Business students' beliefs in learning mathematics

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Abstract

This study explores the students' beliefs in learning mathematics in a university mathematics class. Complete data were collected from three hundred and seventy six students in three higher learning institutions enrolled in the business mathematics subject. The reliability coefficient alpha was 0.80, indicating a high degree of internal consistency for group analyses. A maximum likelihood factor analysis with a varimax rotation yielded four factors: teacher's role, value, competency and learning. The results indicated that business students appeared to hold positive beliefs in learning mathematics. In addition, teacher's role was the most important factor, followed by value, learning and competency. The results also indicated that there were significant differences in means between students' beliefs based on institutions and mathematics grade. However, our results showed no significant differences in means between beliefs based on gender, secondary education and students' major. The findings of this study could assist the relevant authorities to develop strategic planning to enhance learning mathematics among Malay students. In addition, learning mathematics does not only build students' ability to think analytically but also develop skills of reasoning and problem solving. These are some of the important elements in environmental management which are invaluable assets to the community.

Introduction

The process of learning Mathematics is affected by many factors. Students that were interviewed indicated that they liked Mathematics very much but were not given the opportunity to explore their capabilities for reasons they themselves failed to identify. Majority of students did not have the confidence to do Mathematics and majority agreed that the role of teachers did influence their level of confidence. As such, many good students failed in Mathematics. Thus, this research is intended to explore why beliefs are considered important in influencing students' success or failure in Mathematics. Beliefs are defined as the personal assumption from which individuals make decisions about the actions they will undertake (Kloosterman *et al.,* 1996). In their study, Kloosterman *et al.* (1996) found that beliefs did influence students' performance towards mathematics.

According to Arredondo and Rucinski (1998), beliefs that one holds about the structure, source, and certainty of knowledge, as well as the source of control of knowledge acquisition, is known as epistemological beliefs. Epistemological beliefs might affect the use of particular teaching strategies in a school or how such beliefs might affect adoption of certain innovations. In this study we use the term beliefs to cover aspects such as learning, value, competency and teacher's role.

According to Pajeras (1996), self-efficacy beliefs help determine the knowledge and skills they had. In addition, Pajeras indicated that academic performance was highly influenced by

students' perceptions of what they believe they can accomplish. Students' perceptions or beliefs shape their cognitive and affective processes in the classroom (Lazim *et. al*., 2004). Substantial evidence has accumulated showing that students' beliefs about learning are related to their academic achievement (Pajeras, 1996). Therefore, beliefs play an important role in one's achievement in mathematics.

Most universities offer Business Mathematics during the first semester of diploma students entering the faculty of Business Management and Accountancy (for example, University Darul Iman Malaysia, KUSZA Campus and University Technology MARA). The course is designed to enhance students' mathematical skills and to enable students to use basic mathematical techniques and their applications in problems in accounting, finance, management, marketing and business in general. Despite the effort devoted by instructors of Business Mathematics to simplify the subject, many students encounter difficulties in this subject. From the experience of the researchers, students need motivation and guidance to enable them to understand mathematics. Mills (2004) found that achievement in statistics was partly influenced by mathematics ability.

Researchers have suggested a number of factors influencing students' ability in learning and doing mathematics. These include teachers' mathematical knowledge (Hill *et al.*, 2005), and positive beliefs (Lazim *et al.*, 2004).

This study aims at investigating business students' beliefs in learning mathematics. Specifically the objectives are as follows:

1. To examine business students beliefs in learning mathematics
2. To identify which items are important in students' beliefs in learning mathematics
3. To investigate how students' beliefs differ by gender, institutions, mathematics grade, secondary education, and major (accounting and non-accounting students)

Literature review

A positive attitude is considered one of the most valuable tools in learning mathematics because any task attempted is vastly influenced by one's attitude towards it. A person who believes that performing a given behavior will lead to mostly positive outcomes will hold a favorable attitude towards performing the behavior, where as a person who believes that performing the behavior will lead to mostly negative outcomes will hold an unfavorable attitude (Ajzen, 1988).

Kloosterman and Stage (1992) measure beliefs about mathematical problem solving using five beliefs scales: I can solve time-consuming mathematics problems, there are word problems that cannot be solved with simple, step-by-step procedures, understanding concept is important in mathematics, word problems are important in mathematics, and effort can increase mathematical ability. They found that these scales were useful tools for researchers and instructors. Consistent with this, as reported by Ajzen (1988), McLeod (1992) has suggested that positive affect might lead to positive achievement. McLeod has categorized beliefs towards mathematics into four categories; beliefs about the nature of mathematics, beliefs about self in learning mathematics, beliefs about the role of teachers in learning mathematics and beliefs about socio context.

Beliefs are also seen to be closely related to learning (Kloosterman and Stage, 1992) and also academic achievement (Purvis, 2000). Kloosterman *et al*. (1996) reported that increasing a student's belief that mathematics is useful will often increase motivation and thus achievement. They indicated that certain beliefs result in high motivation whereas other beliefs diminish motivation. To explain how motivation improves learning is not an easy task. But there is a considerable amount of research done on understanding how motivation relates to academic achievement (see for example, Izah Mohd Tahir *et al*, 2005).

Most studies on students' beliefs focus on students at elementary level (for example, Kloosterman *et al*., 1996; Vanayan, 1997), middle school (Purvis, 2000), and secondary level (Lazim *et al*., 2004, Kadriye, 2005), but very little on students at tertiary level (Mc Lemore, 2004). Due to the shift in teaching and learning mathematics and the use of technology in mathematics instruction at lower levels of education (primary and secondary), it is an important concern to investigate the university students' beliefs towards mathematics.

Kloosterman *et al*. (1996) did a three-year study involving students at elementary level to examine changes in their beliefs in learning and doing mathematics. They found that students had a narrow conception of the usefulness of mathematics, their perspectives on the value of group versus individual work reflected the variety of classrooms environments to which they had been exposed, they had fairly accurate conceptions of their own achievement, and had a tendency to like mathematics more as it became harder.

Carter and Norwood (1997) examined the relationship between teachers' and students' beliefs about mathematics. Results from the study indicated that the students of the teachers whose beliefs were in alignment with the NCTM Standards had significantly different beliefs about factors that lead to success in mathematics than did other students. Students felt that interest, effort and striving for understanding would help them do well in mathematics. It is evident that what the teacher does in classroom influences students' beliefs about mathematics. It is also evident that what teachers believe about mathematics influence what they do in the classroom and that their beliefs may be translated into students' beliefs.

Purvis (2000) looked at the relationship between students' attitude towards mathematics and their performance. By grouping students (middle school) according to response towards mathematics (negative, neutral or positive) and calculating the academic average for each group, a positive relationship is found between self-perceived academic performance and academic average. A positive relationship is also found between students' self perceived academic performance and their liking for mathematics.

A survey on students' habits was conducted by Cerrito (2000), using a cluster sampling of all entry level courses. Students were asked to write a one week diary listing times of study, work and leisure activities. The diary results were compared to results of the survey and found to correlate highly. It was found that students had tremendous leeway in their leisure activities, and had sufficient time to study mathematics. However, students choose not to utilize their time. In addition, results also show that regular collection and grading of homework correlated highly with increased study time in mathematics.

In another study by Lazim *et al.* (2004), four factors were identified; teacher and learning, usefulness, competency and excellence, in the components of beliefs. Students hold strong beliefs that the teachers play a major role in contributing to their interest in mathematics. They also found that 'drill and practice' is a very important element in learning mathematics.

A study by McLemore (2004) analysed students' perspectives on their learning and mathematics anxiety by using notebooks in a mathematics classroom. Students responded with overwhelmingly positive comments on the use of the notebooks, demonstrating an ability to use the journal as a productive instrument in a problem-oriented classroom. They used the journal as a means of discourse with themselves and the teacher, and in so doing recreated their own understanding of the nature of mathematics. The positive results demonstrate that reflection is a valuable way to enhance students' understanding of and appreciation for mathematics.

Leedy *et al*. (2003) found persistence in the belief that mathematics is a male domain. Even in a sample of students chosen for their interest and aptitude in mathematics, the girls have less confidence in their abilities and view their mothers as having lower expectations of their success in mathematics. Also, parental differences were noted, with the mothers frequently focusing on the use of mathematics for computational task, while the fathers more frequently topics. Skaalvik (2004) explored gender differences in self-perceived abilities and motivation in mathematics and verbal arts. In all samples, male students had significantly higher math self-concept than female students. Male students in the grade and among adult students had significantly higher performance expectations and intrinsic motivational interest for mathematics than female students.

Kadriye (2005) used an exploratory study examining factors that might be associated with achievement in mathematics and participation in advanced courses in various countries. Confidence in mathematics was the strongest predictor of achievement for students from Canada and Norway, whereas for the students from the USA, parents' education level was the main predictor of achievement. Schommer-Aikins *et al*. (2005) examined the structure of middle school students' general epistemological beliefs and domain-specific mathematical problem-solving beliefs to 1,269 students in the Midwest of US. They found that epistemological beliefs are linked to mathematical problem-solving beliefs.

Data

This study is conducted to examine students' beliefs in learning mathematics. The research was undertaken at three different higher institutions in the East Coast of Malaysia and was done under the university grant. Questionnaires were distributed among the students from Business Mathematics classes enrolled in May and November session 2005/06. Students were randomly selected using the convenience sampling method. A total of 376 students (100 males and 276 females) participated. Students were from KUSZA (42%), Kolej Yayasan Terengganu (KYT) (53.3%) and Universiti Teknologi MARA (UiTM) (44.7%). The majority of students (52.4%) obtained grade A, 30% with grade B, 15.2% grade C and the rest, 2.4% with grade D, in mathematics at secondary level. The majority of students (68.4%) had a secondary education at National secondary schools, 18.4 % from Islamic schools, 5.6% from Chinese schools and 7.7% from schools with technical background. Of these, 27.7% majoring in Accounting and the rest 73.3% business related course (non-accounting).

Methodology

The questionnaire was adopted from Lazim *et al*. (2004). Instead of taking all the 19 items as suggested by Lazim *et al*. (2004), we selected only 17 statements pertaining to students' beliefs towards learning mathematics. These items were measured using a 5-point, Likert-type format with the following anchors: 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree and 5 = strongly disagree.

A frequency distribution was used to describe the sample. Internal consistency of reliability and factor analysis were established to determine reliability of the various variables and factors used in the study. Mean and standard deviation of the factors were also computed. Finally, independent *t*-tests and one-way analysis of variance (ANOVA) procedures were applied to the data set to test whether the mean of the students' beliefs differ by gender, institutions, mathematics grade at secondary level, secondary education and major.

Results

Internal Consistency of Reliability

Using SPSS, we estimated internal consistency of the scores (Cronbach alpha coefficient). The 17 items had an alpha of 0.80, indicating a high degree of internal consistency for group analyses.

Factor Analysis

Factor analysis is a statistical technique used to reduce many variables to a few dimensions (Seiler, 2004). Responses were subjected to a factor analysis using the maximum likelihood method of extraction and varimax, orthogonal rotation. Based on Seiler (2004), both Kaiser-Guttman criterion of retaining factors with eigenvalues greater than 1.0 and Catell's scree test were considered. From the results in Table 1 below, four factors were retained, which accounted for 55.98% of the variance. Bartlett's test of Sphericity to measure the applicability of factor analysis showed a value of 1810.083. The value of Kaiser-Meyer-Olkin Measure of Sampling Adequacy is recorded at 0.839 (<0.01) provided an acceptable adequacy of using factor analysis.

Varimax with Kaiser Normalization

Items with loadings of more than 0.4 are considered valid contributors. Table 2 presents the factor loading under four different categories. Factor 1 = Teacher's role, Factor 2 = Value, Factor 3 = Competency, and Factor 4 = Learning. Items 4, 3, 5, 6 and 12 were loaded under Factor 1. Items 7, 9, 8, and 13 were loaded under Factor 2. Under Factor 3, five items (2, 14, 10, 1, and 11) were loaded while three items (16, 17, 15) were loaded under Factor 4.

For Factor 1, item "I still remember very well my good mathematics teacher" loaded highest with factor loading of 0.749. Factor 2 loaded highest on item 'Mathematics is a field of manipulating numbers and symbols', with factor loading of 0.787. Factor 3 loaded highest on item 'I have been interested in Mathematics since primary school' with factor loading of 0.727 while Factor 4 loaded highest on item ' my lecturer really wants us to enjoy learning' with factor loading of 0.748.

Table 1: Exploratory Factor Analysis of the Students' Beliefs in Learning Mathematics

Items no.	Items	Factors			
		1	2	3	4
1	I have been doing well in mathematics	0.450	-0.270	-0.559	0.027
2	I have been interested in mathematics since primary school	0.537	-0.590	-0.147	-0.001
3	Good mathematics teachers spark my interest in mathematics	0.556	-0.152	0.441	0.101
4	I still remember very well my good mathematics teachers	0.483	-0.177	0.420	0.393
5	Teacher gives me encouragement to work harder	0.621	0.076	0.325	0.135
6	My teacher contributed to my interest in mathematics	0.603	-0.198	0.281	0.068
7	Mathematics is a field of manipulating numbers and symbols	0.480	0.383	-0.369	0.345
8	Mathematics is important in real life	0.600	0.228	-0.108	0.312
9	Mathematics is a way of thinking using symbols and equations	0.531	0.323	-0.344	0.240
10	Mathematics is considered as one of the difficult subjects	-0.084	0.697	0.090	-0.050
11	Mathematics is a challenging subject	0.235	0.484	0.420	-0.173
12	I believe 'drills and practice' is one of the best ways of learning mathematics	0.571	0.178	0.259	0.025
13	Mathematics provides foundation for applied sciences	0.493	0.382	-0.270	-0.024
14	I like mathematics	0.617	-0.544	-0.166	-0.119
15	Mathematics enables men to understand the world better	0.473	0.261	-0.363	-0.303
16	My teacher really wants us to enjoy learning	0.675	-0.015	0.087	-0.483
17	My teacher appreciates it when I tried hard	0.589	0.114	0.077	-0.485
Eigenvalues		4.69	2.10	1.65	1.07
Percentage of Variance		27.61	12.34	9.73	6.30
Cumulative Percentage		27.61	39.95	49.68	55.98

Table 2: Details of Factor Analysis Showing the Loadings of Each Item

Items no	Items	Factors			
		1	2	3	4
4	I still remember very well my good mathematics teachers	0.749			
3	Good mathematics teachers spark my interest in mathematics	0.704			
5	Teacher gives me encouragement to work harder	0.648			
6	My teacher contributed to my interest in mathematics	0.616			
12	I believe 'drills and practice' is one of the best ways of learning mathematics	0.520			
7	Mathematics is a field of manipulating numbers and symbols		0.787		
9	Mathematics is a way of thinking using symbols and equations		0.729		
8	Mathematics is important in real life		0.611		
13	Mathematics provides foundation for applied sciences		0.592		
2	I have been interested in mathematics since primary school			0.727	
14	I like mathematics			0.717	
10	Mathematics is considered one of the difficult subjects			-0.657	
1	I have been doing well in mathematics			0.609	
11	Mathematics is a challenging subject			-0.526	
16	My teacher really wants us to enjoy learning				0.748
17	My teacher appreciates it when I tried hard				0.726
15	Mathematics enables men to understand the world better				0.532

Descriptive Statistics

Table 3 presents the descriptive statistics for all the items under four factors. The results showed that all the items under four different factors are positive and significant at <0.01. This finding is consistent with Lazim *et al*. (2004). From the table, in Factor 1, business students strongly believed that 'I still remember very well my good mathematics teacher'. In Factor 2, they strongly believe that 'mathematics is important in real life' and 'mathematics is a challenging subject' in Factor 3. In Factor 4, they strongly believe that 'my lecturer really wants us to enjoy learning'.

Table 3: Descriptive Statistics of the Students' Beliefs in Learning Mathematics

Items no.	Item	Mode	Mean	SD	*t*-test
	Teacher's Role				
3	Good mathematics teachers spark my interest in mathematics	1.00	1.694	0.769	42.71**
4	I still remember very well my good mathematics teachers	1.00	1.676	0.820	39.60**
5	Teacher gives encouragement to work harder	2.00	1.774	0.700	49.14**
6	My teacher contributed to my interest in mathematics	2.00	1.971	0.791	48.31**
12	I believe 'drills and practice' is one of the best ways of learning mathematics	1.00	1.444	0.728	38.46**
	Value				
7	Mathematics is a field of manipulating numbers and symbols	2.00	2.035	0.880	44.82**
8	Mathematics is important in real life	1.00	1.657	0.814	39.45**
9	Mathematics is a way of thinking using symbols and equations	2.00	1.955	0.820	46.22**
13	Mathematics provides foundation applied sciences	2.00	2.077	0.824	48.87**
	Competency				
1	I have been doing well in	3.00	2.407	0.865	53.94**
2	mathematics	2.00	2.197	1.009	42.24**
10	I have been interested in mathematics since primary school	2.00	2.372	1.115	41.27**
11	Mathematics is considered as one of the difficult subjects	1.00	1.678	0.817	39.85**
14	Mathematics is a challenging subject	1.00	2.037	1.009	39.17**
	I like mathematics				
	Learning				
15	Mathematics enables men to understand the world better	3.00	2.508	0.929	52.32**
16	My lecturer really wants us to enjoy learning	2.00	1.872	0.813	44.66**
17	My lecturer appreciates it when I tried hard	2.00	1.915	0.866	42.87**

Note: SD = standard deviations, One-sample *t*-test, ** significant at <0.01

Table 4 shows the grand mean score for different factors and the overall mean score. The mean for all the items was 1.957. The mean for Factor 1 was 1.717, Factor 2 with mean value of 1.931, Factor 3 with a mean value of 2.138 and Factor 4 with a mean value of 2.098. The results indicate that students hold strong beliefs that teacher's role is the most important item in influencing student's beliefs in learning mathematics. This is similar to the results found by Lazim *et al*. (2004). Competency is ranked as the least important factor.

Table 4: Grand Mean Score

Factors	Mode	Mean	Standard deviations	Rank
Teacher's Role	1.00	1.717	0.537	1
Value	2.00	1.931	0.614	2
Competency	2.00	2.138	0.497	4
Learning	2.00	2.098	0.666	3
Overall Mean Score	2.00	1.957	0.424	

Independent t-test and Analysis of Variance

Independent *t*-test and analysis of variance were performed to test whether the mean of the students' beliefs in learning mathematics differ by gender, institutions, mathematics grade at secondary level, secondary education and major.

Students' Beliefs by Gender

Table 5 presents the results between students' beliefs and gender. Results indicate that no significant differences in means between students' beliefs and gender in learning mathematics. Therefore, female and male students showed no difference in terms of beliefs for all factors in learning mathematics.

Table 5: Spearman's Correlations Analysis between Students' Beliefs and Gender

Factor	Male	Female	*t*-test	Significance
Teacher's Role	1.796(0.58)	1.681(0.51)	1.853	0.065
Value	1.998(0.64)	1.907(0.60)	1.268	0.206
Competency	2.210(0.56)	2.112(0.47)	1.686	0.093
Learning	2.153(0.69)	2.079(0.66)	0.963	0.336
Note: Male = 100, Female = 276. Standard deviations in parentheses				

Students' Beliefs by Institutions

One-way analysis of variance (ANOVA) was carried out to see if any significant difference existed between institutions and students' beliefs in learning mathematics. Table 6 presents the results. As can be seen from the table, two factors are significant at <0.05: value (0.000) and learning (0.035). Therefore, the results showed that there is significant difference in means between value and learning based on institutions. However, teacher's role and competency did not show any significant difference with *p* value of 0.110 and 0.266 respectively.

Table 6: ANOVA: Students' Beliefs and Institutions

Factors		Sum of Squares	Degrees of freedom	Mean Square	F	Significance
Teacher's Role	Between Groups	1.250	2	0.625	2.217	0.110
	Within Groups	105.178	373	0.282		
	Total	106.429	375			
Value	Between Groups	10.597	2	5.299	15.104	0.000
	Within Groups	130.855	373	0.351		
	Total	141.452	375			
Competency	Between Groups	0.657	2	0.329	1.330	0.266
	Within Groups	92.151	373	0.247		
	Total	92.809	375			
Learning	Between Groups	2.960	2	1.480	3.381	0.035
	Within Groups	163.294	373	0.438		
	Total	166.254	375			

Note: The mean difference is significant at <0.05

Students' Beliefs by Mathematics Grade at Secondary Level

Analysis of variance by mathematics grade in Table 7 shows the level of significance at <0.05 for teacher's role (0.000), value (0.000) and competency (0.000). Therefore, there are significant difference between teacher's role, value and competency based on mathematics grade at secondary level. Learning, however, is insignificant with a *p* value of 0.473

Table 7: ANOVA: Students' Beliefs and Mathematics Grade

Factors		Sum of Squares	Degrees of freedom	Mean Square	F	Significance
Teacher's Role	Between Groups	5.437	3	1.812	6.675	0.000
	Within Groups	100.992	372	0.271		
	Total	106.429	375			
Value	Between Groups	7.740	3	2.580	7.178	0.000
	Within Groups	133.712	372	0.359		
	Total	141.452	375			
Competency	Between Groups	7.699	3	2.566	11.217	0.000
	Within Groups	85.109	372	0.229		
	Total	92.809	375			
Learning	Between Groups	1.117	3	0.372	0.839	0.473
	Within Groups	165.137	372	0.444		
	Total	166.254	375			

Note: The mean difference is significant at <0.05

Students' Beliefs by Secondary Education

In Table 8, the mean difference for all factors is not significant with a *p* value of 0.848, 0.097, 0.134, and 0.548 respectively. Therefore we can conclude that there were no significant differences between students' beliefs in learning mathematics based on secondary education.

Table 8: ANOVA: Students' Beliefs and Secondary Education

Factors		Sum of Squares	Degrees of freedom	Mean Square	F	Significance
Teacher's Role	Between Groups	0.230	3	0.077	0.269	0.848
	Within Groups	106.198	372	0.285		
	Total	106.429	375			
Value	Between Groups	2.379	3	0.793	2.121	0.097
	Within Groups	139.074	372	0.374		
	Total	141.452	375			
Competency	Between Groups	1.381	3	0.460	1.873	0.134
	Within Groups	91.427	372	0.246		
	Total	92.809	375			
Learning	Between Groups	0.866	3	0.289	0.649	0.584
	Within Groups	165.388	372	0.445		
	Total	166.254	375			

Note: $p < 0.05$

Students' Beliefs by Major

Analysis of variance was also performed to test whether the mean of the students' beliefs in learning mathematics by items and by factors differs by major. The results in Table 9 indicate that there were no significant differences in means between students' beliefs and major.

Table 9: Spearman's Correlations Analysis between Students' Beliefs and Major

Factors	Accounting	Non-Accounting	*t*-test	Significance
Teacher's Role	1.717(0.54)	1.710(0.52)	0.126	0.900
Value	1.988(0.64)	1.909(0.60)	1.116	0.265
Competency	2.085(0.47)	2.159(0.51)	-1.295	0.196
Learning	2.061(0.71)	2.113(0.65)	-0.675	0.500

Note: $p < 0.05$

Standard deviation in parentheses

Conclusion

This study was carried out to examine business students' beliefs in learning mathematics. Initial step was taken to verify the items used by Lazim *et al*. (2004) and test the internal consistency and reliability of the items used in the study. Results suggest that all the items were retained and were categorized under four different categories; Teacher's role, Value, Competency, and Learning. Five items (which include, items 3, 4, 5, 6 and 12 were categorized under Factor 1 (Teacher's role). In Factor 2 (Value), five items (7, 9, 8, 13 and 15) were included where as in Factor 3 (Competency), five items were included. These items were items 1, 2, 10, 11 and 14. Two items, 16 and 17 were categorized under Factor 4 (Learning).

Our study indicated that business students held positive beliefs in learning mathematics. The results also indicated that teacher's role was the most important factor which influenced business student's beliefs in learning mathematics followed by learning, value and competency.

Independent *t*-test and analysis of variance were also performed to test whether the mean of the students' beliefs differ by gender, institutions, mathematics grade, secondary education and major. Overall, the results indicated that there were significant differences in means between students' beliefs based on institutions and mathematics grade and there were no significant differences in means between beliefs based on gender, secondary education and major.

The findings of this study could be used by the relevant authorities to develop various plans to enhance the learning of mathematics among students in an effort to assist them in their future career. Further research is however, recommended to study these differences in detail to see how far these beliefs differ among students.

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