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Relationships Between and among Pre-service Mathematics Teachers' Conceptions, Efficacy Beliefs and Anxiety

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ABSTRACT The purpose of this research study was to examine the relationships between and among the conceptions of mathematics, mathematics teaching efficacy beliefs and mathematics anxiety of pre-service students with mathematics as their major subject (mathematics majors). Participants were 130 mathematics majors enrolled in a college of education in South West Nigeria. Internal consistency reliability coefficients from the administered self-report measure were acceptable for all scales. The analyzed results led to the following conclusions: (a) fragmented conceptions had positive associations with personal mathematics teaching efficacy, mathematics teaching outcome expectancy, mathematics evaluation anxiety and learning mathematics anxiety; (b) cohesive conceptions were positively associated with mathematics teaching efficacy; (c) positive associations were established between mathematics teaching efficacy and mathematics anxiety; (d) teaching efficacy and outcome expectancy were predictors of the conceptions of mathematics. Implications of these findings for pre-service mathematics majors are discussed. It is also recommended that educators of pre-service teachers should focus on motivating them and stress the usefulness of mathematics.

INTRODUCTION

Gresham (2010) requested pre-service students to respond to; *how should a teacher finish this statement*? Mathematics is? ....
The following are exemplars of what they said:

"scary!" ….. "definitely my worst subject ever!" … something I dread and hate, literally!" ….. "…. making me nervous and anxious just thinking about it!"

In Nigeria, there is a shortage of suitably qualified mathematics and science teachers. This shortage may be contributing to the low numbers of graduates in advanced scientific professions such as engineering, astronomy, information technology, and medicine. Mathematics knowledge and competence is a pre-requisite in almost all scientific courses. It is important therefore that research should constantly examine the state of teacher education in general and the teaching and learning of mathematics in particular. Also, for changes to be effectively implemented in mathematics education, it is necessary that base line information be made available on a number of important aspects. Such aspects include, for example, how teachers view mathematics, issues relating to attitudes toward the subject, mathematical anxiety and others. In Nigeria, while research has focused on a number of areas related to mathematics education, none has focused on pre-service mathematics majors' conceptions of mathematics and how these relate to variables such as mathematics teaching efficacy beliefs, and mathematics anxiety. The aim of the present study was to connect research conducted elsewhere to the Nigerian context. In doing this, baseline information is provided on the relationships among mathematics majors' conceptions of mathematics, their teaching efficacy beliefs, and anxiety.

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Literature Review

The literature review focuses on (a) conceptions of mathematics, (b) mathematics teaching efficacy beliefs, and (c) mathematics anxiety.

Conceptions of Mathematics

Conceptions of mathematics held by beginning university students are differentiated into fragmented and cohesive (Crawford et al. 1994). *Fragmented conceptions* relate to descriptions of mathematics as consisting of numbers, rules, and formulas. In these descriptions, students focus on parts of mathematics rather than the whole subject. Also, students holding fragmented conceptions relied more on algorithms to solve problems. *Cohesive conceptions*, on the other hand, are about describing mathematics as a complex logical system that is used to understand real-life contexts and situations related to the subject. Associated with the two conceptions are approaches used to study the subject. Crawford et al. (1998) indicate that (1) fragmented conceptions are associated with learning where the attention and activities centre on reproducing knowledge, and (2) cohesive conceptions are associated with learning in which a more global and personal perspective is adopted in an attempt to construct one's own understanding. It is noticeable from these descriptions that students who hold cohesive conceptions would thrive in situations where higher order learning skills and good outcomes are encouraged. This suggests that it is important to encourage cohesive conceptions, in order to promote higher order learning skills, for improving the learning and teaching of mathematics. Studies that have investigated the context of learning mathematics report that students displaying cohesive conceptions reveal high scores on confidence as well as "… greater motivation in and enjoyment of the subject and increased recognition of its usefulness" (Tariq and Durrani 2012: 351). Also, it is essential that students are discouraged from resorting to unnecessary retention of facts, where the sole aim is to consciously commit information to memory so as to recall it later (Cooper et al. 2002).

Mathematics Teaching Efficacy Beliefs

Bandura (1997: 2) describes *self-efficacy* as "… beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments." He further argued that individuals who had high self-efficacy saw themselves as capable of performing tasks as opposed to individuals with low self-efficacy. Pajares (2003: 140) has written, "… according to Bandura, how people behave can often be better predicted by the beliefs they hold about their capabilities, what he calls *self-efficacy* beliefs … for these self-perceptions help determine what individuals do with the knowledge and skills they have." Czerniak (1990) corroborates this by reporting that teachers with high self-efficacy followed inquiry-based and student-centred teaching methods whereas those with low self-efficacy followed teacher directed methods.

Bandura (1977, 1989, 1993) indicates that outcome expectations involve individuals' feelings that a particular behaviour should lead to specific outcomes. On the other hand, efficacy expectations involve individuals evaluating their ability to execute the behaviour successfully in order to produce the outcome. It has been argued (for example, Gibson and Dembo 1984) that teacher efficacy beliefs also correspond with these two dimensions of self-efficacy. In fact, Enochs et al. (2000) developed the Mathematics Teaching Efficacy Belief Inventory (MTEBI) for pre-service teachers. These authors reported that MTEBI comprised two subscales which correspond to the Bandura outcome and efficacy expectations (Enochs et al. 2000). In this inventory, the former is known as mathematics teaching outcome expectancy while the latter is the personal mathematics teaching efficacy. It is important that students taking mathematics should be exposed to positive outcomes because "… exposure to mathematics with positive outcomes increases mathematics self-efficacy, whereas exposure to mathematics with negative outcomes decreases mathematics self-efficacy, provided the positive outcomes are attributed to increase in personal capability and/or effort …" (Hall and Ponton 2005: 28).

The importance of teachers' high levels of self-efficacy is based on the assumption that they will impart the mathematics they teach with much more confidence. An advantage of this is that mathematics teachers with high levels of self-efficacy will invariably transmit the confidence to their students. About this, it is reported that students of such teachers have displayed positive attitudes and good performance in achievement tests (Utley et al. 2005). In a related manner it has been suggested that high levels of teacher efficacy beliefs result in them following student-centred teaching strategies (Marshall et al. 2009). Student-centred teaching strategies are indeed beneficial in the learning process. Based on the theory presented here, it appears that mathematics teaching efficacy beliefs play a vital role in the teaching and learning context. In fact, researchers have argued that it is not only the mathematics content that should be taught to pre-service teachers but their efficacy beliefs should also be addressed (Cantrell et al. 2003; Swars et al. 2006).

Mathematics Anxiety

Mathematics anxiety is described as involving "… feelings of tension and anxiety that interfere with the manipulation of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson and Suinn 1972: 551). Cemen (1987) similarly described this anxiety as a state of discomfort which occurs in response to situations involving mathematical tasks which are perceived as threatening to self-esteem. Such feelings are shown to lead to panic, tension, helplessness, fear, distress, shame, inability to cope, sweaty palms, nervous stomach, difficulty in breathing, and loss of ability to concentrate (Cemen 1987; Posamentier and Stepelman 1990). Undoubtedly, this type of condition hampers mathematics performance. For instance it is reported that mathematics anxiety is related to mathematics performance albeit in a more complex way (Cates and Rhymer 2003).

It has been shown (for example, Buhlman and Young 1982; Wood 1988) that teachers who experience mathematics anxiety are likely to pass it on to vulnerable students. In a similar manner it is argued that teachers too impact on their students' mathematics anxiety (Emenaker 1996). Mathematics anxiety renders such teachers' teaching ineffective (Hadfield and McNeil 1994) and questionable (Trice and Ogden 1986). Studies have also shown that a number of pre-service teachers start their studies with apprehension and anxiety toward mathematics (for example, Hembree 1990; Harper and Daane 1998). Dealing with issues related to mathematics anxiety in this study was seen as an important contribution to the body of knowledge in this area. This is because it is also argued that less is known in relation to pre-service mathematics teachers' anxieties (Peker 2009).

Objectives

The objectives of this research study were to examine relationships among conceptions of mathematics, mathematics teaching efficacy beliefs, mathematics anxiety, and pre-service mathematics majors' achievement. First year mathematics majors were selected in order to gain a sense of their views as early as possible in their chosen teaching area. In determining the relationships, the aims were to find out: (a) What association is there between fragmented conceptions of mathematics, mathematics teaching efficacy beliefs, and mathematics anxiety? (b) What association is there between cohesive conceptions of mathematics, mathematics teaching efficacy beliefs, and mathematics anxiety? (c) What association is there among the variables with student achievement? (d) Are there differences among all these variables between pre-service women and men? Answers to these questions should provide an understanding of how the different variables affected pre-service teachers. Findings should also be useful to educators and psychologists in providing advice to students identified to hold inappropriate conceptions, negative efficacy beliefs and highly anxious with respect to mathematics learning.

METHOD

Participants

Self-report measures were administered to a convenience sample of 221 pre-service mathematics majors enrolled in a college of education in South West Nigeria.

Procedure and Instrumentation

Data were collected by means of a questionnaire made up of a combination of the Conceptions of Mathematics Questionnaire (Crawford et al. 1998). The collection included the Enochs et al. (2000) developed Mathematics Teaching Efficacy Belief Inventory (MTEBI) for pre-service teachers, and the Mathematics Anxiety Rating Scale – Revised (MARS-R) (Plake and Parker 1982). A background information sheet was also included in which participants provided data relating to gender, age and subject majors. In the present study achievement comprised a composite score of marks allocated throughout the year for different activities (tests, assignments, classroom presentations, and micro-teaching).

The Conceptions of Mathematics Questionnaire (CMQ) was developed by Crawford et al. (1998) to measure students' conceptions of the subject. It is an 18-item scale made up of a 10-item cohesive conceptions subscale and an 8-item fragmented conceptions subscale. Responses are rated on a five point scale anchored by 1 (strongly disagree) and 5 (strongly agree). Crawford et al. (1998) reported alpha coefficients between .79 and .85 for fragmented conceptions while these were between .84 and .88 for the cohesive conceptions.

The Mathematics Teaching Efficacy Belief Inventory (MTEBI) for pre-service teachers was developed to measure mathematics teaching efficacy and outcome expectancy. This inventory was developed for pre-service teachers by modifying item statements of the original Enochs and Riggs (1990) pre-service Science Teaching Efficacy Beliefs Instrument Form B (STEBI-B), to reflect "future mathematics teaching beliefs" (Enochs et al. 2000: 195). The MTEBI is a 21-item scale made up of eight items comprising the Mathematics Teaching Outcome Expectancy (MTOE) subscale and 13 making up the Personal Mathematics Teaching Efficacy (PMTE) subscale. Responses are rated on a five point scale anchored by 1 (strongly disagree) and 5 (strongly agree). Internal consistency reliability coefficients were reported (Enochs et al. 2000) to be .77 and .88 for the MTOE and PMTE respectively.

The MARS-R measures anxiety in contexts related to the teaching and learning of mathematics. It is a 24-item version of the Mathematics Anxiety Rating Scale originally developed by Richardson and Suinn (1972). This instrument comprises a 16-item Learning Mathematics Anxiety (LMA) subscale and an 8-item Mathematics Evaluation Anxiety (MEA) subscale. Responses are rated on a five point scale anchored by 0 (no anxiety) and 4 (high anxiety). Internal consistency reliability coefficients were found to be .92 (LMA) and .89 (MEA) (Hopko 2003). Also, scores from the MARS-R were reported to yield a coefficient alpha reliability of .98, while they correlated at .97 with Richard and Suinn's (1972) original scores (Hopko 2003).

Participation was voluntary and it was explained that it was not related to course grade. Of the total participants, 130 (58.8%) returned their self-report measures. The majority of participants were 82 women (63%) with 48 (37%) men. The participants' mean age was 21.4 years (*SD* = 2.3). All were in their first year of study, taking mathematics modules in Algebra, Trigonometry, Calculus, and Coordinate geometry.

RESULTS

In presenting the results, firstly the reliability of the scales is reported where the different coefficient alpha values are compared with those from the original instruments. Secondly, a correlational analysis is reported. In this analysis the scores from the subscales of the three instruments were correlated. So, what is reported are the correlations of *fragmented conceptions*, *cohesive conceptions*, *personal mathematics teaching efficacy*, *mathematics teaching outcome expectancy*, *mathematics evaluation anxiety* and *learning mathematics anxiety*. Thirdly, variables that were predicted by fragmented and cohesive conceptions are outlined. Finally, gender differences are reported.

Reliability of the Scales

In the present study internal consistency reliability was calculated using Cronbach's (1951) coefficient alpha. Cronbach's alpha is computed by taking an average of correlations of all possible ways in which a test is divided into two sets whenever all of the half-tests have the same variances (Knapp 2001). It is recommended that when using Likert-type scales "… it is imperative to calculate and report Cronbach's alpha coefficient for internal consistency reliability for any scales or subscales one may be using" (Gliem and Gliem 2003: 89). In following this recommendation internal consistency reliability of each instrument used is reported. Further, Table 1 shows the means, standard deviations and reliability coefficients of the subscales of each instrument. The internal consistency coefficient of scores obtained from of the CMQ had an alpha value of .89. For the CMQ subscales, alpha scores similar to those reported by Crawford et al. (1998) were computed. For the MTEBI, internal consistency scores yielded an alpha value of .80. In the present study, the value of alpha from scores obtained from the PMTE was lower than the Enochs et al. (2000) reported .88 while MTOE scores were similar. For the MARS-R scale, the internal consistency scores yielded an alpha value of .96. With respect to the subscales of the MARS-R, the internal consistency scores were similar to those reported by Hopko (2003).

Correlational Analyses

Table 2 shows the emergence of a pattern of associations from the correlation matrix. Fragmented conceptions had positive associations

Table 1: Means, standard deviations and reliability coefficients of the subscales of the CMQ, MTEBI and MARS-R

Scale	*Subscale*	*M*	*SD*	*α*	*95% CI*		
CMQ							
	FC	21.4923	7.1118	.86	.82	-	.89
	CC	18.6231	6.3163	.84	.80	-	.88
MTEBI							
	MTOE	18.0472	5.7582	.79	.73	-	.84
	PMTE	32.6780	6.4010	.62	.52	-	.71
MARS-R							
	MEA	16.1000	9.4916	.91	.88	-	.93
	LMA	29.4154	19.0177	.95	.94	-	.96

Note: FC = Fragmented Conception; CC = Cohesive Conceptions; PMTE = Personal Mathematics Teaching Efficacy; MTOE = Mathematics Teaching Outcome Expectancy; MEA = Mathematics Evaluation Anxiety; LMA = Learning Mathematics Anxiety

with cohesive conceptions, personal mathematics teaching efficacy, and mathematics teaching outcome expectancy. Also, fragmented conceptions had low and positive associations with mathematics evaluation anxiety and learning mathematics anxiety. On the other hand, cohesive conceptions were positively associated with mathematics teaching efficacy variables but not with mathematics anxiety variables. Both the efficacy variables (PMTE and MTOE) were positively associated with the mathematics anxiety variables (MEA and LMA). None of the measured variables, that is, conceptions, mathematics teaching efficacy beliefs and mathematics anxiety had an association with achievement.

Regression Analyses

Linear regression analyses in which fragmented and cohesive conceptions were the criterion variables were computed. The analyses included all the variables that had association but excluded pre-service teachers' achievement because it had no association with either criterion variable. Table 3 shows the regression analyses involving both fragmented and cohesive conceptions. Personal mathematics teaching efficacy and mathematics teaching outcome expectancy were found to be statistically significant predictors of both fragmented and cohesive conceptions. Included variables accounted for 87% of the variance in fragmented conceptions (R^2 = .87), which was statistically significant, $F(4,124) = 199.18$, $p <$ 05. The two efficacy beliefs variables, PMTE ($\beta = .12$, $p < .05$) and MTOE ($\beta = .81$, $p < .05$) were statistically significant predictors. With respect to cohesive conceptions, included variables accounted for 77% of the variance (R^2 = .77), also statistically significant, $F(4,124) = 103.19$, $p <$ 05. Here, PMTE ($\beta = .77$, $p < .05$) and MTOE ($\beta = .15$, $p < .05$) were also statistically significant predictors of cohesive conceptions.

Sex Differences

Independent samples t-tests were computed to determine sex differences among mean scores of the CMQ and MTEBI subscales and those of the MARS-R scale. Table 4 shows the means, standard deviations, t-test scores and the effect sizes for the subscales and the MARS-R scale. It may be observed from this table that with respect to conceptions and efficacy beliefs, women had relatively higher mean scores. However in terms of mathematics anxiety, men had rela-

Table 2: Inter-correlations among the subscale scores of the MCQ, MTEBI, and MARS-R together with pre-service teachers' achievement scores

	1	*2*	*3*	*4*	*5*	*6*	*7*
1. Fragmented							
2. Cohesive	.58*						
3. PMTE	.77*	.87*					
4. MTOE	.92*	.73*	.77*				
5. MEA	.28*	.15	.24*	.22*			
6. LMA	.27*	.14	.23*	.20*	.98*		
7. Achievement	.00	-.03	-.06	.01	-.01	-.02	

* p < .05

Table 3: Regression analyses involving fragmented and cohesive conceptions

	R	*R square*	*Adjusted R square*	*Std error of the estimate*
Fragmented Conceptions	.93	.87	.86	2.65
Cohesive Conceptions	.88	.77	.76	3.08

	Sum of squares	*df*	*Mean square*	*F*	*p*
Fragmented Conceptions					
Regression	5609.02	4	1402.25	199.18	.000
Residual	873.00	124	7.04		
Total	6482.02	128			
Cohesive Conceptions					
Regression	3923.62	4	980.91	103.19	.000
Residual	1178.70	124	9.51		
Total	5102.33	128			

	Unstandardized coefficients		*Standardized coefficients*	*t*	*p*
	B	*Std error*	*Beta*		
Fragmented Conceptions					
(Constant)	-1.20	1.01		-1.18	.239
MEA	.04	.07	.11	.66	.510
LMA	-.02	.07	-.04	-.22	.822
PMTE	.12	.05	.12	2.33	.022
MTOE	1.01	.06	.81	15.76	.000
Cohesive Conceptions					
(Constant)	-3.99	1.18		-3.39	.001
MEA	-.03	.08	-.08	-.34	.735
LMA	.00	.08	.00	.015	.988
PMTE	.67	.06	.77	11.38	.000
MTOE	.16	.07	.15	2.19	.030

tively higher mean scores than their women counterparts. Nonetheless, no statistically significant gender effects among all three variables were established. For the MARS-R, this result was in contrast with Hopko's (2003) statistically significant gender effect where women reported more mathematics anxiety than men.

DISCUSSION

The purpose of this study was to examine how conceptions of mathematics were related to mathematics teaching efficacy beliefs and mathematics anxiety. The results supported the inference that fragmented conceptions of mathematics significantly correlated positively with the two mathematics anxiety subscales. This suggests that pre-service majors who see mathematics as consisting of rules and formulae were anxious about the subject. This is not to be unexpected considering that mathematics anxiety results in feelings of panic, fear, and an inability to cope with mathematical demands (Bursal and Paznokas 2006). Fragmented conceptions are about following surface approaches to learning. Here students 'scratch the surface' in striving to memorise facts. In most instances the memorisation is without understanding, and its aim is to reproduce the facts (Yang and Tsai 2010). Cohesive conceptions in contrast, were

Table 4: Means, standard deviations, t-test scores and effect sizes

	Women (n = 82)		*Men (n = 46)*		*t*	*p*	*d*
	M	*SD*	*M*	*SD*			
Fragmented	21.63	7.19	21.25	7.04	.296	0.768	.05
Cohesive	18.98	6.61	18.02	5.80	.831	0.408	.15
MTOE	30.66	7.15	29.73	7.69	.696	0.488	.13
PMTE	18.35	6.08	17.46	5.00	.863	0.390	.16
MARS-R	41.62	27.94	45.44	27.26	.757	0.450	.14

not associated with anxiety toward mathematics but with teaching efficacy and teaching outcome expectancy beliefs. This is because students holding cohesive conceptions seek deeper understanding of what they were learning (Yang and Tsai 2010). Such students' approach to learning is such that they adopt a more global and personal perspective to construct own understanding. They therefore would be expected to be confident about their ability to teach mathematics successfully.

A more positive finding was that no statistically significant sex differences were established. In Nigeria, one factor that has been identified to have "… contributed to disparity in the empowerment of male and female groups is gender stereotyping" (Salman et al. 2011: 15). This finding is positive in Nigerian sense therefore because it contrasts the widely held "…stereotypical image of mathematics as an essentially male domain" (Glencross et al. 2000: 130). These findings also correspond with Bursal's (2010) finding of no significant gender effects among pre-service teachers in Turkey.

None of the variables, conceptions of mathematics, mathematics efficacy beliefs and mathematics anxiety, were associated with achievement. Interestingly though participants had good grades. This finding suggests that pre-service mathematics majors' performance in their school work was not susceptible to their feelings about mathematics. This is a confounding result because it is not supported by theory on psychological aspects relating to the variables examined in the present study. It could be that students had learned to anticipate what was expected of them by their lecturers, which influenced their achievement.

Mathematics teaching efficacy beliefs were found to be significant predictors of conceptions of mathematics, while mathematics anxiety was not. Personal teaching efficacy is about "…a belief in one's ability to teach effectively and teaching outcome expectancy … the belief that effective teaching will have a positive effect on student learning" (Enochs et. al. 2000: 195). These findings suggest that the pre-service teachers were confident in their ability to effectively teach mathematics and have a positive effect on their students, irrespective of the differing conceptions about the subject. The expression of a positive effect on students by pre-service teachers who believed success in mathematics was through learning without understanding is a cause for concern. The concern is based on the fact that past experiences may have helped such pre-service teachers build personal theories and beliefs that lead to convictions, philosophies and opinions (Czerniak et al. 1999) about what success entails. However, such convictions are based on conceptions that are not sustainable in the long term because they focus on repeating knowledge rather than learning for understanding. Bandura (1997) described self-efficacy as involving individuals' assessment of competence with respect to successful task completion, where those with high efficacy appraised their abilities more favourably. It should be expected then that the pre-service mathematics teachers who relied on memorization, would feel confident about their abilities in spite of teaching opinions grounded on learning mathematics through repeating learned facts. Their success in studies noted through good assessment feedbacks may have enhanced their favourable self-appraisals.

It was reported in this study that conceptions of mathematics, mathematics teaching efficacy beliefs and mathematics anxiety had no association with achievement. This is in contrast to studies that have reported that conceptions of learning were strongly related to learning outcomes (Chin and Brown 2000; Cano 2005). Also, these results are contrary to the finding by Karimi and Venkatesan (2009) of a significant relationship between mathematics anxiety and mathematics performance. The results reported here, have important implications for counsellors and teacher educators in Nigeria because they indicate different relationships on important variables relating to pre-service teachers. This is important because, students who hold positive efficacy beliefs but with fragmented conceptions, for example, may be identified. Such students may then seek and receive appropriate counselling and interventions designed to help them. Interventions are critical because what pre-service teachers experience early on in their student days is crucial to how they will teach later when qualified (Brown et al. 2011). Also, changing pre-service teachers' habits is important because it is argued that if they have negative experiences in their mathematics classrooms, then this may discourage individuals "… from pursuing formal mathematics instruction beyond that which was necessary to fulfil high school graduation or university admission requirements" (Brady and Bowd 2005: 45). This suggests that remedial interventions should be introduced as early as possible to avoid transmitting negative effects from teachers to students. When this happens, hopefully the psychological issues investigated here, such as efficacy beliefs and anxiety will be minimised. Also, this may have the positive influence of changing how pre-service teachers conceptualise mathematics.

CONCLUSION

Regression analysis revealed that fragmented conceptions of mathematics positively predicted teaching efficacy beliefs and mathematics anxiety. On the other hand, cohesive conceptions of mathematics only predicted teaching efficacy beliefs. Achievement in this study was not related to any of the variables tested. There are a number of reasons that may drive students into following fragmented conceptions. These could be as a result of influences from the students' perspective or from perceptions they derive from the learning and teaching context.

Influences from the students' perspective may involve anxiety stemming from fear of failure. The fear of failure may result in students confining their learning to what is in the syllabus and therefore relying on memorisation of facts rather than understanding them. On the other hand, influences from the learning and teaching context such as tests and assignments that target the recall of facts may also drive students to fragmented conceptions. One of the ways in which influences from the learning and teaching context may be addressed is by asking students to write and keep journals. An important aspect of this is that journals allow students to reflect their feelings and beliefs about mathematics.

RECOMMENDATIONS

An important aspect about understanding students' conceptions of and its relationship with mathematics anxiety is that it will help those teaching pre-service teachers address their shortcomings before embarking on a teaching career. Such help will be critical in reducing and preventing mathematics anxiety of the pre-service teachers' future learners. It is recommended in this study therefore that those who teach pre-service mathematics teachers should among others, focus on motivation and the usefulness of the subject. Motivating students plays an important role in the learning and teaching process. This is because motivated students will always look forward to new challenges in the mathematics classroom. Also, those who are sufficiently motivated are unlikely to exhibit mathematics anxiety. Tied to motivation is the understanding of the usefulness of mathematics. It is important that teachers should constantly point out the utility of mathematics in other subjects and fields of study. For instance, if students wanting to specialise in physics are not made aware of the importance of mathematics in this subject while they experience mathematics anxiety then it may be difficult for them to succeed in physics too.

LIMITATIONS

In this study we utilized self-report measures to solicit information from a convenient sample. It is important therefore that these findings may not be generalized to pre-service students in other universities in Nigeria. The study's design leads to participants reflecting their views at a given point in time. It could be that at another time the pre-service students' views may have been different. For instance, if they had been to training that addressed the variables measured here, then the findings might have been influenced in one way or the other. This is critical because it is recommended that for students' learning experiences to be fairly reflected, the complex context wherein learning takes place, their learning environment, the content of and course demands should be thoroughly looked at (Kieser et al. 2005). Nonetheless, as we intended, pre-service teachers provided their perspectives which we feel will be useful in identifying students who need help.

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