



Full Length Research Paper

Evaluating Measurement Model for Values Inculcation in Mathematical Contents Delivery

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Abstract

A value based educational system is an integral part of human intellectual development. This is because knowledge acquired and valued tends to remain in the learners' memory longer than procedural knowledge. As such, this study aims to examine the constructs of values inculcation in mathematics teaching and learning in order to ascertain the extent to which the conceptualized measure for the inculcation of mathematical values reproduces the data. The study also evaluates the adequacy of the inculcation framework across mathematics teachers' gender and academic qualifications. Data was collected from a self-reported questionnaire administered to (n=509) secondary schools mathematics teachers' in Nigeria. The results of confirmatory factor analysis (CFA) support the adequacy of the values inculcation measures across gender and academic qualifications of mathematics teachers.

Keywords: Validity, Values System, Measurement Model, CFA.

INTRODUCTION

The inculcation of mathematical values in the teaching and learning of mathematics is grounded in the cognitive and affective domains of Bloom's well-known taxonomy of educational objectives. Lim and Ernest (1997), Bishop (1988) and Seah (1999) argue that efficacy of mathematics teachers value inculcation is an individual's ability or competence of imbibing ideological, attitudinal, and sociological knowledge and strategies in the effective organization of mathematical content and delivery. Mathematics teachers' self-efficacy in regard to values inculcation is a strong predictor of students' conceptual understanding and a profound determinant of students' achievement. A strong sense of the efficacy of values inculcation enhances teacher instruction and learning strategies (Bishop, Gunstone, Clarke, & Corrigan, 2010, Bishop & Clarkson, 1998; Liman, Ibrahim & Shittu, 2011a). In Bishop's view,

"values in mathematics education are the deep affective qualities which education fosters through the school subject of mathematics. They appear to survive longer in people's memories than does conceptual and procedural knowledge, which unless it is regularly used tends to fade" (Bishop, 1999, p. 2).

It was against this background the study intended to extend the Bishop, (1988) conceptualization of values in mathematics teaching and learning by two additional constructs, namely: computational and motivational mathematical values. The addition of computational mathematical values construct for value inculcation in mathematics teaching and learning was born out of the fact that mathematical instruction via computer usually arose learners' interest and attention. According to Basturk, (2005) studies which are guides through computerized means usually impact and improve students' overall level of mastery of the subject matter. Basturk, (2005) advocated that computer applications and usages facilitates effective mathematics instructional contents delivery and enable mathematics learners to cultivate the values of curiosity, self management and control, learners' interest and attention, neatness and beauty, self discovery and instant feedback.

Motivational mathematical values which was also considered important and added to the values inculcation model is intimately linked to the ways students think, feel, and act in schools mathematics teaching and learning. Furthermore, research has proven that student motivation and related outcomes in mathematics teaching and learning are sensitive to the characteristics of the learning context, which include teachers' instructional practices as well as the school and classroom climate (Ames, 1992;

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Anderman & Maehr, 1999; Eccles, Wigfield & Reuman, 1989). According to Fennema, (1989) and Schoenfeld, (1992) motivational mathematical values construct enable mathematics teachers to cultivate in learners the values of encouragement in such a way that of rewarding higher achievers and encouraging the lower ones, unveiling incentives attached to the learning of mathematics, cultivating the culture of perseverance and diligence.

Finally, the hypothesized 5-dimension for values inculcation in mathematics teaching and learning can contribute toward realization of effective mathematical contents delivery. Measures of values inculcation in mathematics teaching and learning were developed through review of a number of researches conducted qualitatively in the area of mathematics education. The measures were subjected to a number of validation processes such as face validity, content validity and exploratory factor analysis in order to find out the factor dimensions of the mathematical value inculcation measures.

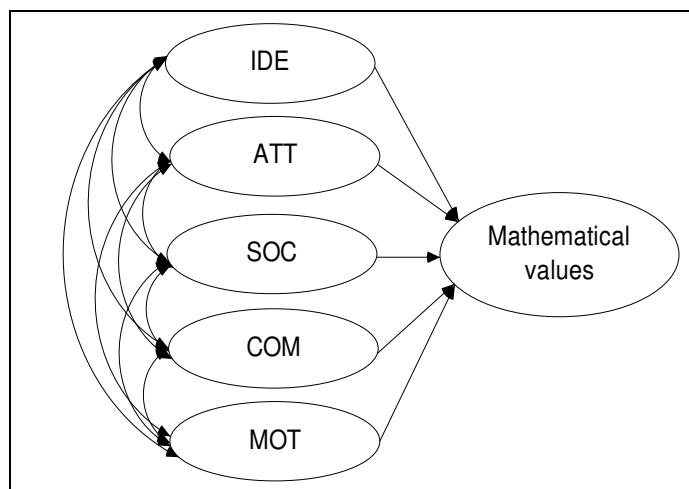


Figure 1.1: Hypothesized Mathematical Values Inculcation Model
MODEL KEY: IDE = Ideological mathematical value, ATT= Attitudinal mathematical value, SOC= Sociological mathematical values, COM= Computational mathematical values, MOT = Motivational mathematical values.

The self-efficacy of mathematics teachers concerning value inculcation in context and task-specific can be perceived from their ability to carry mathematics instruction and learning beyond the scope of ideological mathematical conceptions. In this context the main task of mathematics teachers is to be able to incorporate the five underlying components of mathematic values, namely: the inculcation of ideological, attitudinal, sociological, computational and motivational values in their teaching (Figure 1.1). This study intends to answer the following research questions and hypotheses based on the underlying conceptual frame-work in order to understand and affirm how values are inculcated in mathematical content delivery.

Research Questions

Q1: Does the model for mathematical value inculcation adequately support the data?

Q2: Is there gender invariance in the mathematical values inculcation model?

Q3: Does the academic qualifications of mathematics teachers lead to invariance of the value inculcation model?

Research Hypotheses

H1: The values inculcation model in mathematics teaching and learning will fit the data.

H2: The gender will be invariant of the mathematical values inculcation model.

H3: The teachers' qualifications will be invariant of the mathematical values inculcation model.

PREVIOUS STUDY

As a discipline mathematics was developed many centuries ago to incorporate the rich traditions, cultures, and histories of many different societies. It developed out of the research of many cultural societies and it was noticed that mathematical development depended heavily on how mathematics was regarded in terms of the values, traditions and norms of a society. The way mathematical education was regarded by different cultures and societies invariably and significantly affects the mathematical competencies and development of a cultural society and variations in this regard usually changed over time (Lancaster, 2006 & Liman, Sahari & Shittu, 2011b). In some societies and cultures the knowledge and practice of mathematics was regarded as the domain of an elite class of philosophers, priests or scribes. In other society's mathematics was a field for merchants and explorers and in yet other societies the work of scientists and industrialist (Lancaster, 2006 & Liman et al., 2011a).

Therefore, it can be deduced that the conception of values in mathematics differs from one society to another and from one culture to another. As such there is an increasing demand for mathematics teachers to be aware of the societal norms, values, and cultural affiliations of learners. This will enable them to inculcate the desirable and needed values based on the needs and aspirations of respective societies and cultures (Liman et al., 2011ab).

In many societies and indeed in contemporary Nigerian society, strong numeracy is expected of all adolescents, and a sound mathematical background is an essential requirement for further study. It is a required part of the compulsory year's curriculum for senior secondary school students in the late adolescent years of

schooling (Liman, et al., 2011ab). For example, in the late 1980s the contemporary research field of values in school mathematics teaching and learning was conceptualized in explicit ways and asserted that there is a need for the academic community to bring together considerations of mathematical instruction with values education if we are to teach mathematics successfully in a democratic ways (Seah, 1999; Bishop et al., 2010 & Liman et al., 2011a). It was also argued that both considerations of mathematical education for democracy and of making school mathematics more relevant to the demands of everyday living involve the teaching and inculcation of values to mathematics students (Bishop, & Clarkson, 1998).

According to Bishop et al., (2010), school mathematics is intimately linked to the society in which it is taught. Whether we are preparing students for a meaningful life in the society or for productive contribution in the workplace, relevant societal values are needed as the notion of school mathematics as being value-laden is increasingly being recognized. Bishop and Clarkson (1998) and Liman et al., (2011) asserted that human beings have always used mathematics. It illustrates the six “universal” activities which every cultural group performs, namely counting, measuring, locating, designing, explaining, and playing. These behaviors are reflective of the culture of the people and are inexorably influenced by what that cultural group values.

The present study aimed to empirically test the probability of a five-common-factor structure for values inculcation in mathematics teaching and learning among secondary school mathematics teachers in the Sub-Saharan Africa; North Eastern region of Nigeria. The study sought to establish the extent to which the conceptualized measure for mathematical value inculcation reproduced the data. Moreover, the study evaluated the adequacy of the value inculcation measure across mathematics teachers’ gender and academic qualifications. The invariance analysis tested the moderating effect of gender and academic qualifications of mathematics teachers a lack of which enhances the usefulness of the measure.

METHODOLOGY

Population and Sample Size

The study used a purposeful sample of 509 out of a population size of 1145 which was a representative of the population size of mathematics teachers from the six states of the North Eastern region of Nigerian secondary schools. These states include: Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe state respectively. The sample size of 509 was obtained from the population size 1145 based on 95% confidence interval and 3.5% margin of error (Krejcie & Morgan, 1970). Therefore, based on the

sample size of the respondents of this study, 301 (59.1%) were male and 208 (40.9%) were female. The academic qualifications of the respondents of this study were classified into two groups, namely professional and non professional mathematics teachers. Mathematics teachers with the requisite teaching qualification were tagged as professionals while those without the pre-requisite teaching qualification constituted non-professional mathematics teachers. Based on this classification, 354 (69.5%) were professional mathematics teachers while 155 (30.5%) were non-professional mathematics teachers.

Instrument

A self-constructed 7-point likert-type scale survey measure of value inculcation in mathematics teaching and learning was used in the data collection of this study. The first section concerns the demographic information of the respondents, which includes gender, length of service, educational qualifications, age of the respondents and tribal sect respectively. Prior to the confirmatory factor analysis the 52 items proposed to measure the 5-latent factor for value inculcation in mathematics teaching and learning were subjected to exploratory factor analysis. Out of which 42 items clinched to the five hypothesized dimensions. These dimensions include: ideological, attitudinal, sociological, computational and motivational mathematical values which were used to obtain the teachers’ responses on the nature of values they inculcate in their mathematics teaching and learning. Thereafter, confirmatory factor analysis was performed in order to ascertain the validity of the hypothesized dimensions.

RESULTS

Adequacy of Mathematical Values Inculcation Measurement Model

The use of structural equation modeling technique for the data analysis in education and social science researches cannot be over emphasized in the sense that it is used in validating structural relationships among exogenous and endogenous variables based on certain theoretical frameworks (Hooper, Coughlan, & Mullen, 2008). Therefore, this study used structural equation modeling technique (SEM) for its data analysis. AMOS graphic window version 16 was used to assess the factorial validation of the hypothesized 5-factors dimensions for value inculcation measurement model. Based on the recommendations of Hair, Black, Babin & Anderson, (2010) and Sahari, (2011) the minimum range of the sample size for the variance analysis is between 150-above. They further reiterated the respondents’ ratio

should be between (1:1.5). For example the ratio of 1:1.5 between male and female was acceptable.

Furthermore, invariance analysis is usually conducted in order to ascertain the quality of the hypothesized measurement model among categorical variables of the study, for examples gender, age, ethnicity...etc...The analysis is to prove that the measurement model is not influenced by certain factors such as gender (Sahari, 2011). The reason involves constraining the measurement model is to ascertain the model fit both within the unrestricted and constrained model for the determination of the models Chi-squares difference for decision making.

The study examined multiple statistics of model fit because a model may achieve good fit on a particular fit statistics but inadequate on others (Bollen, 1990). The selection of statistics for this study was based on the recommendations of (Hu and Bentler, 1999) and (Hair et al., 2010). According to their recommendations to achieve goodness-of-fit for the empirical data, the measurement and model should meet the requirements of selected indices. Going by the suggestion of Hair et al., (2010), the first overall test of model fit selected was the chi-square test. A significant chi-square statistics indicates a poor model fit. As the Chi-square test is extremely sensitive to sample size (Bentler, 1990). The Chi-square normalized by degrees of freedom (χ^2/df) was also used. An acceptable ratio for χ^2/df value should be less than 3.0 (Hair et al. 2010).

According to Hair et al. (2010) researchers should report at least one incremental statistics and one absolute index, in addition to the Chi-square value; at least one of the indices should be the badness-of-fit index. For the badness-of-fit index, RMSEA was chosen as it often provides consistent results across different estimation approaches (Sugawara & MacCallum 1993). Following this guideline, other than Chi-square and normed χ^2/df value, model fit for the present study was examined using multiple indices which include Goodness-of-Fit Index (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standardized Root Mean Square Residual (SRMR) and a badness-of-fit index, Root Mean Square Error of Approximation (RMSEA) (Hu & Bentler, 1999).

Following common practice, acceptable model fit is indicated by a value greater than .90 for GFI, CFI, TLI, IFI and a value of less than 0.08 for RMSEA. However, a cut-off value close to .95 for TLI, CFI; and a cut-off value close to .06 for RMSEA are needed to support that there is a relatively good fit between the hypothesized model and the observed data (Hu and Bentler 1999). Much in the same way as many other SEM researches, the more stringent criteria proposed by Hu and Bentler (1999) for approximate fit statistics were adopted in the present study. Therefore, based on these criteria the initial model revealed lack of fit as the fit statistics showed that the model did not fit the data ($\chi^2/df = 2.124$; CFI =

.870; GFI = .857; RMSEA = .047; SRMR = .0452). The results also suggest a revision of the model since there were a few cases of cross-loaded indicators, some of which showed big error variances (Byrne, 2010; Hu & Bentler, 1999). Figure 1.2 gives the initial model of the study.

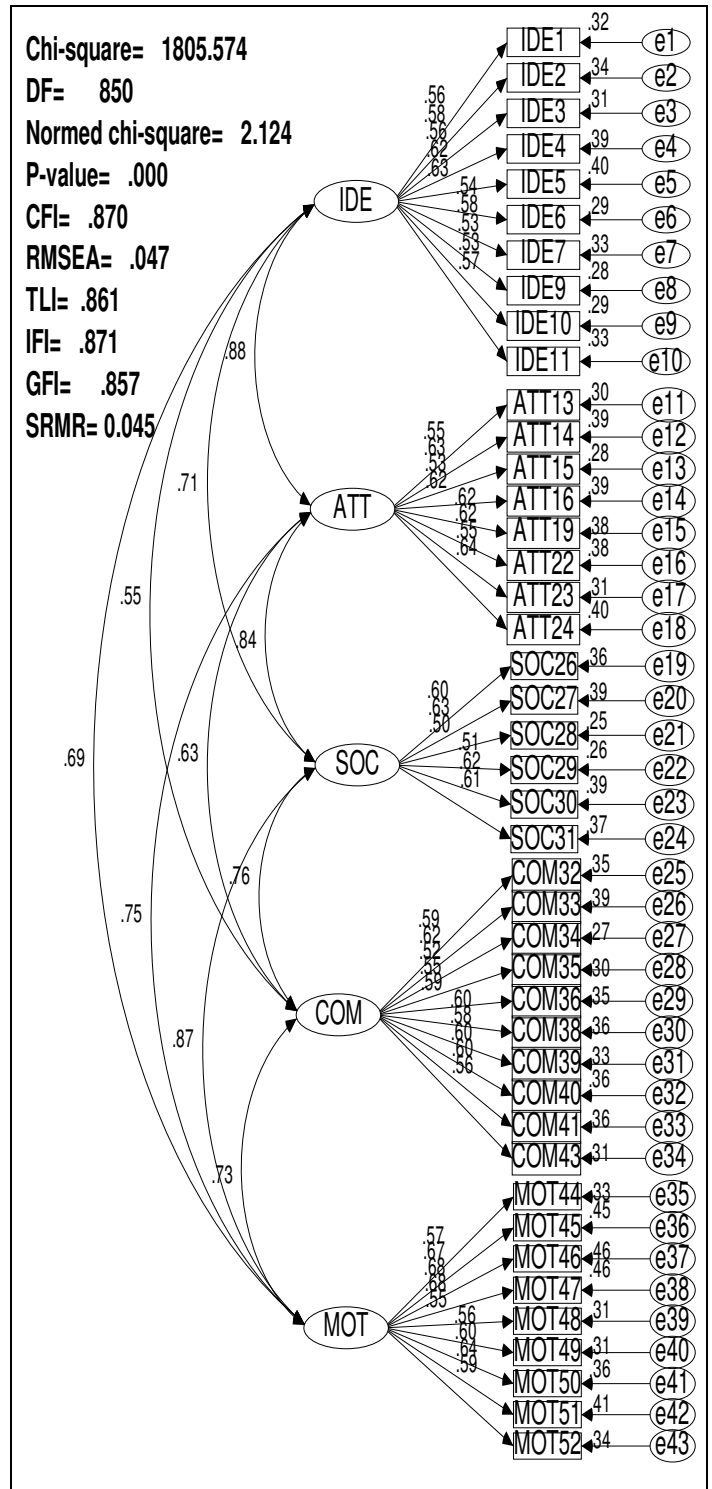


Figure 1.2: The Initial Structural Equation Measurement Model

Figure 1.3 presents the revised 28-item five-factor measurement model analyzed by performing CFA. This revised model was consistent with the data ($X^2(340) = 660.609$; $P = .000$; $CFI = .926$; $GFI = .915$; $TLI = .918$; $IFI = .927$; $RMSEA = .043$; $SRMR = .041$). The direction and magnitude of the factor loading were substantial and statistically significant (Hair, 2010 & Kline, 2011). Table 1 shows the standardized loadings derived from the maximum likelihood (ML), Cronbach's Alpha reliability, Composite reliability and convergent validity of each item measured using t-values.

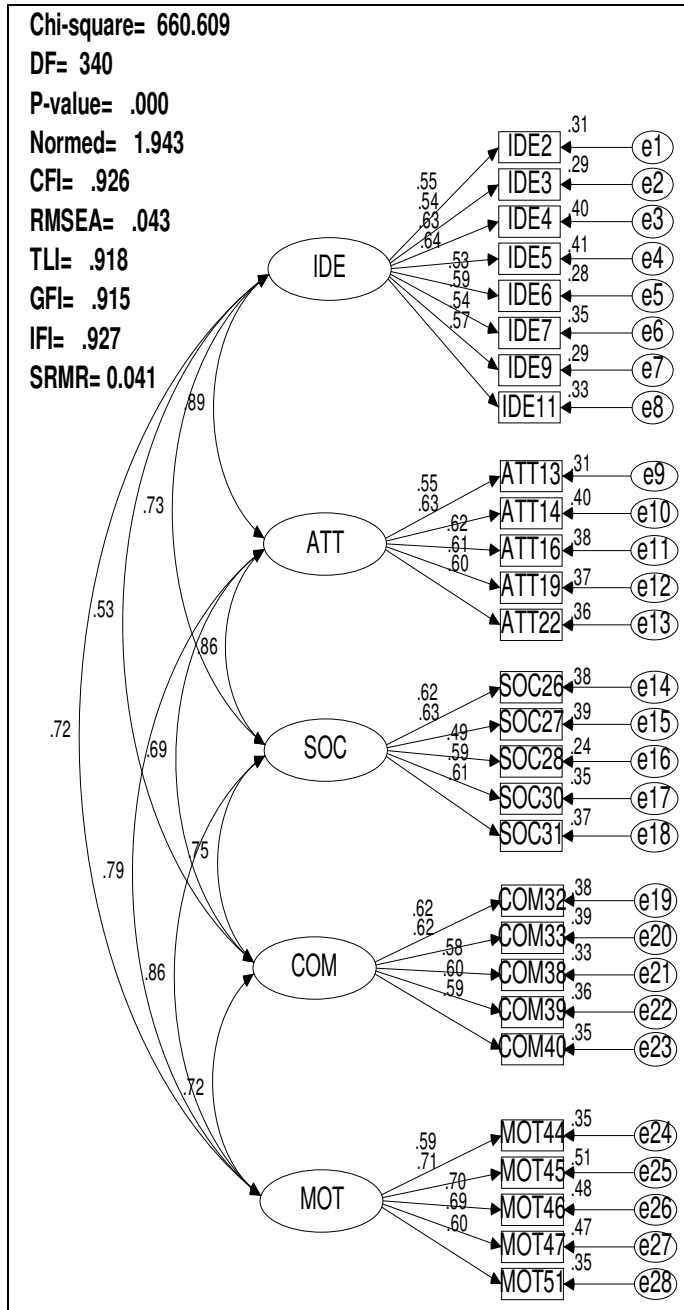


Figure 1.3: The Revised Structural Equation Measurement Model.

Table 1: Summary of the Model Standardized Loadings, Cronbach's Alpha, and Composite Reliability and Convergent validity (assessed by examining t-values)

Item	Measure	ML	t-Values
IDE2	I emphasize on the value of precision in my mathematics teaching.	.55	9.57
IDE3	Logical reasoning is one of the values I encourage in my mathematics teaching.	.54	9.57
IDE4	In my mathematics teaching, I emphasize on the value of working collaboratively.	.63	10.45
IDE5	The teaching of equations enables me to convey the value of equality in treatment to my students.	.64	10.41
IDE6	I cultivate the value of truthfulness in my mathematics teaching and learning.	.53	9.26
IDE7	Perseverance is one value I encourage in my mathematics teaching and learning.	.59	9.73
IDE9	In teaching mathematics, I encourage the value of competency in problem solving of my students.	.54	9.41
IDE11	The teaching of ratios and proportions enable me to convey the value of honesty to my students.	.57	9.64
Total Number of Items = 08		α - Value (.816)	Composite Reliability (.86)
ATT13	Mathematical classroom discussions enable me to convey the value of positive feeling to my students.	.55	10.64
ATT14	Individual mathematical assignment presentations enable me to cultivate the value of confidence in my students.	.63	10.64
ATT16	I act as a source of guidance to students in my mathematics teaching.	.62	10.44
ATT19	Punctuality is one of the values I emphasize in my mathematics teaching and learning.	.61	10.45
ATT22	By allowing students to explore on mathematical problems, I cultivate in them the value of creativity.	.60	10.08

Total Number of Items = 05	α – Value (.797)	Composite Reliability (.82)	
SOC26	Equal treatments of my students in mathematics teaching enable me to convey the value of social justice.	.62	11.71
SOC27	Mathematical knowledge sharing among students via project based learning promotes the value of friendships.	.63	11.71
SOC28	By allowing individual contributions to mathematics teaching and learning of my students, I emphasize on the value of being democratic.	.49	9.52
SOC30	I organize mathematics career talk on values attached to mathematics as a discipline.	.59	10.73
SOC31	In teaching the concepts of probability, I emphasize on the value of predictive tendencies of my students.	.61	11.05
Total Number of Items = 05	α – Value (.753)	Composite Reliability (.81)	
COM32	I inculcate the value of curiosity in my students via mathematics computer aided instruction (CAI).	.62	11.18
COM33	Mathematics computer aided instruction (CAI) serve as a means of inculcating the value of self management in my students.	.62	11.18
COM38	Mathematics computer aided instruction (CAI) enables me cultivate the value of social interaction in my students.	.58	9.94
COM39	Presentations of mathematics instruction via computers enable me to convey the value of accuracy in my students.	.60	10.23
COM40	Mathematics instruction via computer enables me to emphasize on the value of preciseness in my students.	.59	9.78

Total Number of Items = 05	α – Value (.835)	Composite Reliability (.82)	
MOT44	I cultivate the value of hardworking in my mathematics students by rewarding best performance.	.59	9.78
MOT45	In my mathematics teaching, I motivate my students by telling them benefits attributed to the learning mathematics.	.71	12.56
MOT46	I motivate my mathematics students by relating mathematics teaching to what they knew in their environment.	.70	12.05
MOT47	I emphasize on the value of perseverance in my mathematics teaching via problem solving of tough questions.	.69	11.47
MOT51	I motivate my mathematics students by seeing me as their role model.	.60	10.75
Total Number of Items = 05	α – Value (.846)	Composite Reliability (.86)	

Analysis of the Gender Invariance of Mathematical values inculcation Measure

The measurement model was further tested for gender-invariance through a three-stage multi group analysis. First, a simultaneous analysis on both the male and female samples was conducted without constraining the loadings; the results derived a baseline Chi-square value. Next, all loadings were constrained to be equal for the male and female groups. The analysis of this constrained model of values inculcation in mathematics teaching and learning produced another chi-square value, which was finally tested against the baseline Chi-square value for statistical significant differences. Figure 1.4 and 1.5 give the unrestricted structural equation measurement model for gender invariance. Figure 1.6 and 1.7 gives the constraint model.

Chi-square = 1288.185
 DF = 680
 Normed Chi-square = 1.894
 CFI = .911
 RMSEA = .033
 TLI = .902
 IFI = .912
 RMR = .128
 SRMR= 0.041

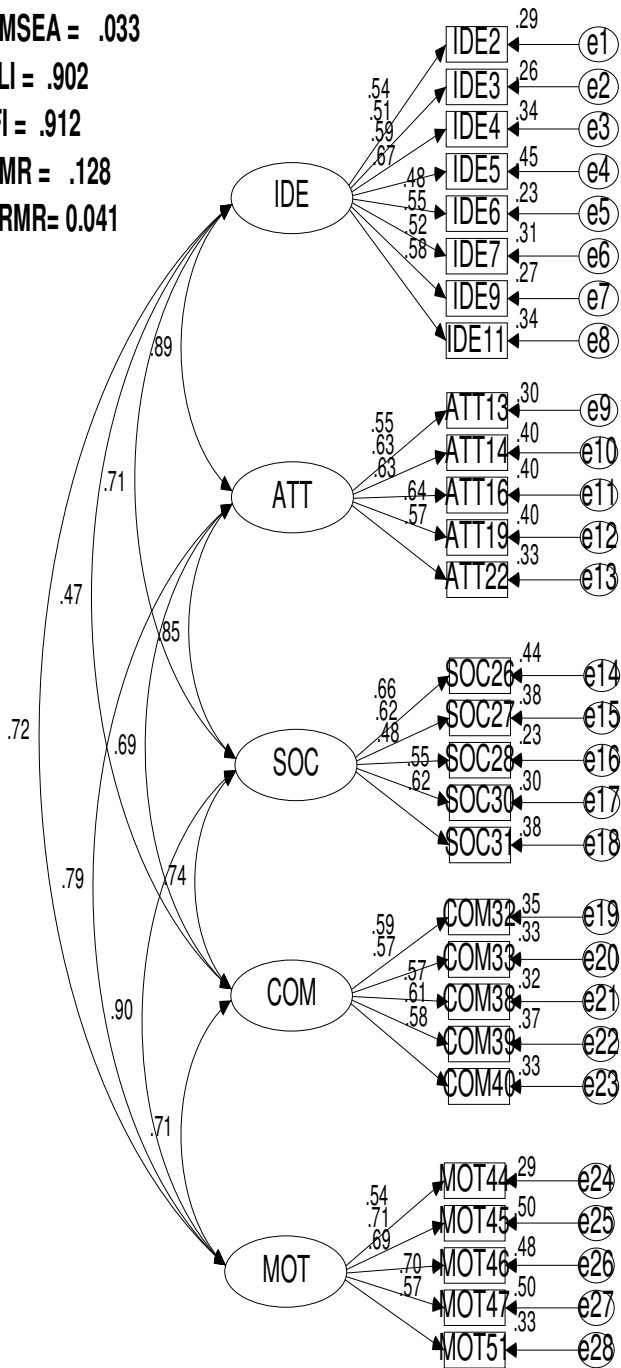


Figure 1.4: Unrestricted Structural Measurement Model Invariance across the Male group

Chi-square = 1288.185
 DF = 680
 Normed Chi-square = 1.894
 CFI = .911
 RMSEA = .033
 TLI = .902
 IFI = .912
 RMR = .128
 SRMR= 0.041

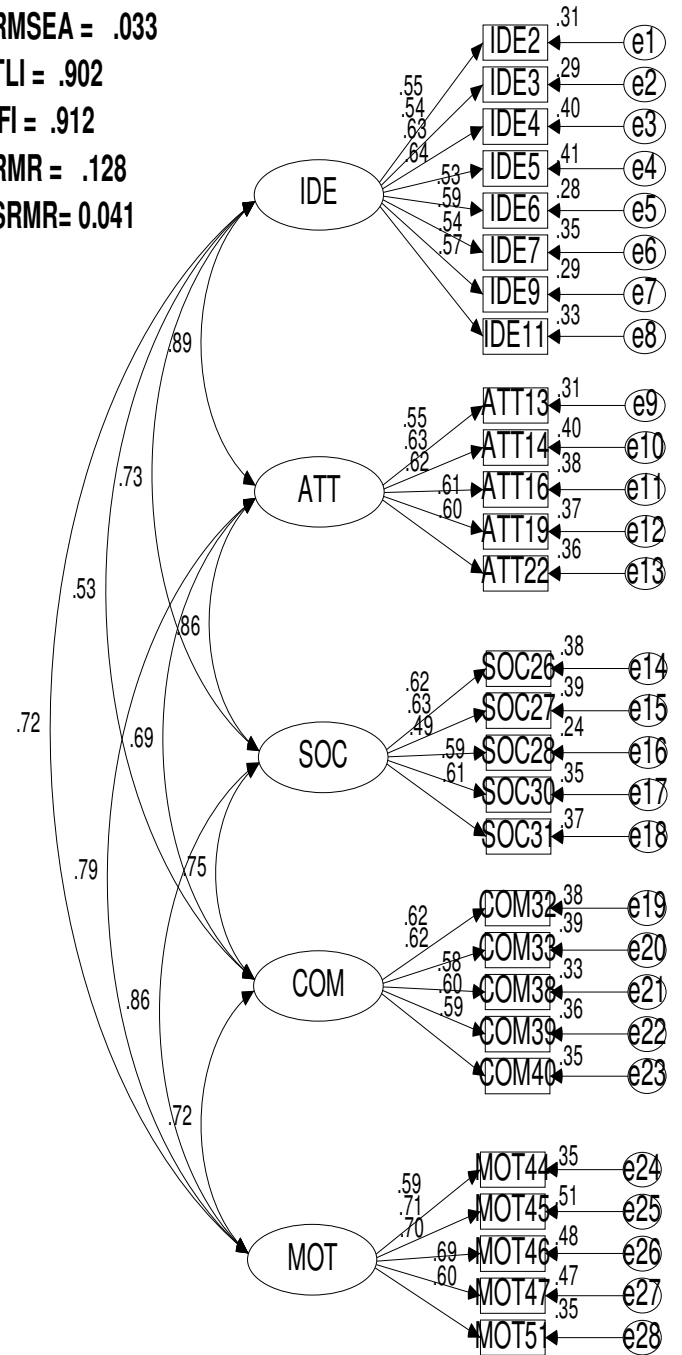


Figure 1.5: Unrestricted Structural Measurement Model Invariance across the Female group

Chi-square = 1295.091
 DF = 703
 Normed Chi-square = 1.842
 CFI = .914
 RMSEA = .032
 TLI = .907
 IFI = .914
 RMR = .132
 SRMR= 0.041

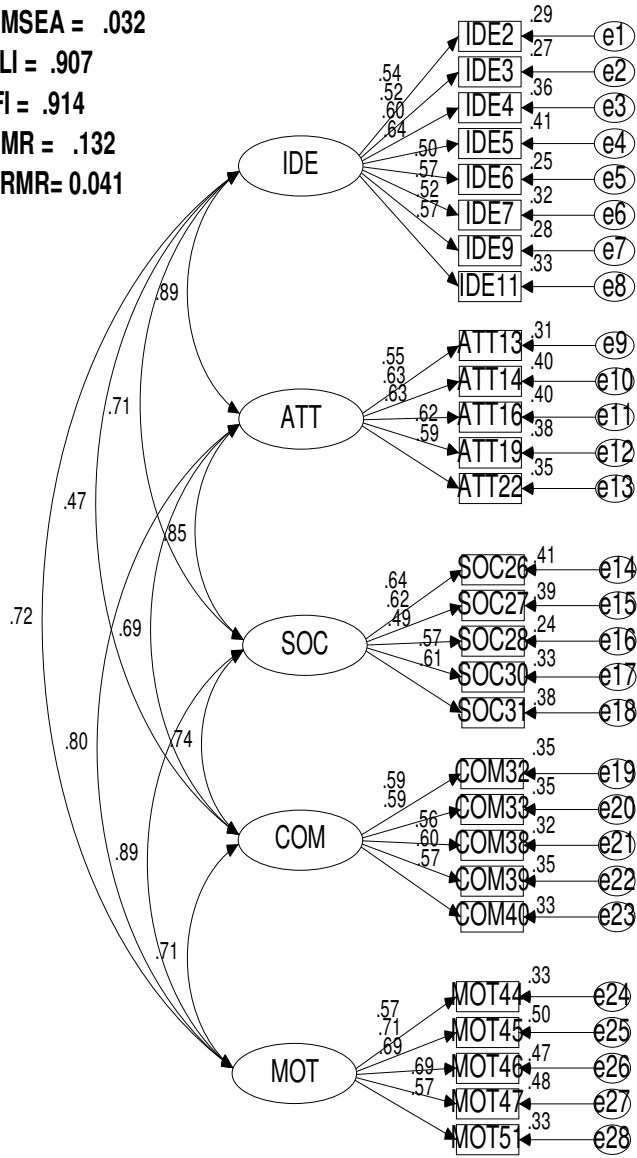


Figure1.6: Constraint Structural Measurement Model Invariance across the Male group

Chi-square = 1295.091
 DF = 703
 Normed Chi-square = 1.842
 CFI = .914
 RMSEA = .032
 TLI = .907
 IFI = .914
 RMR = .132
 SRMR= 0.041

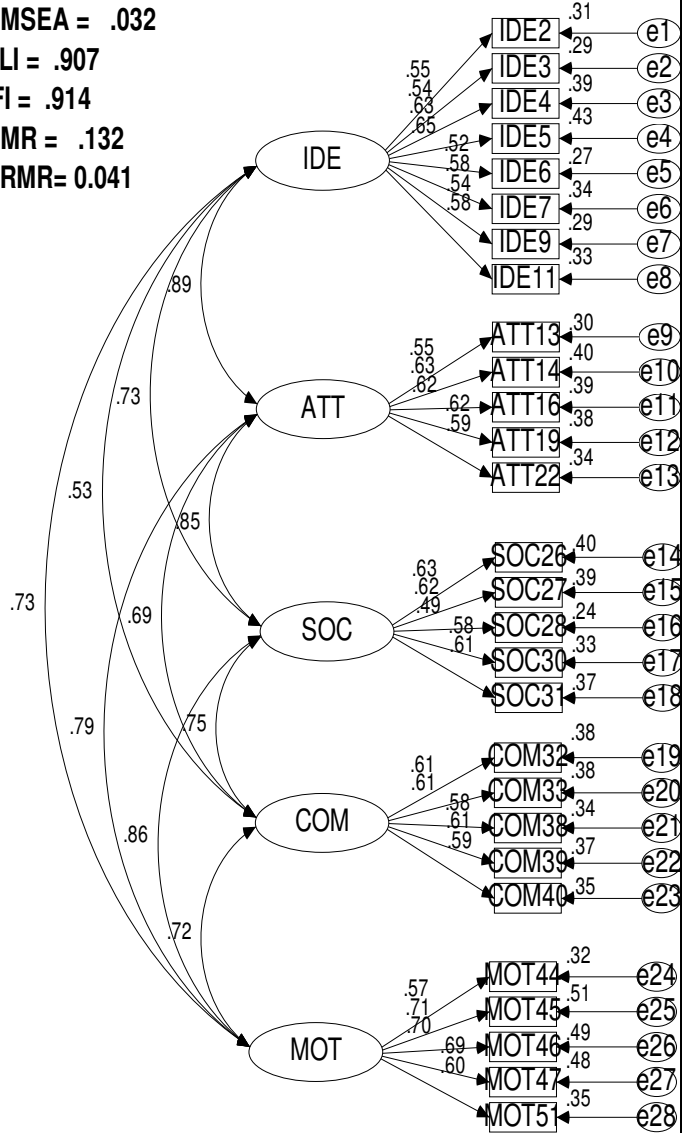


Figure1.7: Constraint Structural Measurement Model Invariance across the Female group

Equality of paths (Paths constrained for gender)

Model	χ^2	df	$\Delta\chi^2$	Δdf	Critical Value	Sig
Unrestricted	1288.185	680				
Constrained	1295.091	703	6.906	23	35.173	Significant

Table 2: Results of Multiple Group Modeling (Gender)

P> .001

The invariant or similarity test conducted across the (male =301) and (female =201) groups resulted in a statistically insignificant change in the Chi-square value, $\Delta\chi^2(23) = 6.906, p > .001$, (Table 2). Simply to say that, the difference in the Chi-square values between the unrestricted model and the constrained model did not produce a poorer-fit model (Tabachnick & Fidell, 2007 & Byrne, 2010). The loadings did not vary significantly across gender. It is justifiable then to conclude that gender did not interact with the underlying traits to influence the mathematics teachers' responses to the indicators of mathematical value inculcation measure; hence, gender is not a moderating variable, merically valid and statistically invariance. That is to say gender does not influence the quality or fitness of the value inculcation model among secondary schools mathematics teachers in the North Eastern region of Nigeria.

Academic Qualifications of Mathematics Teachers' invariance Analysis of the Model

Based on the descriptive statistics analysis of the mathematics teachers' qualifications, it was found and deemed necessary to categorize the qualifications in two groups. This was because for the invariance analysis to be performed across groups of respondents, the respondents' ratios of the group must be within one to one and a half (1:1.5) (Sahari, 2011). For the purposes of meeting this criterion, mathematics teachers' qualifications were categorized into two groups, namely professional and non-professional mathematics teachers.

The mathematical value inculcation measurement model was further investigated for mathematics teachers' academic qualifications-invariance through a three-stage multi group analysis. First, a simultaneous analysis on both the professional and non professional mathematics teachers' samples was conducted. Without constraining the loadings the results derived a baseline Chi-square value. Next, all loadings were constrained to be equal for the professional and non-professional groups. The analysis of this constrained model of value inculcation in mathematics teaching and learning produced another chi-square value, which was finally tested against the baseline Chi-square value for statistical significant differences.

Thereafter the invariance analysis across mathematics teachers' qualifications was conducted. The unconstrained model was acceptable and the chi-statistic test revealed a non significant model fit with $p=0.000$ at $p<0.001$ and Chi-statistics of 1236.253 and 680 degree of freedom. Other fit statistics that supported the model include the Normed Chi-square = 1.818, CFI= 0.922, TLI= 0.913, IFI= 0.923, RMSEA=0.031 and SRMR = 0.0406. The ratio of the minimum discrepancy to its degree of freedom was (CMIN/df= 1.818). The estimates

indicated that the model represented the structure of the observe data (Bentler & Bonnet, 1980). Figure 1.8 and 1.9 shows the unrestricted structural equation measurement model for academic qualifications of mathematics teachers' invariance while figure 1.10 and 1.11 give the constraint model for academic qualifications.

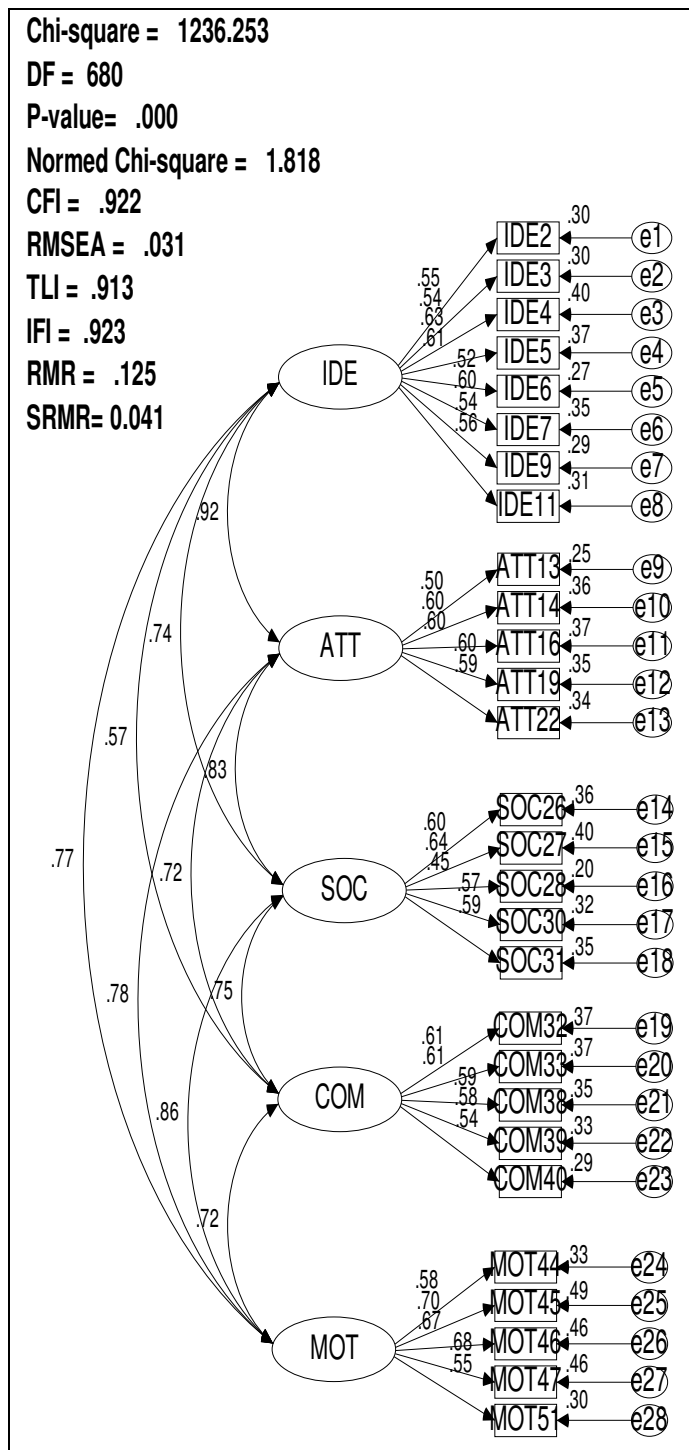


Figure1.8: Unrestricted Structural Model Invariance across Professional group

Chi-square = 1236.253
 DF = 680
 P-value= .000
 Normed Chi-square = 1.818
 CFI = .922
 RMSEA = .031
 TLI = .913
 IFI = .923
 RMR = .125
 SRMR= 0.041

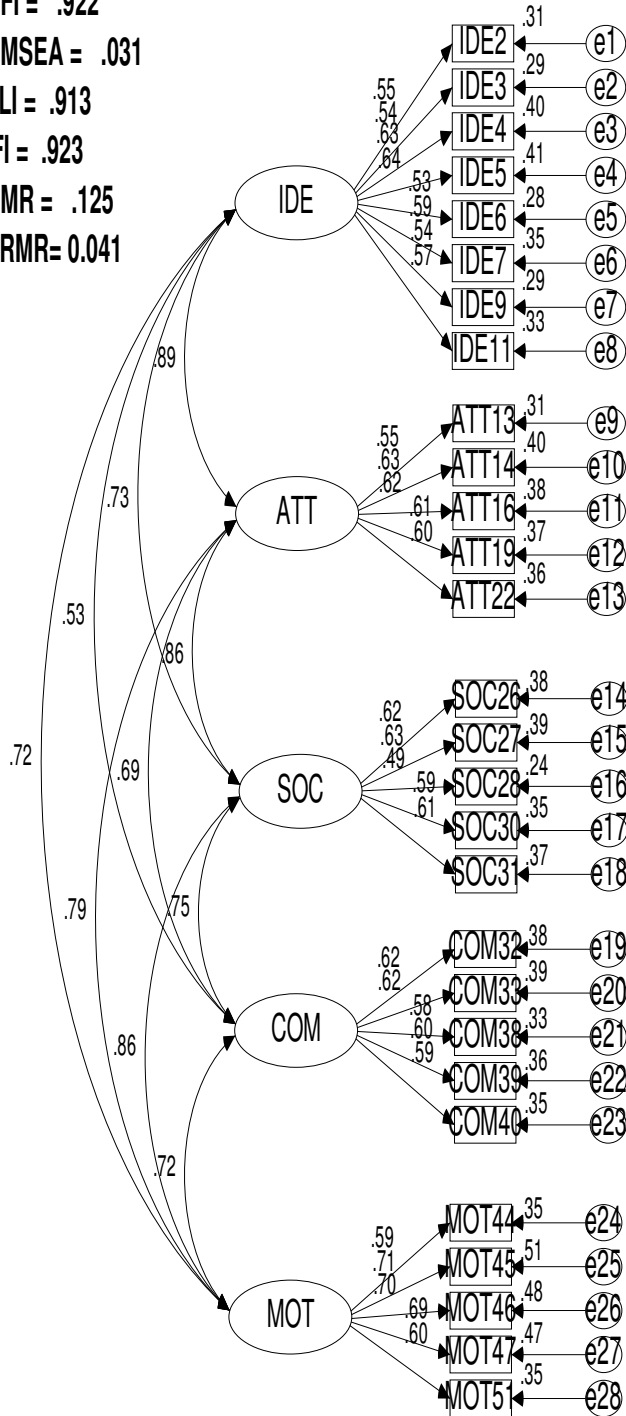


Figure 1.9: Unrestricted Structural Model Invariance across Non professional group

Chi-square = 1238.856
 DF = 703
 P-value= .000
 Normed Chi-square = 1.762
 CFI = .925
 RMSEA = .030
 TLI = .919
 IFI = .926
 RMR = .126
 SRMR= 0.041

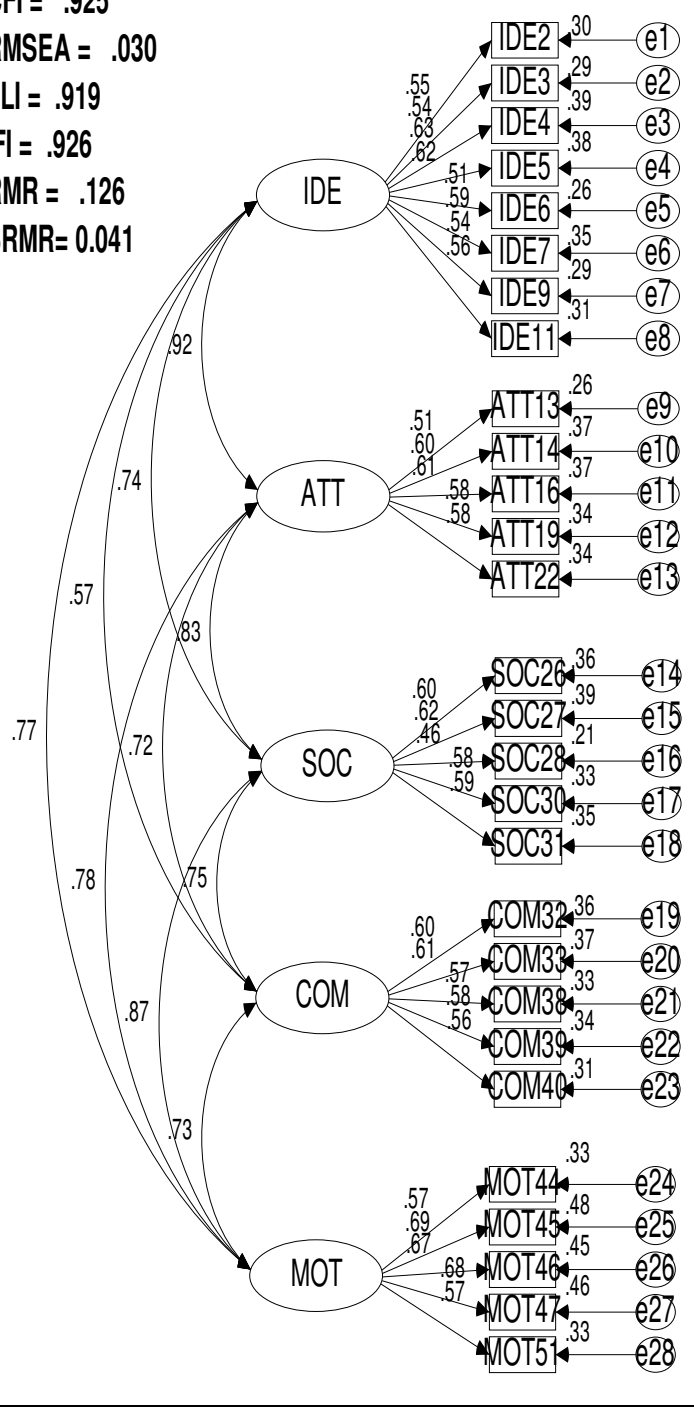


Figure 1.10: Constraint Structural Measurement Model Invariance across the Professional group

Chi-square = 1238.856
 DF = 703
 P-value= .000
 Normed Chi-square = 1.762
 CFI = .925
 RMSEA = .030
 TLI = .919
 IFI = .926
 RMR = .126
 SRMR= 0.041

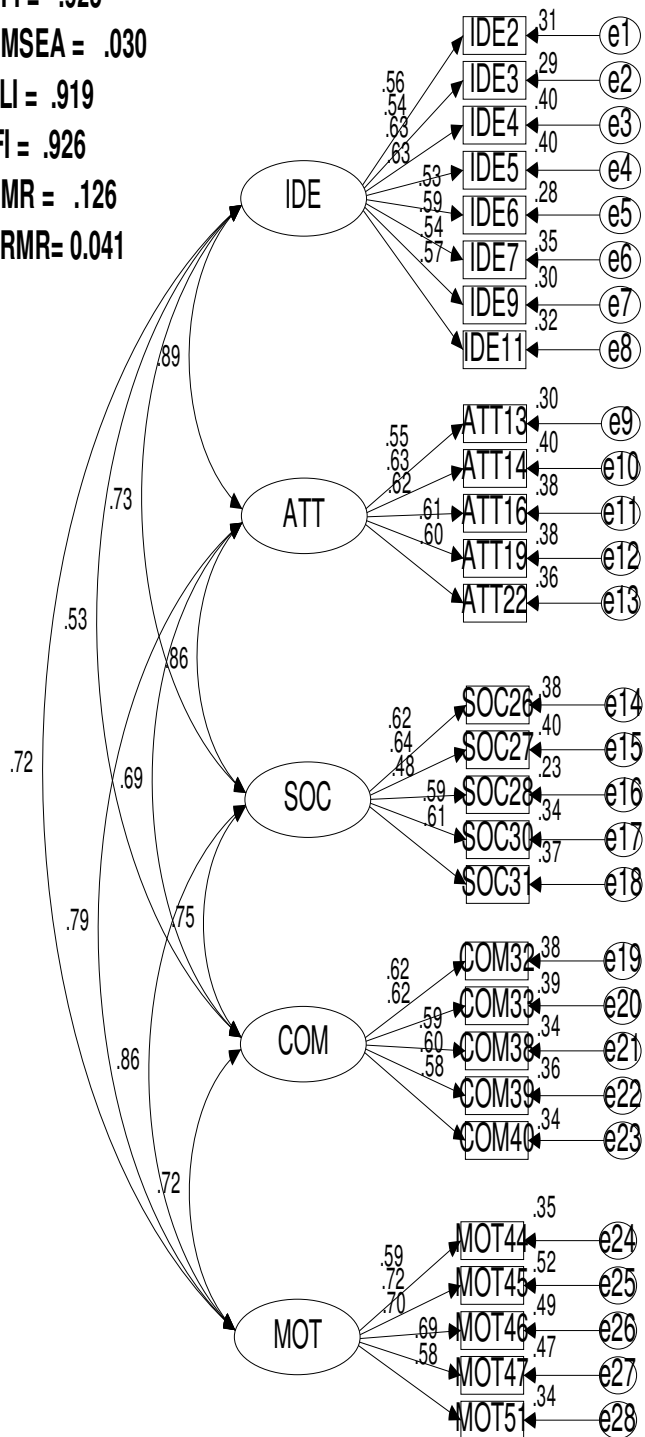


Figure 1.11: Constraint Structural Measurement Model Invariance across the non-professional group

Equality of paths (Paths constrained for Academic qualifications)

Table 3: Results of Multiple Group Modeling (Professional and Non-professional Mathematics teachers')

Model	χ^2	df	$\Delta\chi^2$	Δdf	Crit. value	Sig.
Unconstrained	1236.253	680				
Constrained	1238.856	703	2.603	23	35.173	Sig.

P > .001

The Chi-square test difference between the unrestricted and constrained model revealed that the model was invariant between the two groups (professional mathematics teachers and non-professional mathematics teachers) with $\Delta X^2(23) = 2.603$, $p > .001$ (Table 3). Table 3 gives the results of the difference between the chi-square = 2.603 and the difference between degree of freedom $df = 23$, cross-checking the chi-square table under the degree of freedom 23, the critical value = 35.173. This explained that $(2.603 < 35.173)$ is less than the obtained critical value of 35.173 from the Chi-square table. Therefore, we concluded that academic qualification based on professionalism is empirically valid or statistically invariant. That is to say academic qualifications of secondary school mathematics teachers in the North Eastern region of Nigeria are not a moderating variable.

DISCUSSION AND CONCLUSION

The theoretical foundation of this study was the Bishop, (1988) conceptual framework for value inculcation in mathematics teaching and learning which was extended by two latent constructs namely: computational and motivational mathematical values. The study evaluated the extended measurement model with five latent constructs namely: ideological, attitudinal, sociological, computational and motivational mathematical values. The findings of this study revealed that the proposed multidimensional mathematical values inculcation model is valid and reliable. With respect to the ideological, attitudinal and sociological mathematical values, this study concurred with the findings of (Bishop, 1988 & 1999, Bishop et al., 2010 & Liman et al., 2011ab). They asserted that effective mathematical contents delivery usually occur within the framework of mathematical values inculcation.

Furthermore, the additional two construct of the value inculcation model were also found to be relevant for effective mathematics teaching and learning in the sense that the findings concurred with that of Basturk, (2005), Ames, (1992), Anderman and Maehr, (1999), Eccles et al., (1989), Fennema, (1989) and Schoenfeld, (1992).

Basturk, (2005) advocated that computer applications and usages contribute toward a successful mathematics instructional contents delivery. Ames, (1992), Anderman and Maehr, (1999), Eccles et al., (1989) asserted that motivation in mathematics teaching greatly influence learners interest and attention learning mathematics. While Fennema, (1989) and Schoenfeld, (1992) found that inculcation of motivational mathematical values enable mathematics teachers to cultivate in learners the values of encouragement and better achievement in mathematics.

The ideological dimension was represented by eight indicators related to the objectivism and rationalism of mathematical contents delivery. The attitudinal dimension is represented by five indicators, which emphasized the values of control and progress of mathematics teaching and learning procedures. The sociological dimension is represented by five manifests which were related to the values of openness and mystery of mathematical contents delivery. The computational mathematical values dimension is related to the values of computer application and usage. Lastly, the motivational mathematical values dimension was linked to the values of reward and re-enforcement of mathematics teaching and learning processes.

Furthermore, the findings revealed that gender and academic qualifications of mathematics teachers were not moderating variables. That is to say irrespective of mathematics teachers gender in the North Eastern region of Nigeria does effectively inculcate values in their mathematics teaching and learning. Similarly, differences in the qualifications of mathematics teacher were found to be insignificant toward values inculcation in mathematics teaching and learning in the North Eastern region of Nigeria. This study has implications for educational practices, especially in value inculcation of mathematics teachers causal judgments of their ability to successfully inculcate the desirable values that could encourage and engage the younger minds in doing well in mathematics or mathematics related courses. Results of such assessment would enable human resource managers and institutional leaders to strategize, design, and implement intervention that would enhance mathematical values inculcation competencies.

Since this is one of the early attempts to establish the psychometric properties of mathematical values inculcation, the study is restricted in terms of its generalizability. This is because the study was conducted in only one of the five regions of Nigeria. Although the study involved a large sample size, further research is required to validate the instrument across the five regions of Nigeria. This would enable generalization of the findings. Furthermore, future studies may examine the relationship between mathematics teachers' length of service and the mathematical values inculcation model.

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