's ability to learn and perform well on mathematical tasks. This dimension ranges from distinct lack of confidence to definite confidence and it is not intended to measure anxiety or mental confusion, interest, enjoyment, or zest in problem solving.
vi.	Mathematics anxiety	Measures feelings of anxiety, dread, nervousness, and associated bodily symptoms related to doing mathematics. The dimension ranges from feeling at ease to feeling distinct anxiety. The scale is not intended to measure confidence in mathematics or enjoyment of mathematics.
vii.	Effectance motivation	Measures effectance as applied to mathematics. The dimension ranges from lack of involvement in mathematics to active enjoyment and seeking challenge. This scale is not intended to measure interest in or enjoyment of mathematics.
viii.	Usefulness of maths	Measures students' beliefs about the usefulness of mathematics and in relationship to their future education, vocation, or other activities.

Note. Source: Fennema and Sherman (1976).

Fennema and Sherman (1977), applying the F-SMAS to high school students' attitudes, found that male students had higher scores on attitude scales: on confidence in learning mathematics, on viewing mathematics as a male domain, on attitude towards success in mathematics, on mother's support, on father's support and on usefulness of mathematics. Bramlett and Herron (2009), using F-SMAS on attitudes to mathematics of African-American college students enrolled in algebra, found that none of the scales had a mean value that indicated an overall negative attitude score, even though the students surveyed had a high failure rate in the course. The mean values of the nine domain scores ranged from a slightly above average or neutral attitude to a positive attitude. The Bramlett and Herron study showed the following ranking order in the F-SMAS: (1) the attitude towards success in mathematics scale; (2) the mathematics as a male domain scale; (3) the mathematics usefulness scale; (4) the teacher scale; (5) the confidence in learning mathematics scale; (6) the father scale; (7) the mother scale; (8) the mathematics anxiety scale; and (9) the effectance motivation in mathematics scale. The rank order indicated that students see the importance of success in mathematics but do not want to put in more effort or work harder doing mathematical problems. Dogbey (2010) investigated the attitudes towards mathematics of developmental students in six community colleges from a large Midwestern state in the United States and reported that community college developmental mathematics students generally showed fairly positive attitudes to mathematics: male domain and success showed highly positive attitudes, teacher and usefulness showed slightly positive attitudes, and confidence, anxiety and motivation showed attitudes which were indifferent or mixed. Mohamad and Waheed (2011), who investigated students' attitudes to mathematics and gender differences in attitude to mathematics in selected schools in the Maldives, found a medium positive student attitude to mathematics, which meant there was possible room for improvement despite low performance of Maldivian secondary students in mathematics. The domains used in the study were confidence in learning mathematics and mathematics usefulness.

Research Methodology

The following methods were adopted in conducting the study.

Research Design, Sampling, and Analysis

A cross-sectional data set was collected containing demographic details and attitudes to mathematics, and quantitative responses (255) were analysed of first- (179), second- (85), and third-year (35) pre-service accounting teachers. All statistical analysis used SPSS version 21.0 (SPSS Inc., Chicago, Illinois, USA). For statistical comparisons, the 5% significance level was used.

Instrument for the study: The F-SMAS with established reliability and validity consists of nine instruments: (i) attitude towards success in mathematics scale, which attempts to measure the degree to which students anticipate positive or negative consequences as a result of success in mathematics; (ii) mother and (iii) father scales, which attempt to measure students' perception of their mother's and father's interest, encouragement, and confidence in the student's ability; (iv) teacher scale, which attempts to measure students' perceptions of their teacher's attitudes towards them as learners of mathematics; (v) confidence in learning mathematics scale, which attempts to measure confidence in one's ability to learn and to perform well on mathematics tasks; (vi) mathematics anxiety scale, which attempts to measure students' level of mathematics anxiety and the effect on doing mathematics; (vii) effectance motivation scale in mathematics, which attempts to measure effectance as applied to mathematics; and (viii) mathematics usefulness scale, which attempts to measure students' beliefs about the usefulness of mathematics currently (Fennema & Sherman, 1976). Eight of the nine scales were selected. Excluded was the mathematics as a male domain scale, because the instrument developer, Dr Elizabeth Fennema, recommended its elimination on the grounds that it had not shown significant results in prior studies (Martin, 2002:67). The following minor changes in language were made to suit the South African context: "math" to "maths" or "mathematics", "grades" to "marks/scores", "mom" to "mother", "dad" to "father".

Domain-specific attitudes relating to cognitive performance and learning in mathematics are the foundations of the scale, and some domains are not technically attitude, but have been termed as such to facilitate communication (Martin, 2002). Each of these scales contained twelve items, with six measuring positive attitudes to mathematics, and six measuring negative attitudes. Each of the five possible Likert-scale responses – strongly agree, agree, not sure, disagree, and strongly disagree – were given a value of 5 to 1, respectively, for positively stated questions and 1 to 5, respectively, for negatively stated questions. The minimum possible score was 12 and the maximum possible score was 60. A higher score indicates a more positive attitude to mathematics and a lower score indicates a more negative attitude to mathematics.

The questionnaires were administered to all pre-service accounting teachers at the beginning of the semester at a university in South Africa. Convenience sampling was used in this study because the pre-service accounting teachers are based at the HEI and easy to reach in person. All pre-service accounting teachers at the HEI were requested to participate in the study and were informed verbally and in writing that their participation in this study was completely voluntary. The objective in including all pre-service accounting teachers was to get a larger sample. Another objective was to look for trends across the years and in pre-service accounting teachers who major in mathematics. Pre-service accounting teachers signed an informed consent form and gave permission for their responses to be used for research purposes.

A quantitative correlation involved the collection of accounting mark sheets to determine the relationship between learning and achievement in accounting in relation to attitudes towards mathematics among Accounting 210, 220, 310, 320, 410 and 420 pre-service accounting teachers. The sample consisted of 128 responses from Accounting 210, 112 from Accounting 220, 62 from Accounting 310, 53 from Accounting 320, 31 from Accounting 410 and 27 from Accounting 420. The numbers differ because of dropouts. Academic achievement was measured by the marks obtained by the sample in their recently held accounting examination at the HEI. The data obtained were analysed and interpreted using the statistical tool of correlation coefficient. A significantly strong relationship between attitudes towards mathematics and achievement in accounting is associated with a correlation above .40 and not very strong (weak or low), from a practical perspective, relates to correlation ranging from .20 to .40 in absolute value (Mubeen, Saeed & Arif, 2013).

Results

Table 2 shows the minimum scores, maximum scores, mean scores and standard deviations for the domain responses and F-SMAS total.

Each domain had 12 items, the first six positively scored and the second six negatively/reverse scored. Each response item on the domains received a score of 5 (strongly agree) to 1 (strongly disagree) respectively for positively weighted items, and 1 (strongly agree) to 5 (strongly disagree) respectively, for negatively weighted items. A minimum possible score for each domain is 1 x 12 = 12, neutral score is 3 x 12 = 36 and a maximum possible score is 5 x 12 = 60. The composite or overall or F-SMAS total was calculated to provide an overall measure of attitude to mathematics. A minimum possible F-SMAS total for all the eight domains is 12 x 8 = 96, neutral F-SMAS total is 36 x 8 = 288 and maximum F-SMAS total is 60 x 8 = 480.

Mathematics anxiety subscale, a summary of the responses is presented in Table 3. The 12 items in combination tested agreement on the construct of mathematics anxiety.

Table 2 Minimums, maximums, means and standard deviations for the domain responses and F-SMAS total

	N	Minimum	Maximum	Mean	Std. Deviation
Attitudes towards success in mathematics	255	26	60	50.00	6.745
Usefulness of mathematics	255	19	60	47.35	9.313
Perception of support of teacher	255	24	60	47.31	7.820
Perception of support of mother	255	20	60	46.85	8.557
Perception of support of father	255	12	60	46.15	10.248
Confidence in doing mathematics	255	12	60	41.57	11.013
Effectance motivation in doing mathematics	255	13	60	40.13	9.275
Mathematics anxiety	255	12	60	36.97	11.489
F-SMAS Total	255	198	472	356.33	53.041

Table 3 Number of students selecting each level of agreement on mathematics anxiety

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

Each of the attitude domains for the entire group of pre-service teachers was measured by the mean scores. The mean gives an idea of the overall attitude of all 255 students. A mean greater than thirty-six ($M > 36.00$) represents positive attitude to mathematics, mean equal to thirty-six ($M = 36.00$) represents neutral or indifferent attitude to mathematics, and mean less than thirty-six ($M < 36.00$) represents a negative attitude to mathematics. Examination of the mean scores for each dependent variable (domain) revealed that students' attitudes were positive for attitude to success in mathematics (50.00), usefulness of mathematics (47.35), teacher's mathematics attitude (47.31), mother's mathematics attitude (46.85), father's mathematics attitude (46.15), confidence in doing mathematics (41.57), and effectance motivation in doing mathematics (40.13), while a mean score for mathematics anxiety (36.97) revealed that students' attitude was slightly above neutral. The overall F-SMAS (Total) mean score (356.33) revealed a positive attitude to mathematics.

Table 4 shows no significant differences in attitudes to mathematics among first-, second- and third-year students ($p > .050$).

Spread of Domain and Overall Scores on the F-SMAS Survey

The overall means revealed in the survey conceal important differences between individual student responses. The spread of domain and overall scores for first-, second- and third-year students is shown in Figures 1–3.

The large number of outliers evident in Figure 1 indicates the diversity in the class. Almost all the students in the first year agree with statement "I would be proud and happy to do well in mathematics" but only just over half the students are above neutral in the mathematical anxiety scale (i.e. in agreement with the statement "I am not anxious about doing mathematics"). So despite the overall F-SMAS score being positive for the cohort, there are many students who experience anxiety in doing mathematics and have low scores in the other domains.

On the mathematical anxiety scale in Figure 2, roughly two-thirds of the second-year students are below neutral. Many thus do experience anxiety in doing mathematics, and they also have low scores in other domains. Notably, the median and variation in Figure 3 indicate that the third-year accounting students are less anxious than the first-year and second-year accounting students.

Comparison of F-SMAS Total with the Demographic Variables

Table 5 shows overall attitudes to mathematics disaggregated by gender, age, race, mother tongue, mathematics schooling background, year of study, and location of schooling.

Correlations

The correlations between dimensions of attitudes towards mathematics and achievement in accounting modules studied in the year of the research have been computed. The results are tabulated in Table 6. It should be noted that six different modules of accounting were used as to measure accounting achievement (the two modules in the current year of study). This does effect the comparability of the results across the year groups, but nevertheless some trends can be noticed.

Table 4 Differences in attitudes to mathematics among first-, second- and third-year students

	Accounting module mean (255)			
Variables	1st year (*n* = 143)	2nd year (*n* = 77)	3rd year (*n* = 35)	*p*
Attitudes towards success in mathematics	50.20	49.34	50.60	.565
Perception of support of mother	47.92	45.44	45.60	.078
Perception of support of father	46.92	45.26	45.00	.404
Mathematics anxiety	37.90	35.55	36.29	.326
Effectance motivation in doing mathematics	40.97	39.35	38.43	.238
Usefulness of mathematics	47.85	46.81	46.51	.623
Perception of support of teacher	48.29	45.73	46.77	.061
Confidence in doing mathematics	42.91	40.31	38.86	.072
F-SMAS Total	362.96	347.78	348.06	.078

Note. * $p < .050$.

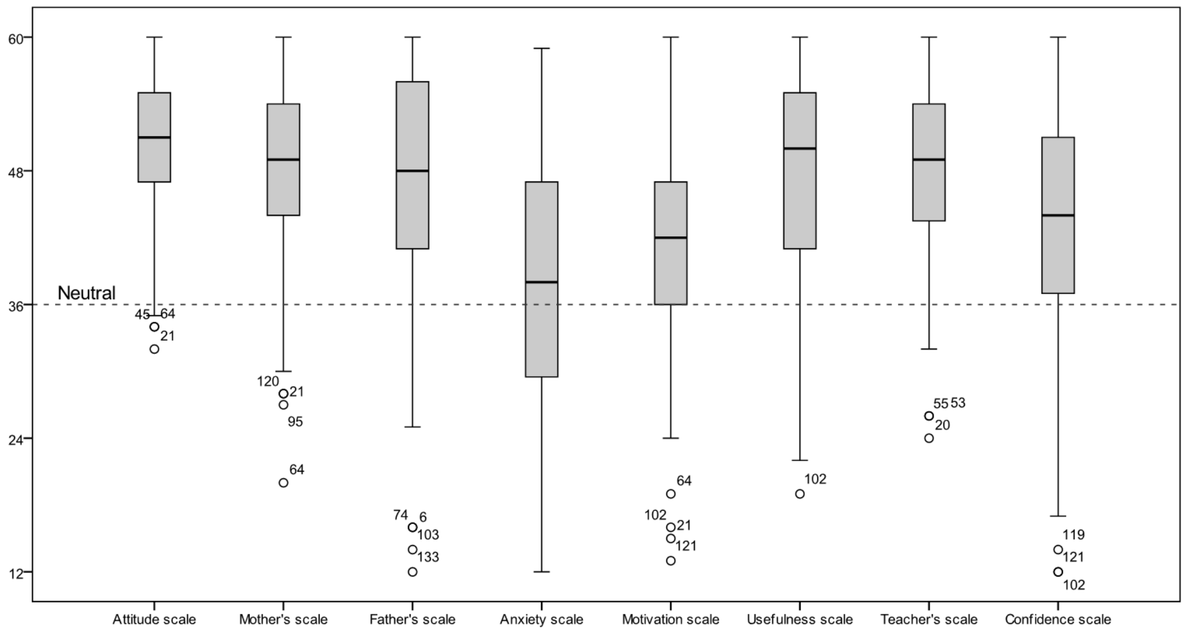

Figure 1 Spread of domain and overall scores for first year accounting students' responses

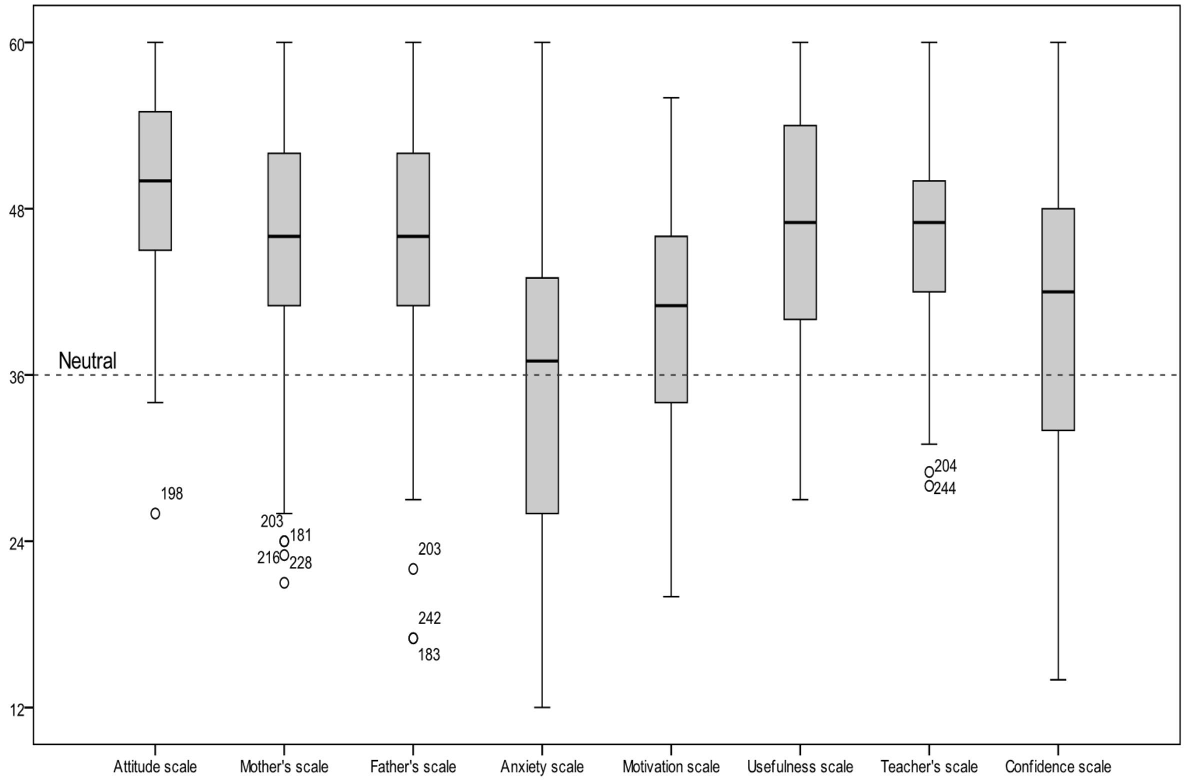

Figure 2 Spread of domain and overall scores for second-year accounting students' responses

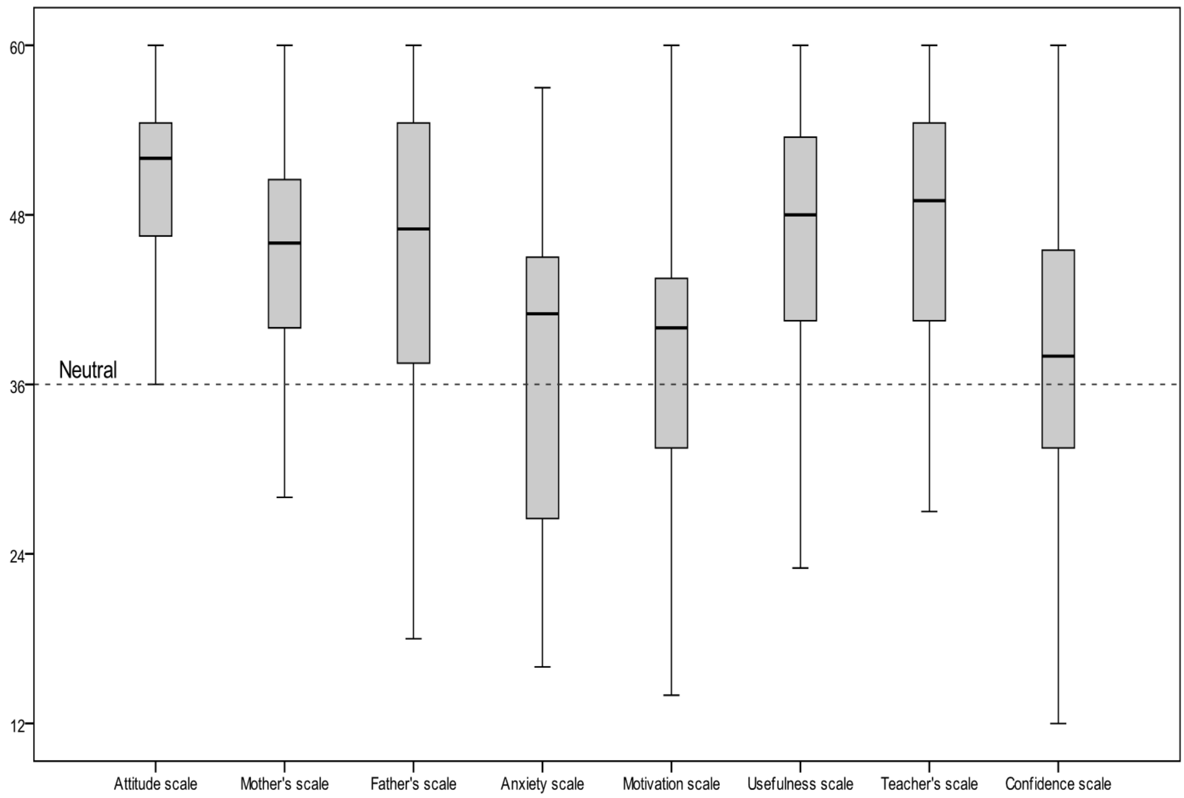

Figure 3 Spread of domain and overall scores for third-year accounting students' responses

Table 5 Comparison of overall attitudes to mathematics (F-SMAS total) with demographic variables using means and *t*-test and ANOVA

				t-test			ANOVA	
Variables	Sub-groups	*N*	Mean	*t*	*df*	*p*	*F*	*p*
Gender	Male	105	350.63	-1.439	253	.151		
	Female	150	360.32					
Age (years)	18–20 years	165	357.33	.406	253	.685		
	21 years and above	90	354.50					
Race group	African	225	353.09	-2.705	253	.007*		
	Indian	30	380.63					
Mother tongue	English	32	379.75	2.704	253	.007*		
	Zulu	223	352.97					
Grade 12 mathematics	Mathematics	146	364.96	3.056	253	.002*		
	Mathematical Literacy	109	344.77					
Accounting module	First year	143	362.96				2.574	.078
	Second year	77	347.78					
	Third year	35	348.06					
Areas/location of school	Rural area	134	351.99				4.354	.014*
	Township area	72	350.92					
	Suburban area	49	376.14					

Note. * $p < 0.05$.

Discussion of Research Results

Surprisingly, the study found that all domains showed means reflecting positive attitude to mathematics, and the F-SMAS total (overall) likewise showed a positive attitude. No significant differences were found between first-, second- and third-year students ($p > .050$). Although students may habitually complain about mathematics, it appears that when they are presented with a questionnaire they become much more positive. Bramlett and Herron (2009) found similarly that none of the F-SMAS had a mean value indicating an overall negative attitude score; likewise Dogbey (2010) reported that community college developmental mathematics students showed a fairly positive attitude to mathematics. Mohamad and Waheed (2011), using confidence and usefulness scales, found that positive attitude of students was medium, meaning there was room for improvement.

In our study, mean values for each of the domains ranged from slightly above neutral attitude to highly positive attitude. Examination of each domain mean indicated that students would be happy and proud to do well in mathematics; that they perceive usefulness of mathematics as important and relevant to their teaching job; that they feel that teachers, mothers and fathers (in that order) are sources of encouragement, support and affirmation for their efforts in mathematics; that they see confidence in doing mathematics as important, along with the motivation that comes from success with challenging calculations in accounting. Although student attitudes to mathematics are positive (somewhat contrary to expectation) an element of mathematics anxiety is nonetheless still there.

The results also revealed that Indian students, mother-tongue English students, Mathematics students and suburban students indicated more positive overall attitude to mathematics than did African students, mother-tongue Zulu students, Mathematical Literacy students, rural students and township students. The same students also indicated parents and teachers as sources of support, encouragement and affirmation in mathematics. This could be seen as a reflection of more favourable socio-economic conditions and education background in South Africa for Indian, mother-tongue English and suburban students than for African, mother-tongue Zulu, rural and township students.

However, a closer look at the distribution of scores revealed that while almost all the accounting students agreed with the statement "I would be proud and happy to do well in mathematics", there were fewer positive responses on the mathematical anxiety scale (i.e. responses in agreement with the statement "I am not anxious about doing mathematics"): positive responses (above neutral) came from just over half of the first-year accounting students, one-third of the second-year students, and half of the third-year students. Thus, although the overall F-SMAS score for the cohort of accounting students was positive, many students do nonetheless experience mathematics anxiety, and also have low scores in the other domains. Furthermore, in the distribution of scores the median for third-year accounting students is greater than the medians for first- and second-year accounting students (which are almost the same). First- and second-year accounting students recorded both higher and lower mathematics anxiety scores (larger variation) than

Table 6 Correlation between dimensions of attitudes towards mathematics and achievement in accounting modules

			F-SMAS Total	Attitude Subscale	Mother's Subscale	Father's Subscale	Anxiety Subscale	Motivation subscale	Usefulness subscale	Teacher's subscale	Confidence subscale
1st year	Accounting 210	Pearson correlation	.240**	.138	.072	.148	.097	.248**	.230**	.209*	.227*
		Sig. (2-tailed)	.006	.121	.421	.096	.276	.005	.009	.018	.010
		N	128	128	128	128	128	128	128	128	128
	Accounting 220	Pearson correlation	.258**	.146	.130	.183	.151	.241*	.262**	.141	.229*
		Sig. (2-tailed)	.006	.125	.171	.054	.113	.010	.005	.139	.015
		N	112	112	112	112	112	112	112	112	112
2nd year	Accounting 310	Pearson correlation	.198	.106	.113	-.001	.252*	.178	.137	.174	.098
		Sig. (2-tailed)	.123	.410	.380	.996	.048	.167	.288	.177	.449
		N	62	62	62	62	62	62	62	62	62
	Accounting 320	Pearson correlation	.167	.083	.217	.061	.185	.178	-.026	.124	.075
		Sig. (2-tailed)	.232	.554	.118	.667	.185	.203	.854	.376	.591
		N	53	53	53	53	53	53	53	53	53
3rd year	Accounting 410	Pearson correlation	.376*	.223	.365*	.311	.245	.327	.167	.221	.339
		Sig. (2-tailed)	.037	.228	.044	.088	.185	.072	.370	.232	.062
		N	31	31	31	31	31	31	31	31	31
	Accounting 420	Pearson correlation	.473*	.066	.355	.277	.287	.506**	.369	.271	.437*
		Sig. (2-tailed)	.013	.744	.069	.162	.147	.007	.058	.172	.023
		N	27	27	27	27	27	27	27	27	27

Note. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

did third-year students (smaller variation), indicating that the third-year accounting students are less maths anxious than first- and second-year students.

Mathematics is connected to accounting achievement, but the connection is not very strong. The effect of mathematics in accounting achievement dissipates with time as students move further into their studies. In the first year of accounting, the correlations are all low indicating only a small connection (albeit statistically significant in some cases) between accounting achievement and affective factors. There is a low positive and significant correlation between perception of support of teacher and achievement in Accounting 210. There is no significant correlation between perception of support of teacher and achievement in Accounting 220. This was possibly due to a change of teacher, as Accounting 210 and Accounting 220 had different accounting teachers. A low positive correlation was found between motivation in doing mathematics, perception of usefulness of mathematics, confidence in doing mathematics, and overall attitudes towards mathematics and achievement in Accounting 210 and 220. Home factors were not significantly related to achievement for Accounting 210 and 220.

In the second year of accounting, a low positive correlation was found between mathematics anxiety and achievement in Accounting 310. No correlation was found between mathematics anxiety and achievement Accounting 320.

In the third year of accounting, a low positive correlation was found between overall attitudes towards mathematics and perception of support of mother and achievement in Accounting 410. A strong positive correlation 420 was found between motivation in doing mathematics, confidence in doing mathematics and overall attitudes towards mathematics and achievement in Accounting. When students get into their fourth year, there is a relationship between motivation, confidence and positive attitudes towards mathematics and achievement in Accounting 420. One could conjecture that this is because students want to finish off their studies in the final year of accounting.

Conclusion and Implications for Higher Education

The results of the study show all the domains of the F-SMAS to be highly positive except for the mathematics anxiety subscale, which is slightly positive. The distribution of scores shows in addition that some students have low scores in some domains (e.g. mathematics anxiety, mother subscale, father subscale, teacher subscale etc.). More positive overall attitude to mathematics came from Indian, mother-tongue English, Mathematics and suburban students.

In the first-year accounting, there is a low positive and significant correlation between perception of support of teacher and achievement in Accounting 210. No significant correlation was found between perception of support of teacher and achievement in Accounting 220. This is due to a change of teacher, as Accounting 210 and Accounting 220 had different accounting teachers. A not very strong but significant positive correlation was found between motivation in doing mathematics, perception of usefulness of mathematics, confidence in doing mathematics, and overall attitudes towards mathematics and achievement in Accounting 210 and 220. Home factors were not significant for Accounting 210 and 220.

In the second year of accounting, there is a low or not strong and significant connection between mathematics anxiety and achievement in accounting. There is no correlation between mathematics anxiety and achievement in Accounting 320. This mathematics anxiety dissipates in Accounting 320. The teacher in this instance specifically covered mathematical calculations when teaching accounting and did not to make it an issue to be concerned about. This could possibly be explained by the explicit integration of mathematics and accounting in the class, which is something that could be carried forward having already set it in place. When students start Accounting 310, mathematics anxiety is evident. The higher the agreement that mathematics is useful, the better students perform and the higher the agreement that they are not anxious, the better they do Accounting 320.

In the third year of accounting, a low and significant connection was found. Between overall attitudes towards mathematics and perception of support of mother and achievement in Accounting 410 a strong significant connection was found between motivation in doing mathematics, confidence in doing mathematics and overall attitudes towards mathematics and achievement in Accounting 420. When students get into their fourth year, there is a relationship between motivation, confidence and positive attitudes towards mathematics and achievement in Accounting 420 because students want to finish off their studies in the final year of accounting.

Mathematics anxiety thus might continue to be a factor potentially affecting student performance in mathematics-dependent disciplines in higher education, indicating that HEIs need to consider how to move away from institutional structural arrangements that support insular mathematics programmes. There is a distinct need for mathematics-dependent disciplines to work more closely with mathematics departments to develop integrated programmes that will best suit the needs of students. This must work at two levels. Firstly, academics offering mathematics-dependent programmes need to identify the very specific mathematics knowledge that each programme requires, with a view to creating learning spaces for students (in need) to master these threshold competences for success in their disciplines. Secondly, there needs to be careful diagnosis of existing competence levels and attitudes to mathematics of entry-level students in particular. This will put faculty in a better position to respond to the specific needs of their students for potentially positively effect on student success in mathematics-dependent subjects.

From a social and economic developmental perspective, nationally and internationally, university subjects that impact on societal advancement call for particularly close attention. Mathematics and mathematics-dependent subjects are highly significant in this category, and better understanding of all factors that may impinge on student success in these subjects (and minimising factors such as mathematics anxiety) is likely to deliver positive long-term results for higher education institutions, for their students and for the nation as a whole.

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