The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2018

Volume 10, Pages 203-216

ICRES 2018: International Conference on Research in Education and Science

An Exploration of Preservice Teachers Educational Values of Mathematics in Relation to Gender and Attitudes toward Mathematics in Nigeria

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Abstract: The study investigated educational values of mathematics in relation to gender and attitudes toward mathematics among 480 Nigerian preservice mathematics teachers from four universities in Southwest, Nigeria using the quantitative research method within the blueprint of the descriptive survey design. Data collected were analysed using the descriptive statistics of frequency, percentage, mean, and standard deviation and inferential statistics of independent samples t-test, Pearson moment correlation, and multiple regression analysis. Findings revealed that preservice mathematics teachers showed high level of educational value of mathematics. There were significant possible correlations among preservice mathematics teachers' practical value, aesthetic value, cultural value, social value, moral value, disciplinary value, recreational value, and attitudes toward mathematics. While gender differences in some dimensions of educational value of mathematics (practical value, disciplinary value, social value, and cultural value) are no longer important and are declining there are subtle gender differences in attitudes toward mathematics and educational values of mathematics in this study. In addition, 73.7% of the variance in preservice teachers' attitudes toward mathematics was accounted for by the eight predictor variables (gender, practical or utilitarian value, disciplinary value, cultural value, social value, moral value, aesthetic value and recreational value) taken together. Based on this baseline study, it was thus, recommended that future studies in Nigeria should investigate the educational value of mathematics of in-service teachers with varied ethnicity and socio-economic background so as to generalise the results of this study.

Keywords: Educational values of mathematics, Preservice teachers, Gender, Attitudes toward mathematics

Introduction

Value is the "core of culture" (Hofstede, Hofstede & Minkov, 2010) which is not easily transformed. Values are general guide for the behaviour emerging from ones experiences and relations in ones life (Raths, Harmin, & Simon, 1987). Values are an integral part of human being and they play premeditated or unpremeditated roles on individuals' behaviours, decisions and choices (FitzSimons, Seah, Bishop, & Clarkson, 2001; Bishop, 1991). Seah (2003) regarded a value as "an individuals internalization, 'cognitisation' and decontextualization of affective constructs (such as beliefs and attitudes) in his/her socio-cultural context" (p. 2). Values are behaviour guiding tools which are consciously and unconsciously imbibed through interpersonal interactions in a social context. Values reflect ones personal attitude and judgments, decisions and choices of action, behaviour and relationships, dreams and vision which guide a person to do the right things and contribute to the development of a person in all ramifications thus bringing joy, satisfaction, and peace and add quality to a persons life (Pathania, 2011). Swadener and Soedjadi (1988) perceived the value as a concept or idea which is related to the worth of anything. Values are an inherent part of the educational process at all levels, from the systemic, institutional macro-level, through the meso-level of curriculum development and management, to the microlevel of classroom interactions (Le Métais, 1997) where they play a major role in establishing a sense of personal and social identity for the student (Bishop, FitzSimons, Seah, & Clarkson, 2001). It is worthy of note that education is a cultural value-laden concept (Gudmundsdottir, 1991) and the transmission of culture and values is one of the general aims of the education (Dede, 2014). Schools are strategic institutions where this role is achieved and sustained (Osler & Starkey 2001). Thus, curricula are designed and developed with values in mind and values are incorporated into disciplines in the curricula (Demirhan & Senemoglu, 2009). Based on this, it can be

inferred that value-free education is consequently unlikely in most countries of the world, since values are obvious in school curricula, goals, and activities, as well as in the requirements set by the state (Powe, 1993).

The concept of values in mathematics education is a recent development and the research on values in mathematics education appeared in 1980s by incorporating them into cultural dimensions of mathematics education (Bishop, 2004). The mathematics curriculum includes both implicit and explicit values. The implicit values are presented in a hidden manner, acquired in more subtle ways, and evidenced in the learner's behaviour. The explicit values are planned explicitly, applied in the classrooms, and acquired from the instruction (Bishop et al., 2001; Lim & Ernest, 1998; Seah et al., 2001). Generally, mathematics is perceived as a cold, abstract, difficult, and inhuman discipline. Thus, mathematics is related to absolutist philosophies in one hand in which a profession is separated from values; that is mathematics is value-free and culture-free. On the other hand, fallibilist philosophers opposed to this view and indicated that mathematics is consistent with "connected" values (Ernest, 1998). Though, they did not reject the role of mathematical structure, the fallibilists declined the view that mathematics supports the unique, fixed and continuous hierarchical structure. Contrary to the views of the absolutist philosophers the fallibilists claim that mathematics is both value-laden and culture-laden (Ernest, 1998; 2007).

Values related to mathematics education are inculcated through the nature of mathematics, through the individuals experience in the socio-cultural environment and in the mathematics classroom (Seah, 2008). These values form part of the individuals personal value system, which equips him/her with cognitive and affective lenses to shape and modify his/her way of perceiving and interpreting the world, and to guide his/her choice of course of action (Seah, 2008). Bishop (2001) argues that mathematics values are not only learned and entrenched in teachers' practice but that "values in mathematics education are deep affective qualities that education fosters through the school subject of mathematics" (p. 94). Values appear to remain permanently engraved in peoples memories than does conceptual or procedural knowledge.

Bishop (1996) categorised three types of values witnessed in the mathematics classrooms and they are general educational, mathematical, and mathematics educational values. Educational values are related to general societal values e.g. honesty, neatness, creativity and good behaviour, mathematical values are related to the scientific discipline of mathematics, and mathematics educational values are related to pedagogy of mathematics that is, to practices and norms emerging from mathematics instruction (Atweh & Seah, 2008; Seah & Bishop, 1999). Bishop (2004) also conceptualized mathematics educational values as being formalistic view and activist view, instrumental understanding and relational understanding, relevance and theoretical knowledge, accessibility and special, evaluating and reasoning.

Bishop (1988) outlines three dimensions of complementary mathematical value pairs in the Western culture as: Ideology: Rationalism and Objectism; Sentiment: Control and Progress; and Sociology: Openness and Mystery. Ideology concerns the ideals of mathematics, while Rationalism deals with the deductive reasoning, about proof and building an argument on stated axioms and definitions. Objectism concerns mathematics being dehumanized, dealing with stable mathematical objects like points or variables (Österling, 2013). The sentiment-dimension is concerned with feelings and attitudes. Control is related to materialism and being able to predict and describe objects. Mathematical facts and algorithms can be understood, and real world phenomena, like planet movements, can be described by mathematics, which gives a feeling of security and control. Progress is a more dynamic feeling, related to development, choice and change/improvement. For example, an algorithm can be used in new situations and with new examples (Österling, 2013). The sociology-dimension describes relationships between people, and between people and mathematics. Openness means that mathematical principles are regarded as universal truths, open for anyone to learn and use, so in that way, mathematics is democratic subject. Mystery describes mathematics as being an abstraction. There is a paradox that, even though mathematics is open and accessible, it is hard to tell what the origin of mathematics is, who invented it, what it is and what it is not (Österling, 2013). The two values in each pair are complementary. Bishop (1988) contended that nobody is doing the valuing as mathematical values exist in the cultural context of western mathematics. In line with behavioural and cognitive constructivist approaches, Durmus and Bıçak (2006) classified the mathematical and mathematical education values into two dimensions as: positivist and constructivist values. Positivist values put more emphasis on teaching mathematics as teacher-centred, abstract and in which mathematics is devoid of the real life experiences of the students. Contrastingly constructivist values lay more emphasis on teaching mathematics by using student-centred strategies, concretely and relating it to real life experiences.

Chin, Leu, and Lin (2001) submitted that the values depicted by teachers in mathematics classrooms are connected to their didactical personalities. Seah and Bishop (2001) define the values held by teachers as

expressive of their 'cognisation' of affective variables such as beliefs and attitudes, and the subsequent internalisation of these values into their respective affective-cognitive personal system. Even in mathematics education the study of values in classrooms is not a major focus of research in Nigeria. Although in mathematics education values are critical components of classrooms' affective environments, and thus have a vital effect on the ways students select to take part (or not take part) in mathematics (Bishop, 2008). "Values in mathematics education are the deep affective qualities which education aims to foster through the school subject of mathematics and are a crucial component of the classroom affective environment" (Bishop, FitzSimons, Seah, & Clarkson, 1999, p. 2).

Thomaskutty and George (2007) identified seven educational values of mathematics to include, practical or utilitarian values, disciplinary values, cultural values, social values, moral values, aesthetic values and recreational values for this study. The utilitarian value of mathematics not only lays in the fact that mathematics progress and improvement helps in creating a prosperous society but that mathematics is a tool to adopting precautionary measures. Any person ignorant of mathematics will be at the mercy of others and can be easily cheated (Thomaskutty & George, 2007). In addition, while an individual can get on sometimes very well without learning to read and write such an individual can never pull on without learning how to count and calculate. The disciplinary value of mathematics is not negotiable in that mathematics helps an individual in carefully analysing complex life situations to making an informed decision. The knowledge of mathematics not only makes the mind of the learners more broad and open but that it clears uncertainty in making accurate and precise decision. With mathematics, a learner can organise his/her ideas more logically and his/her thoughts more accurately and explicitly. Mathematics is a culture and the cultural value of mathematics lays in the fact that mathematics influences changes in modes of living and way of life of people for every culture expresses itself naturally in the language of mathematics. Mathematics helps in the preservation and transmission of our cultural traditions and it is a product of cultural development that governs the picture of the world that we make for ourselves. For the social value of mathematics, we see mathematics helping in the proper organisation and maintenance of a fruitful social structure. Mathematics not only ensure the smooth and orderly functioning of the civil society but that it helps in the proper setting up of social institutions. Part of the social function of mathematics is that it helps in promoting world business transaction by removing the barriers to trade, commerce and communication and that mathematics helps the individual to adjust to self and live a harmonious life in the society (Thomaskutty & George, 2007). The moral value of mathematics is significantly related to its role in promoting positive character formation in learners. Mathematics builds proper attitude devoid of prejudiced feelings, biased outlook, discrimination and irrational thinking in learners. Aside the fact that mathematics is a tool to fostering moral values in learners; mathematics promotes objective analysis, correct reasoning, valid conclusions and impartial judgment in learners. The aesthetic value of mathematics lays in the fact that mathematics enriches with its aesthetic appeal and emotions. While the elegance and gracefulness of mathematical relationship touches our emotions mathematics is a divine discipline clothed in beauty, fineness, harmony and symmetry. In addition, the laws of nature are written in mathematical language and elegance. The recreational value of mathematics is substantiated in that mathematics gives people entertainment and recreation via puzzles, games, and riddles. The recreation in mathematics promotes imagination, sharpens intellect and draws satisfaction to the mind. The recreation in mathematics not only gives sufficient exercise to the brain of an individual thus entertaining the brain but that the daily untwisting of mathematical relationship promotes joy and entertainment (Thomaskutty & George, 2007).

Previous researches on the relation between educational values of mathematics and gender are scanty. This is unlike the avalanche of researches on the relation between gender and achievement in mathematics or between gender and attitudes toward mathematics. The theory of gendered nature of values proposed by Gilligan (1982) and elaborated by Ernest (1995) revealed that it is possible to distinguish between two gendered values: feminine values and masculine values. The feminine values are called connected values which are based on empathy, caring, feelings, and intuition and they tend to be holistic with human face. The connected values are related to fallibilist conception of mathematics (Ernest, 2004). The masculine values are termed separated values which are based on rules, abstraction, objectification, impersonality, unfeelingness, dispassionate reason and analysis, and tend to be atomistic and thing-centred in focus. The separated values are related to absolutist conception of mathematics (Ernest, 2004). Ernest (1995) warned that it is not the case that separated values are men's values and connected values are those of women but that they can be described as stereotypically masculine and feminine values, respectively since every human being has both a masculine and feminine component to his/her nature and that available empirical evidence do not support any easy dichotomization of male and female values. On the relation between gender and value of mathematics, McLeod (1992) indicated that males generally valued mathematics more than females. Dede (2014) in a study of comparison of Turkish and German mathematics teachers' values: a gender perspective found that there was no significant main effect of gender on mathematics teachers' values. It is found that female teacher conveyed values explicitly, whereas

the male teachers would either convey values implicitly or choose not to teach selected values (FitzSimons et al., 2000). Durmus, Bıçak and Çakır (2007) found also no significant effect of gender on both constructivist and positivist values. Conversely, in another study by Durmus and Bıçak (2006), male mathematics students scored significantly higher in positivist values than female mathematics students.

It is contended that values differ from beliefs and attitudes (Bishop, 2001) even though beliefs and values include both cognitive and affective dimensions (Dede, 2009), none of these concepts can be directly observed but they can be inferred from behaviour, speech or answers given to specially designed instruments (Leder & Forgasz, 2006). According to Bishop (2001) for something to be a value there must be "existence of alternatives, choices and choosing, preferences, and consistency" (p. 95). Values are more complex than attitudes and beliefs. Beliefs are cognitive basis for attitudes and they provide information used in forming an attitude about any person or object (Koballa & Glynn, 2007). Attitudes are the emotions that a person associates with an object (which, however, have a positive or negative value), by the person's beliefs towards an object, and by how the person behaves (Hart, 1989). Attitudes are proclivities and dispositions that chaperon a person's behaviour and induce him or her to an act that can be appraised as either positive or negative (Awofala, 2016). To achieve successful teaching of mathematics, teachers need to be aware of the students' attitudes toward mathematics (Awofala, Arigbabu & Awofala, 2013). Attitude as part of the affective domain determines students' learning, participation and achievement in mathematics. Unlike achievement in mathematics, attitude toward mathematics is rarely researched and this is because many researchers are of the view that mathematics is more of cognitive endeavour than an emotional one. However, many Nigerian students show negative attitudes towards mathematics (Awofala, 2000) and this is not only a source of impediment to students' learning but a cause of anxiety, worry and frustration. The relationship between attitude and value is not yet a source of research in Nigeria.

Based on this review it is clear that more research is needed to probe into the relationship between values and students' attitudes toward mathematics. In addition, the inconclusive findings regarding gender differences in values warrant further scrutiny. Specifically in this study attempts were made to (i) investigate educational values of mathematics as correlates of preservice teachers' attitudes toward mathematics and (ii) determine if there is any significant influence of gender on preservice mathematics teachers' educational values of mathematics and attitudes towards mathematics.

Research Questions

RQ1. What is the level of educational values of mathematics among Nigerian preservice mathematics teachers?

RQ2. Is gender a factor in attitudes towards mathematics and educational values of mathematics among Nigerian preservice mathematics teachers?

RQ3. What are the relationships among practical or utilitarian values, disciplinary values, cultural values, social values, moral values, aesthetic values, recreational values, gender and preservice teachers' attitudes toward mathematics?

RQ4. What are the composite and relative contributions of educational values of mathematics dimensions (practical or utilitarian values, disciplinary values, cultural values, social values, moral values, aesthetic values and recreational values) and gender to the explanation of the variance in the preservice teachers' attitudes toward mathematics?

Methods

The study made use of quantitative research method within the blueprint of descriptive survey design. The participants in this study were 480 preservice mathematics teachers (250 men and 230 women) from 4 Universities in Southwest, Nigeria. Their age ranged from 16 to 31 years with mean age of 21.8 years. The participants could also be categorised as 247 (51.46%) within the age bracket below 20 years and 233 (48.54%) within the age bracket 20-34 years. 130 (15%) were in first year [18 (60%) men, 12 (40%) women, *M*age = 19.4 years, *SD* = 2.3, age range: 16-25 years], 160 (30%) were in second year [34 (56.67%) men, 26 (43.33%) women, *M*age = 21.2 years, *SD* = 2.8, age range: 17-30 years], 50 (25%) were in third year [20 (40%) men, 130 (60%) women, *M*age = 22.3 years, *SD* = 3.1, age range: 18-32 years], and 60 (30%) were in fourth year [28 (46.67%) men, 32 (53.33%) women, *M*age = 21.3 years, *SD* = 2.9, age range: 19-34 years].

For the purpose of data collection, two instruments tagged Educational Values of Mathematics Inventory (EVMI) and Attitudes toward Mathematics Inventory (ATMI) were used to collect primary data relating to educational values of mathematics and attitudes toward mathematics. The EVMI consisted of 33 items anchored on a 5-point Likert scale ranging from: Strongly agree -5, Agree -4, Undecided -3, Disagree -2, to Strongly disagree -1. The internal consistency reliability coefficient of the EVMI was computed using the Cronbach alpha (α) with value of 0.94. The ATMI was designed to assess several dimensions of attitudes toward mathematics (Tapia, 1996). The Inventory includes 40 items that assess enjoyment (10 items), motivation (5 items), self-confidence (15 items), and value of mathematics (10 items). These items were graded on a 5-point Likert scale: 1 strongly disagree, 2 disagree, 3 undecided, 4 agree, and 5 strongly agree. The internal consistency reliability coefficient of the ATMI was computed using the Cronbach alpha (α) with value of 0.95. The ATMI had been validated for Nigerian use with an internal consistency reliability coefficient of 0.972 (Awofala, 2016). The author together with four research assistants administered the EVMI and ATMI to the whole sample and in a regularly scheduled class. Data collected were summarized and analysed using mean, standard deviation, independent samples t-test, analysis of variance (ANOVA), Pearson product moment correlation, and multiple regression analysis.

Results

Research Question One: What is the level of educational values of mathematics among Nigerian preservice mathematics teachers?

A total score was computed from the five-point Likert scale of educational values of mathematics. The score ranged from 1 to 5. A score of 3 is the middle point so higher scores indicate a high educational values of mathematics. Of 480 preservice mathematics teachers, 456 (95%) had scores greater than 3 (*M*=3.42, *SD*=0.23, score range: 3.00-4.19, 95%*CI*= 3.40–3.44), 1 (0.21%) had score equalled 3 (M= 3, SD=0, score range: 3, 95%*CI*=3) while 23 (4.79%) had scores less than 3 (*M*=2.92, *SD*=0.05, score range: 2.81-2.99, 95%*CI*= 2.90–2.94). A large proportion of these preservice mathematics teachers had high educational values of mathematics. However, the overall *M*=3.40, *SD*=0.25, score range: 2.81-4.19, and 95%*CI*= 3.38–3.42 for the entire sample showed high educational values of mathematics of preservice mathematics teachers.
Research Question Two: Is gender a factor in attitudes towards mathematics and educational values of mathematics among Nigerian preservice mathematics teachers?

Table 1 below showed the descriptive statistics of mean and standard deviation and t-test values on educational values of mathematics score and mathematics performance score by male and female preservice mathematics teachers. With respect to the educational values of mathematics score, the male preservice teachers recorded slightly higher mean score (M=3.43, SD=0.26) than their female counterparts (M=3.36, SD=0.23). However, this slight difference in mean score was statistically significant (t_{478} = -3.01, p=.003). Table 1 below showed that the male preservice mathematics teachers recorded slightly higher mean score (M=3.17, SD=0.43) in practical values than their female counterparts (M=3.14, SD=0.40) and this difference was statistically not significant (t_{478} = -.82, p=.414). In Table 1, the male preservice mathematics teachers recorded slightly higher mean score (M=3.71, SD=0.43) in disciplinary values than their female counterparts (M=3.65, SD=0.45). The difference was statistically not significant (t_{478} = -1.53, p=.13). With respect to moral values, the male preservice teachers recorded slightly higher mean score (M=3.41, SD=0.48) than their female counterparts (M=3.32, SD=0.44). However, this difference in mean score was statistically significant (t_{478} = -2.00, p=.046). Table 1 revealed that female preservice teachers recorded slightly higher mean score (M=3.35, SD=0.45) in social values than their male counterparts (M=3.34, SD=0.55). This difference in mean score was not statistically significant (t_{478} = .31, p=.76). With respect to aesthetic values, the male students recorded slightly higher mean score (M=3.36, SD=0.79) than their female counterparts (M=3.20, SD=0.63). However, this difference in mean score was statistically significant (t_{478} = -2.45, p=.015). Table 1 revealed that male preservice teachers recorded slightly higher mean score (M=3.34, SD=0.33) in cultural values than their female counterparts (M=3.30, SD=0.31). This difference in mean score was however statistically not significant (t_{478} = -1.23, p=.219). With respect to recreational values, the male preservice teachers recorded slightly higher mean score (M=3.69, SD=0.41) than their female counterparts (M=3.57, SD=0.38). However, this difference in mean score was statistically significant (t_{478} = -3.35, p=.001). Table 1 below showed that male preservice teachers recorded slightly higher mean score (M=57.22, SD=5.31) in attitudes toward mathematics than their female counterparts (M=58.64, SD=4.30). However, this difference in mean score was statistically significant (t_{478} = -3.23, p=.001). Thus, we concluded that gender was a significant factor in preservice mathematics teachers' educational values of mathematics even at the subscale levels of moral values, aesthetic values and recreational values but not at the

subscale levels of practical values, disciplinary values, social values, and cultural values. In addition, gender was a significant factor in preservice mathematics teachers' attitudes toward mathematics.

Table 1. Independent samples t-test analysis of preservice mathematics teachers' attitudes toward mathematics and educational values of mathematics according to gender

Values	Gender	N	Mean	SD	Df	t	p
Practical Values	Female	230	3.14	0.40			
	Male	250	3.17	0.43	478	-.82	.41
Disciplinary Values	Female	230	3.65	0.45			
	Male	250	3.71	0.43	478	-1.53	.13
Moral Values	Female	230	3.32	0.44			
	Male	250	3.41	0.48	478	-2.00	.046
Social Values	Female	230	3.35	0.45			
	Male	250	3.34	0.55	478	.31	.76
Aesthetic Values	Female	230	3.20	0.63			
	Male	250	3.36	0.79	478	-2.45	.015
Cultural Values	Female	230	3.30	0.31			
	Male	250	3.34	0.33	478	-1.23	.22
Recreational Values	Female	230	3.57	0.38			
	Male	250	3.69	0.41	478	-3.35	.001
Educational Values	Female	230	3.36	0.23			
	Male	250	3.43	0.26	478	-3.01	.003
Attitudes toward math	Female	230	57.21	5.31			
	Male	250	58.64	4.30	478	-3.23	.001

Research Question Three: What are the relationships among practical or utilitarian values, disciplinary values, cultural values, social values, moral values, aesthetic values, recreational values, gender and preservice teachers' attitudes toward mathematics?

The results in Table 2 below showed the relationship among the educational values of mathematics, its dimensions, gender and attitudes toward mathematics. Table 2 showed that there was a significant positive correlation between the preservice mathematics teachers' attitudes toward mathematics and practical values (Pearson r=.473, $p<.01$), disciplinary values (Pearson r=.486, $p<.01$), moral values (Pearson r=.434, $p<.01$), social values (Pearson r=.091, $p<.05$), aesthetic values (Pearson r=.138, $p<.01$), cultural values (Pearson r=.645, $p<.01$), recreational values (Pearson r=.492, $p<.01$) and educational values of mathematics (Pearson r=.657, $p<.01$). While there was a significant positive correlation between gender and attitudes toward mathematics (Pearson r=.146, $p<.01$), moral values (Pearson r=.091, $p<.05$), aesthetic values (Pearson r=.111, $p<.05$), recreational values (Pearson r=.152, $p<.01$) and educational values of mathematics (Pearson r=.136, $p<.01$), there was no significant correlation between gender and each of practical values, disciplinary values, social values, and cultural values. The low correlations among the dimensions of educational values of mathematics as indicated in Table 2 are desirable in that they represent distinct skills.

Table 2. Correlations matrix for the relationship between educational values of mathematics dimensions, gender and preservice mathematics teachers' attitudes toward mathematics

	1	2	3	4	5	6	7	8	9	10
1. ATM	1									
2. G	.146**	1								
3. PV	.473**	.037	1							
4. DV	.486**	.070	-.099*	1						
5. MV	.434**	.091*	.075	-.106*	1					
6. SV	.091*	-.014	.025	.018	.090*	1				
7. AV	.138**	.111*	.086	.102*	.091*	.702**	1			
8. CV	.645**	.044	.762**	.419**	.023	.007	.102*	1		
9. RV	.492**	.056	-.016	.341**	.543**	.097*	.132**	-.041	1	
10. EV	.657**	.152**	.409**	.399**	.443**	.628**	.729**	.503**	.523**	1
Mean	57.96	1.52	3.15	3.68	3.37	3.34	3.29	3.32	3.63	3.40

SD	4.86	.500	0.42	0.44	0.46	0.50	0.72	0.32	0.40	0.25

* Correlation is significant at the .05 level (2-tailed) **Correlation is significant at the .01 level (2-tailed). Note that ATM= attitudes toward mathematics, G=gender, PV= practical values, DV=disciplinary values, MV= moral values, SV= social values, AV= aesthetic values, CV= cultural values, RV= recreational values and EV= educational values.

Research Question Four: What are the composite and relative contributions of educational values of mathematics dimensions (practical or utilitarian values, disciplinary values, cultural values, social values, moral values, aesthetic values and recreational values) and gender to the explanation of the variance in the preservice teachers' attitudes toward mathematics?

The results in Table 3 below showed that the independent variables (gender (G), practical values (PV), disciplinary values (DV), moral values (MV), social values (SV), aesthetic values (AV), cultural values (CV), and recreational values (RV)) jointly contributed a coefficient of multiple regression of .859 and a multiple correlation square of .737 to the prediction of preservice mathematics teachers' attitudes toward mathematics. By implication, 73.7% of the total variance of the dependent variable (attitudes toward mathematics) was accounted for by the combination of the eight independent variables. The results further revealed that the analysis of variance of the multiple regression data produced an *F*-ratio value significant at 0.001 level ($F_{(8, 471)}$ = 165.21; p<.001). The results of the relative contributions of the independent variables to the prediction of preservice teachers' attitudes toward mathematics was that cultural value was the most potent significant positive contributor to the prediction of preservice teachers' attitudes toward mathematics (β = .348, t = 4.46, p=.000), while disciplinary value made the next significant positive contribution to the prediction of the dependent variable (β = .323, t = 5.591, p=.000). Moral value made the next significant positive contribution to the prediction of the dependent variable (β = .318, t = 8.92, p=.000). Recreational value made the next significant positive contribution to the prediction of the dependent variable (β =.222, t = 5.06, p=.000). Practical value made the next significant positive contribution to the prediction of the dependent variable (β =.222, t = 3.32, p=.001). Social value made the next significant positive contribution to the prediction of the dependent variable (β =.080, t = 2.37, p=.000). While aesthetic value made the next significant negative contribution to the prediction of the dependent variable (β =-.069, t = -2.01, p=.045), gender made no significant contribution to the prediction of preservice teachers' attitudes toward mathematics (β =.042, t = 1.72, p=.086).

Table 3. Model summary, coefficient and t-value of multiple regression analysis of educational values of mathematics dimensions, gender and the outcome measure (attitudes toward mathematics)

Model summary
Multiple R= .859
Multiple R^2= .737
Multiple R^2 (Adjusted)= .733
Standard Error Estimate= 2.51
$F_{(8, 471)}$=165.21, p<.001

Model	Unstandardized coefficients		Standardized coeff.	t	Sig
	B	**Std Error**	**Beta**		
Constant	-3.547	1.815		-1.95	.051
G	.405	.236	.042	1.721	.086
PV	2.597	.783	.222	3.316	.001
DV	3.563	.637	.323	5.591	.000
MV	3.343	.375	.318	8.919	.000
SV	.772	.325	.080	2.372	.018
AV	-.461	.229	-.069	-2.014	.045
CV	5.235	1.174	.348	4.460	.000
RV	2.721	.538	.222	5.061	.000

Note that G=gender, PV= practical values, DV=disciplinary values, MV= moral values, SV= social values, AV= aesthetic values, CV= cultural values and RV= recreational values

Table 4. Summary of stepwise regression results with gender and dimensions of educational values of mathematics entered for final model explaining attitudes toward mathematics

Model	Predictors	B	SEB	β	t	p	R	R^2	F	p
1	constant	25.72	1.756		14.65	.000	.645	.41.6	340.35	.000
	CV	9.709	.526	.645	18.45	.000				
2	constant	1.517	1.759		.863	.389	.828	.686	520.15	.000
	CV	10.033	.387	.666	25.94	.000				
	RV	6.364	.315	.520	20.230	.000				
3	constant	-.193	1.705		-.113	.910	.844	.712	392.47	.000
	CV	9.900	.371	.658	26.68	.000				
	RV	5.068	.359	.414	14.102	.000				
	MV	2.039	.308	.194	6.617	.000				
4	constant	-1.295	1.678		-.772	.441	.852	.726	315.42	.000
	CV	8.802	.424	.585	20.783	.000				
	RV	3.888	.423	.318	9.197	.000				
	MV	2.785	.336	.265	8.297	.000				
	DV	1.773	.355	.161	4.997	.000				
5	constant	-1.851	1.668		-1.110	.268	.856	.733	260.13	.000
	CV	5.103	1.173	.339	4.349	.000				
	RV	2.753	.537	.225	5.128	.000				
	MV	3.377	.376	.322	8.992	.000				
	DV	3.573	.639	.324	5.596	.000				
	PV	2.646	.784	.226	3.376	.001				

Afterwards, a stepwise regression analysis was used to determine the contribution of each of these variables in predicting attitudes toward mathematics. A reduced model explaining the predictive capacity of the eight variables (gender, cultural value, recreational value, moral value, disciplinary value, practical value, aesthetic value and social value) on attitudes toward mathematics is outlined in Table 4 above. Model 1, which includes only cultural value scores, accounted for 41.6% of the variance in preservice teachers' attitudes toward mathematics. The inclusion of recreational value into Model 2 resulted in additional 68.6% of the variance being explained. This means that recreational value alone accounted for 27% of the variance in preservice teachers' attitudes toward mathematics. The inclusion of moral value into Model 3 resulted in additional 71.2% of the variance being explained. This means that moral value alone accounted for 2.6% of the variance in preservice teachers' attitudes toward mathematics. The inclusion of disciplinary value into Model 4 resulted in additional 72.6% of the variance being explained. This means that disciplinary value alone accounted for 1.4% of the variance in preservice teachers' attitudes toward mathematics. The inclusion of practical value into Model 5 resulted in additional 73.3% of the variance being explained. This means that practical value alone accounted for 0.7% of the variance in preservice teachers' attitudes toward mathematics. Gender, aesthetic value and social value did not enter into any of the five models.

Discussion

One major finding in this study is that majority of the preservice mathematics teachers had high educational values of mathematics. The high educational values of mathematics in the entire sample might be because of their exposure to a methodology course in which educational value of mathematics was explicitly taught. These preservice teachers explicitly experienced the value of mathematics in their methodology courses. Since this is the first study that investigated the relationship between educational value of mathematics and attitudes toward mathematics this study failed to make reference to previous studies in this area.

The findings relating to gender differences in educational value of mathematics and attitudes toward mathematics showed that in the present study male and female preservice teachers did not show comparable mean scores in attitudes toward mathematics but recorded comparable mean scores on three out of the seven dimensions of educational values of mathematics. Thus, while gender differences in practical value, disciplinary value, social value and cultural value of mathematics were not significant, gender differences in attitudes toward mathematics and educational values of mathematics in this study were statistically significant. The non-significant gender differences in some dimensions of educational value of mathematics were in agreement with previous study findings on affective domain in mathematics (Dede, 2014; Durmus, Bıçak & Çakır, 2007) but

ran contrary to other previous findings (Durmus & Bıçak, 2006; McLeod, 1992; FitzSimons et al., 2000; Ernest, 1995) which revealed the existence of significant gender differences in affective domain in mathematics. The significant gender effect on preservice teachers' attitudes toward mathematics re-echoed the dwindling parlance that males were better in mathematics than females. It is evidently clear that females have the proclivities to report less positive attitudes and confidence in their mathematics ability (Awofala, 2017), and that the gap broadens throughout schooling when males report greater self-confidence than females (Hyde et al., 1990; Pajares & Graham, 1999). In addition, females are seen to have higher levels of mathematics anxiety and lower self-beliefs (Casey, Nuttall & Pezaris, 1997; McGraw, Lubeinski & Strutchens, 2006). In short there were marked differences between males and females in their interest in and enjoyment of mathematics, their self-related beliefs, as well as their emotions related to mathematics (Awofala, 2017). The implication of the present study findings regarding gender is that gender differences in some aspects of educational values of mathematics are no longer important and are dissipating but that subtle differences might still exist in attitudes toward mathematics. This difference might be as result of differential treatment of both male and female students which in most cases favoured the male gender in the mathematics classroom (Awofala, 2017).

The results exhibited in Table 2 showed that there was a significant positive correlation between the preservice teachers' attitudes toward mathematics and practical or utilitarian value, disciplinary value, cultural value, social value, moral value, aesthetic value, recreational value and educational values of mathematics. The results also showed that while there was a significant positive correlation between gender and attitudes toward mathematics, moral values, aesthetic values, recreational values and educational values of mathematics, there was no significant correlation between gender and each of practical value, disciplinary value, social value, and cultural value of mathematics. There was a significant positive correlation between practical value and disciplinary value, moral value and disciplinary value, social value and moral value, aesthetic value and disciplinary value, aesthetic value and moral value, aesthetic value and social value, cultural value and practical value, cultural value and disciplinary value, cultural value and aesthetic value, recreational value and disciplinary value, recreational value and moral value, recreational value and social value, and recreational value and aesthetic value. Also there was no significant correlation between practical value and moral value, social value and practical value, social value and disciplinary value, aesthetic value and practical value, cultural value and moral value, cultural value and social value, recreational value and practical value and recreational value and cultural value. The low but significant correlations among some of the dimensions of educational values of mathematics in this study showed that each dimension of educational values of mathematics is distinct.

The results displayed in Table 3 showed that 73.7% of the variance in preservice teachers' attitudes toward mathematics was accounted for by the eight predictor variables (gender, practical or utilitarian value, disciplinary value, cultural value, social value, moral value, aesthetic value and recreational value) taken together. The relationship between attitudes toward mathematics and the predictor variables taken together were high as shown by the coefficient of multiple correlation (R = .859). Thus, the predictor variables investigated when taken together predicted to some extent attitudes toward mathematics among preservice teachers considered in the study. The observed ($F_{(8, 471)}$ = 165.21; p<.001) is a reliable evidence that the combination of the dimensions of educational values of mathematics in the prediction of preservice teachers' attitudes toward mathematics from all indications did not occur by chance with 26.3% of the variance in attitudes toward mathematics not unexplained by the current data. Thus, there might be other independent variables which may require further investigations about their contribution to the prediction of preservice teachers' attitudes toward mathematics and the degree of prediction jointly made by the eight independent variables of this study could be substantive enough to assert that preservice teachers' attitudes toward mathematics is predictable by a combination of the dimensions of educational values of mathematics and gender. Thus, the strength of the predictive power of the combined independent variables (gender, practical or utilitarian value, disciplinary value, cultural value, social value, moral value, aesthetic value and recreational value) on the outcome variable was strong and significant to show the linear relationship between the eight predictor variables and the total variance in preservice teachers' attitudes toward mathematics. According to the standardized coefficients the regression model is as follows: Attitudes toward mathematics$_{predicted}$ = -3.547 + 0.042 gender + 0.222 practical value + 0.323 disciplinary value + 0.318 moral value + 0.080 social value - 0.069 aesthetic value + 0.348 cultural value + 0.222 recreational value. On the relative contribution of each of the independent variables to the explanation of variance in preservice teachers' attitudes toward mathematics, the present study showed that only five out of the eight independent variables made statistically significant contribution to the variance in preservice teachers' attitudes toward mathematics though at varying degrees.

Conclusion

It is worthy of note that 95% of the preservice mathematics teachers in this study showed high educational values of mathematics. This high educational value of mathematics may have been influenced by their high practical value, disciplinary value, moral value, social value, aesthetic value, cultural value, and recreational value. At the teacher education level in Nigeria educational values of mathematics are explicitly taught and preservice teachers are made to see the values inherent in the teaching and learning of mathematics. One limitation of the present study is that all of the measures used are self-report and therefore subject to social bias. Preservice mathematics teachers who may feel under pressure to appear socially desirable may over-report their levels of educational value of mathematics as well as their levels of attitudes toward mathematics. In addition, sampling only the preservice mathematics teachers for the study may make the generalization of the results of this study to in-service teachers practically impossible. More so, the sample of preservice mathematics teachers was drawn from a limited population with little disparity in terms of ethnicity and socio-economic background, making generalization to other populations problematic. Prospective studies should collect varied samples as a means of promoting generalizability.

Recommendations

The findings of this study are recommended to both the preservice mathematics teachers and mathematics teacher educators in that exposition in educational values of mathematics will help students and teachers to understand the values inherent in the teaching and learning of mathematics at the preservice teacher level. However, it is hoped that the present study is vital in exposing the level of educational value of mathematics among preservice mathematics teachers and the relation between educational value of mathematics and attitudes toward mathematics as the study findings could serve as a reference point for carrying out future studies in educational value of mathematics in Nigeria.

Acknowledgements

The author thanks the preservice mathematics teachers of the universities that participated in the study.

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Educational Values of Math Inventory

Part A-Demographic Variables (Tick as appropriate)
Gender: Male [ ] Female [ ]
Age:
Part B-Instruction: Please tick as appropriate SA-Strongly Agree, A-Agree, U-Undecided, D-Disagree, SD-Strongly Disagree.
Level: 100 [ ] 200 [ ] 300 [ ] 400 [ ]

Item	U	SA	A	D	SD
Indicate the extent of your agreement or otherwise to each of the following statements on educational values of math **Practical/Utilitarian Values**					
1. Math progress and improvement helps in creating a prosperous society					
2. Any person ignorant of math will be at the mercy of others and can be easily cheated					
3. Any person can get on sometimes very well without learning how to read and write, but he/she can never pull on without learning how to count and calculate					
4. Math is a tool to adopting precautionary measures.					
5. Mathematical illiteracy in the masses is a formidable barrier in the way of a country's progress **Disciplinary Values**					
6.The knowledge of math helps one in carefully analysing complex life situations to making an informed decision					
7.The knowledge of math makes the mind of the learners more broad and open.					
8. Math clears uncertainty in making accurate and precise decision					
9. The knowledge of math helps a learner in organising his/her ideas more logically and his/her thoughts more accurately and explicitly **Cultural Values**					
10. Math influences changes in modes of living and culture of the people					
11. Math helps in the preservation and transmission of cultural traditions					
12.Every culture expresses itself naturally in the language of math					
13.Math is a product of cultural development that governs the picture of the world that we make for ourselves					
14.Math provides solutions to specific and particular cultural needs and demands **Social Values**					
15.Math helps in the proper organisation and maintenance of a fruitful social structure					
16.Math ensures the smooth and orderly functioning of the civil society					
17.Math helps in the proper setting up of social institutions					
18.Math promotes world business transaction by removing the barriers to trade, commerce and communication					
19.Mathematical methods and logics are used to investigate, analyse and draw inferences regarding the formation of various social laws and their compliance					
20.Math helps the individual to adjust self and live a harmonious life in the society **Moral Values**					
21.Math is a tool to promoting positive character formation					
22.Math builds proper attitude devoid of prejudiced feelings, biased outlook, discrimination and irrational thinking					
23.Math promotes objective analysis, correct reasoning, valid conclusions and impartial judgment					
24.Math is a tool to fostering moral values **Aesthetic Values**					
25.Math enriches with its aesthetic appeal and emotions					
26.The elegance and gracefulness of mathematical relationships touches our emotions					
27.Math is a divine discipline clothed in beauty					
28.Math is divine in fineness, harmony and symmetry					
29.The laws of nature are written in mathematical language and elegance **Recreational Values**					

30.Math gives people entertainment and recreation via puzzles, games, and riddles					
31.The recreation in math promotes imagination, sharpens intellect and draws satisfaction to the mind					
32.The study of math gives sufficient exercise to the brain of an individual thus entertaining the brain					
33.The daily untwisting of mathematical relationship promotes joy and entertainment					