An Assessment of the Psychometric Properties of the Conceptions of Teaching and Learning Questionnaire by Pre-service Mathematics Teachers in South-West, Nigeria

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ABSTRACT

This paper reports on the psychometric properties of the Conceptions of Teaching and Learning Questionnaire (TLCQ) developed by Chan and Elliot (2004), based on the responses of 220 pre-service mathematics teachers from five public universities in South-West Nigeria. The term mathematics was introduced into the 30 item-statements, which measured both constructivist and traditional conceptions of teaching and learning, to reflect beliefs specific to mathematics teaching and students' learning of mathematics. The reliability estimated as internal consistency had a Cronbach alpha of .89 for the constructivist scale, .86 for the traditional scale, and .87 for the entire scale. Findings revealed that Principal components factor analysis with varimax rotation yielded a two-factor solution accounting for 38% of the total variance, interpreted as Constructivist Conceptions and Traditional Conceptions of mathematics teaching and learning; as in the original study and other replicating studies. However, a notable difference was the significant loading of the item statement "learning primarily occurs from drilling and practice" on Constructivist Conceptions for the South West Nigeria, while it loaded on the Traditional Conceptions as reported in the original study in Hong Kong and other replicating studies. It is suggested that pre-service mathematics teachers be exposed to the constructivist teaching practices in the teacher education training programme in Nigeria.

Keywords: Conceptions of Teaching and Learning Questionnaire; Pre-service Mathematics Teachers; Psychometric properties; Nigeria.

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INTRODUCTION

Globally, recent curriculum reforms have moved away from teacher-centred pedagogic approaches to more learner-centred active approaches. Prominent national educational organizations have identified constructivist teaching practices as preferred to the prevalent traditional practices. Particularly in Nigeria, a major reform in school mathematics in the area of content, pedagogy, and assessment (Awofala & Awolola, 2011a), has led to the adoption of the New 9-year Basic Education Mathematics Curriculum (Awofala, 2012a; Awofala & Awolola, 2011b; Awofala, Ola-oluwa, & Fatade, 2012) and new Senior Secondary School Mathematics Curriculum (Awofala & Sopekan, 2013). The reform became necessary given the recurring poor performance of Nigerian students' in public mathematics examination like West African Senior Secondary Certificate Examinations (WASSCE) (Usman & Musa, 2015; Onwuka, 2015). Motivations for the reforms included: the launch of the 9-year basic education reform policy (which merged the curricula of junior secondary education with the primary school curricula), meeting the needs of the Universal Basic Education Programme (UBEP), promoting the ideal of National Economic Empowerment and Development Strategy (NEEDS), Education for All (EFA) and Millennium Development Goals (MDGs), the need to produce better informed, ICT complaint, bilingual citizens of high ethical standard, dissatisfaction with the previous curricula, and keeping pace with the emergent global and national issues (Awofala, 2012a).

The new mathematics curriculum strongly adopts a more student-centred instructional approach at the expense of the traditional teacher-centred instruction that has persisted in the Nigerian mathematics classroom; especially given that the unsatisfactory performance of students in mathematics could be the result of the classroom environment created by the teacher-centred pedagogy emphasized in the old mathematics curricula (Awofala, 2012a; Olosunde & Akinpelu, 2012). However, the implementation of these reforms has rather been slow as the Nigerian mathematics classrooms remain heavily teacher-centred in its disposition towards teaching and students learning. These traditional teacher-centred methods in which teacher talk dominates the learning process emphasize mostly mental calculation and computational skills rather than conceptual understanding, problem-solving and quantitative reasoning abilities (NCTM, 2000, Awofala, 2012a), which lead students to engage in memorization of facts through rote learning. This kind of shallow formal mathematics education received by students, raise questions on the ability of the educational system to produce quality human capital possessing the kind of cognitive and psychomotor skills requisite for Nigeria's economic growth and national development.

Mathematics teachers' methods and practices signify their dispositions towards teaching and learning. However, according to Westbrook, Durrani, Brown, Orr, Pryor, Boddy, and Salvi (2013) and Lortie (1975), teachers' thinking and ideas are manifested in their overall pedagogic approaches, garnered from their apprenticeship by observation, which include the kinds of teaching and learning experienced as school students themselves, the approaches promoted in initial teacher education, and continuing professional development, those specified in the current school curriculum and those pervasive in colleagues' classrooms. It therefore implies that the prevalent use of traditional teaching methods among Nigerian teachers is rooted in teacher beliefs of their preferred way of teaching and learning. More so, the OECD (2009) stressed that teacher beliefs, practices, and attitudes should be considered in order to understand and improve educational processes; hence addressing teachers' beliefs becomes fundamental to the effective implementation of change in mathematics education in Nigeria.

Belief has been defined as a factor responsible for the way individuals think and take decisions through their lives (Bandura, 1986); which is manifested in their preference of doing something (Pintrich, 1990). Pertaining to pedagogical approach preference, research results reflect the idea that teachers' conceptions of teaching and learning are affected by their beliefs (Chan, 2004; Chan & Elliot, 2004a), and that there is a direct connection between teachers' instructional practices and their beliefs regarding teaching and learning (Chan, 2003; Lee, Zhang, Song, & Huang, 2013). According to Chan and Elliot (2004b), the traditional and constructivist conceptions of teaching and learning reflect the two major instructional approaches to classroom instruction; the teacher-centred (captured in the traditional conceptions) and the learner-centred (strongly advocated for in the constructivist conceptions). The two pedagogical beliefs could also be seen as a continuum describing teachers' perception of the processes of teaching and learning are viewed as either students learning dependent on the teachers or learning constructed by the students with teachers serving to facilitate learning.

Furthermore, as published by the OECD (2009: Cited in Yilmaz & Sahin, 2011), teachers' beliefs about instructional conceptions are often based on the following:

> In the traditional beliefs about teaching: Effective/good teachers demonstrate the correct way to solve a problem, instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly. How much students learn depends on how much background knowledge they have; that is why teaching facts is so necessary, and a quiet classroom is generally needed for effective learning. Whereas in constructivist beliefs about teaching: the teacher role is to facilitate students' own inquiry on the argument that students learn best by finding solutions to problems on their own. Students should be allowed to think of solutions to practical problems themselves before the teacher shows them how they are solved, because thinking and reasoning processes are more important than specific curriculum content (p. 75).

Since teachers come to be affected by their teachers and often teach accordingly (Lortie, 1975; Kennedy, 1999; Stuart &Thurlow, 2000), identifying pre-service teachers' beliefs and conceptions about teaching and learning is necessary to prepare pre-service teachers for real-world teaching. This is especially because pre-service teachers gain exposure in terms of teaching experience in the classroom during their teacher education and this experience affects their beliefs about teaching. Based on literature that have established correlations between teacher beliefs regarding teaching and learning, and teaching practices, it becomes crucial that pre-service teacher's conceptions of teaching and learning are assessed so as to identify whether these beliefs are aligned to the preference for constructivist teaching practices, otherwise they serve to better expose these teacher candidates to constructivist teaching, in order to construct or reconstruct their beliefs about teaching. Up to the present moment, no research in teacher education in Nigeria has focused on pre-service mathematics teachers' conceptions of mathematics teaching and learning, and how it relates to teaching practices.

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 psychometric properties of Chan and Elliot's (2004a) Teaching and Learning Conceptions Questionnaire (TLCQ) with Nigerian samples; and on the level of conceptions about teaching and learning expressed among Nigerian pre-service mathematics teachers.

Specifically in this study, the following research questions were addressed:

1. What is the factor structure of the (mathematics) Teaching and Learning Conceptions Questionnaire, as a measure of conceptions of teaching and learning among Nigerian pre-service mathematics teachers?
2. What is the level of expressed conceptions of mathematics teaching and learning among Nigerian pre-service mathematics teachers?

MATERIALS AND METHODS

The study made use of quantitative research method within the blueprint of the descriptive survey design. The participants in this study were 228 pre-service mathematics teachers: comprising of 42 first-year students (freshmen) (18.4%), 85 second-year students (sophomores) (37.3%), 55 third-year students (juniors) (24.1%), and 46 fourth-year students (seniors) (20.2%), from five public universities in South-West, Nigeria. There were 133 (59.1%) males and 85 (37.8%) females. Ten pre-service teachers did not reveal their gender. For the purpose of data collection, one instrument tagged Teaching and Learning Conceptions Questionnaire (TLCQ) developed by Chan and Elliot (2004a) was adopted for the study and used to collect primary data relating to pre-service teachers' mathematics teachers' beliefs regarding the teaching and learning of mathematics. The original 30 item questionnaire was validated with 385 teacher education students of a tertiary institution in Hong Kong, using a 5-point Likert-type scale (1: Never, 2: Rarely, 3: Sometimes, 4: Often, and 5: Always); and recorded a reliability coefficient of alpha value of 0.84. In the context of this study, the term mathematics was introduced into the 30 item-statements of the TLCQ to reflect beliefs specific to mathematics teaching and students' learning of mathematics. Adopting the (mathematics) TLCQ afforded the opportunity to validate its purported psychometric properties with Nigerian samples. The (mathematics) TLCQ, which consisted of 30 items and measured two distinct dimensions labelled: Constructivist conceptions and Traditional conceptions of teaching and learning; was anchored on a 5-point scale ranging from: Strongly Disagree -1, Disagree -2, Neutral -3, Agree -4, to Strongly Agree -5. The internal consistency reliability coefficient of the (mathematics) TLCQ was computed using the Cronbach alpha (α) with a value of 0.87. The second author personally

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administered the (mathematics) TLCQ for the purpose of this study. Data collected were summarized and analysed using percentages, means, standard deviations, and principal components factor analysis.

RESULTS

Research Question One: What is the factor structure of the (mathematics) teaching and learning conceptions questionnaire, as a measure of conceptions of teaching and learning among Nigerian pre-service mathematics teachers?

Findings from research question 1 showed the responses of the participants to the 30 items of (mathematics) TLCQ that were subjected to principal components factor analyses (PCA) to identify their underlying dimensions. Initially, data collected were subjected to data screening processes and missing values detected were specified in the computer syntax. Subsequently, further screening for multivariate outliers indicated eight cases (with $p<0.001$) as multivariate outliers and these were discarded as Tabachnick and Fidell (2007) suggested. Screening also showed no concern about normality, linearity, multicollinearity, and singularity. Hence, only 220 responses were analysed. The PCA included the statistical assessment of the correlation matrix for factor analysis of the 30 items, which was performed using both the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The correlation matrix of the 30 items revealed that the correlations when taken overall were statistically significant as indicated by the Bartlett's test of test of sphericity, $\chi 2 = 2173.436$; df = 741; $p<.005$, which test the null hypothesis that the correlation matrix is an identity matrix. The ratio of shared inter-item variance to total variance, evaluated by the KMO, fell within acceptable range (values of .60 and above) with a value of .72. These measures led to the conclusion that the set of 30 items of teaching and learning conceptions questionnaire was appropriate for PCA.

Three criteria were used to determine the number of factors to rotate to a final solution; the Kaiser criterion (1960), Cattell's scree plot (1966), and Horn's parallel analysis (1965). The Kaiser criterion is a default option in SPSS that extracts any factor that has an eigenvalue greater than unity (1.0), the Cattell's scree test is a graphical representation of the eigenvalues presented in order of size, which is interpreted by identifying the number of factors that occur prior to the levelling off or scree, while parallel analysis compares the actual eigenvalues generated by the data to eigenvalues of a random data matrix of the same size on the basis that any factor producing an eigenvalue greater than the corresponding random data eigenvalue should be extracted (Wheeler, 2007).

The initial rotated PCA using the varimax rotation resulted in a factor model of eight dimensions as indicated by the eigenvalues exceeding unity but the scree plot showed a factor model of two dimensions. A parallel analysis run for the 30 items of the mathematics TLCQ indicated that a two factor solution was appropriate for extraction (see Figure 2). On this basis, the data from the TLCQ was re-analysed, rotating two factors orthogonally to a final solution using varimax rotation. Figure 1 below is the scree plot which graphs the eigenvalue against the component number for a two-component solution. The factor loadings for the orthogonal two factor model of mathematics teaching and learning conceptions scale are presented in Table 1. Together the two factors accounted for 38.09% of the total variance. The first factor accounted for 23.15% of the variance (eigenvalue= 6.946) and the second factor accounted for 14.93% of the variance (eigenvalue = 4.48).

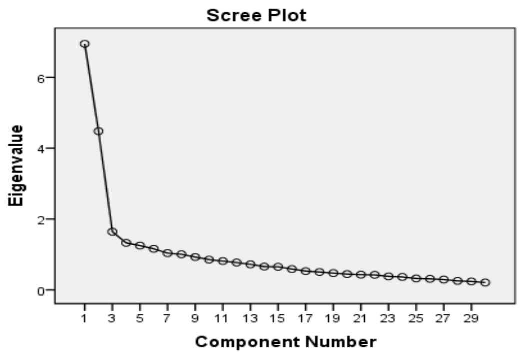

Figure 1: Cattell scree plot showing number of components and eigenvalues of the correlation matrix

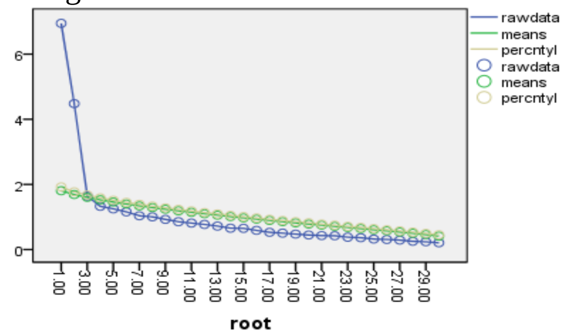

Figure 2: Parallel Analysis for MTLCQ

Table 1: The mathematics TLCQ summary of factor loadings and communalities by PCA for the orthogonal two factor model

Questionnaire Item	Factor loading	*h²*
Constructivist Conceptions (α =.89)ᵃ		
1. It is important that a math teacher understands the feelings of the students	.74	.57
2.Good math teachers will always encourage students to think for answers themselves	.73	.54
3.During math lessons, students should have ample opportunities to explore, discuss and express their ideas	.63	.41
4.In a good classroom, there is a democratic and free atmosphere that stimulate students to think and interact	.66	.44
5.Every child in a math class is unique or special and deserves an education tailored to his or her particular needs	.78	.61
6.Effective math teaching encourages more discussion and hand on activities for students	.69	.48
7.The focus of math teaching is to help students construct knowledge from their learning experience instead of knowledge communication	.65	.44
8.Math instruction should be flexible enough to accommodate individual differences among students	.64	.44
9. Different objectives and expectations in learning should be applied to different students.	.43	.19

10. Students should be given many opportunities to express their ideas during math lessons.	.62	.39
11. In learning math, the ideas of students are important and should be carefully considered.	.67	.45
12.Good teachers always make their students feel important	.68	.47
*Learning mathematics primarily occurs from drilling and practice	.47	.31
Traditional Conceptions (α =.86)[a]		
13.The traditional lecture method for teaching math is best because it covers more information/ knowledge	.51	.26
14.It is best that math teachers exercise as much authority as possible in the classroom	.58	.35
15.Good mathematics teaching occurs when there is mostly teacher talk in the classroom	.67	.52
16.Learning math mainly involve absorbing as much information as possible	.63	.41
17.The math teacher has to call the students all the time to keep them under control	.61	.37
18.In learning mathematics, students depend on teachers to provide them with accurate and complete knowledge rather than to discover it themselves	.54	.29
19.A math teacher's task is to correct learning misconceptions of student right away instead of verifying them for themselves	.51	.27
20.No learning can take place unless students are controlled	.52	.31
21.Math teachers should have control over what students do all the time	.48	.36
22.In learning to teach math, students practice the ideas observed from their math teachers without questioning them	.50	.25
23.Students have really learned something, when I can remember it later	.42	.21
24.Math teaching simply involves telling, presenting or explaining the mathematics subject matter	.56	.44
25. The major role of the math teacher is to transmit knowledge to students.	.49	.34
26.During math lesson, it is important to keep students confined to text books and desks.	.61	.38
27.Learning math means remembering what the math teacher has taught	.58	.34
28.The math teacher's major task is to give students knowledge/information and assign them drill and practice, and test their recall	.46	.25
29.During math class it is the good students who keep quiet and follow teacher's instruction in class	.54	.29

Note: [a] Reliability is Cronbach's alpha coefficient, h^2 is communalities

The two factor structure model solution indicated by factor analysis using PCA confirmed the validity of the scale as reported by other studies. The items that clustered around these factors suggested they represented both constructivist conceptions and traditional conceptions, respectively. However, a significant difference was the significant loading of Item *: *Learning mathematics primarily occurs from drilling and practice* on the constructivist conceptions for the Nigerian sample, while it loaded originally on TLCQ (Chan & Elliot, 2004a) on the traditional conceptions. Apparently, this could probably be because the term mathematics was introduced into the original TLQC to reflect conceptions of teaching and learning regarding mathematics. Checking for the refinement of the subscales without item*, indicated a Cronbach's alpha reliability coefficient scores of 0.89 and 0.86 for constructivist conceptions and traditional conceptions, respectively. To establish the reliability of the scores obtained from the Nigerian sample using the TLCQ scale which measured 29 items, the Cronbach' alpha was calculated to be .87, which meets a recommended satisfactory coefficient of at least .80 (Carmines & Zeller, 1979).

Research Question Two: What is the level of expressed conceptions of mathematics teaching and learning among Nigerian pre-service mathematics teachers?

Table 2 below showed the responses of pre-service mathematics teachers with respect to teaching and learning conceptions about mathematics in, which the pre-service teachers had a high average score (Mean= 3.84, SD= .983). As indicated in the response data in Table 2 below, a high percentage of Nigerian pre-service teachers did not express constructivist conceptions about teaching and learning. Over 80 percent of the pre-service teachers disagreed with all the item statements that measured the constructivist conceptions of mathematics teaching and learning subscale. This was unexpected considering the global advocacy for constructivist teaching practices and its implications for academic achievement.

However, as anticipated, pre-service teachers' responses to the traditional conceptions question items indicated dissatisfaction with traditional teaching methods as the largest percentage of their response was distributed among the strongly disagree and disagree ratings for the statements it measured. Specifically, more than 40 per cent of the pre-service teachers disapproved that the traditional lecture method for teaching math is best because it covers more information (item 13), that students must be confined to text books and desks during math learning (item 26), and that in learning to teach math, students practice the ideas observed from their math teachers without questioning them (item 22). The table also indicated that the average pre-service teachers disapproved the math teachers exercising much authority in the classroom (item 14); believe that learning math goes beyond absorbing as much information as possible and remembering what the teacher has taught (items 16 & 27); are of the opinion that the teacher does not have to call the students all the time to keep them under control (items 17 & 21). Surprisingly, over 60 per cent of the pre-service teachers believed that learning can take place whether students are controlled or not (item 20).

Table 2: Summary of pre-service teachers' conceptions about mathematics teaching and learning as measured by TLCQ

	N (%)					Mean	Std.
	SD	D	N	A	SA		
Constructivist Conceptions							
1. It is important that a math teacher understands the feelings of the students	92(40.9)	98(43.6)	11(4.9)	8(3.6)	11(4.9)	4.15	1.023
2.Good math teachers will always encourage students to think for answers themselves	87(38.7)	95(42.2)	27(12.0)	10(4.4)	1(0.4)	4.17	.846
3.During math lessons, students should have ample opportunities to explore, discuss and express their ideas	102(45.3)	92(40.9)	15(6.7)	7(3.1)	4(1.8)	4.28	.866
4.In a good classroom, there is a democratic and free atmosphere that stimulate students to think and interact	97(43.1)	96(42.7)	21(9.3)	2(0.9)	1(0.4)	4.32	.723
5.Every child in a math class is unique or special and deserves an education tailored to his or her particular needs	82(36.4)	94(41.8)	25(11.1)	13(5.8)	3(1.3)	4.10	.922
6.Effective math teaching encourages more discussion and hand on activities for students	83(36.9)	101(44.9)	27(12.0)	6(2.7)	3(1.3)	4.16	.842

7.The focus of math teaching is to help students construct knowledge from their learning experience instead of knowledge communication	72(32.0)	100(44.4)	35(15.6)	11(4.9)	1(0.4)	4.05	.855
8.Math instruction should be flexible enough to accommodate individual differences among students	91(40.4)	94(41.8)	21(9.3)	10(4.4)	3(1.3)	4.19	.887
9.Different objectives and expectations in learning should be applied to different students.	73(32.4)	95(42.2)	28(12.4)	18(8.0)	5(2.2)	3.97	1.000
10.Students should be given many opportunities to express their ideas during math lessons.	98(43.6)	97(43.1)	15(6.7)	8(3.6)	2(0.9)	4.28	.817
11.In learning math, the ideas of students are important and should be carefully considered.	92(40.9)	98(43.6)	24(10.7)	5(2.2)	1(0.4)	4.25	.774
12.Good teachers always make their students feel important	116(51.6)	74(32.9)	13(5.8)	6(2.7)	2(0.9)	4.40	.807
Sub-total						**4.19**	**.864**
Traditional Conceptions							
13.The traditional lecture method for teaching math is best because it covers more information/ knowledge	24(10.7)	76(33.8)	52(23.1)	49(21.8)	19(8.4)	3.17	1.152
14.It is best that math teachers exercise as much authority as possible in the classroom	36(16.0)	78(34.7)	49(21.8)	47(20.9)	10(4.4)	3.38	1.126
15.Good mathematics teaching occurs when there is mostly teacher talk in the classroom	32(14.2)	48(21.3)	41(18.2)	76(33.8)	22(9.8)	2.96	1.248
16.Learning math mainly involve absorbing as much information as possible	30(13.3)	93(41.3)	43(19.1)	45(20.0)	8(3.6)	3.42	1.074
17.The math teacher has to call the students all the time to keep them under control	33(14.7)	81(36.0)	53(23.6)	43(19.1)	8(3.6)	3.40	1.079
18.In learning mathematics, students depend on teachers to provide them with accurate and complete knowledge rather than to discover it themselves	29(12.9)	67(29.8)	33(14.7)	68(30.2)	22(9.8)	3.06	1.246
19.A math teacher's task is to correct learning misconceptions of student right away instead of verifying them for themselves	52(23.1)	95(42.2)	37(16.4)	27(12.0)	9(4.0)	3.70	1.086
20.No learning can take place unless students are controlled	64(28.4)	68(39.1)	29(12.9)	30(13.3)	9(4.0)	3.76	1.134
21.Math teachers should have control over what students do all the time	39(17.3)	86(38.2)	40(17.8)	36(16.0)	17(7.6)	3.43	1.186
22.In learning to teach math, students practice the ideas observed from their math teachers without questioning them	27(12.0)	71(31.6)	49(21.8)	59(26.2)	12(5.3)	3.19	1.132
23.Students have really learned something, when I can remember it later	46(20.4)	94(41.8)	58(25.8)	18(8.0)	3(1.3)	3.74	.929
24.Math teaching simply involves telling, presenting or explaining the mathematics subject matter	50(23.6)	113(50.2)	29(12.9)	21(9.3)	2(0.9)	3.89	.914
25.The major role of the math teacher is to transmit knowledge to students.	78(34.7)	92(40.9)	25(11.1)	19(8.4)	5(2.2)	4.00	1.014
26.During math lesson, it is important to keep students confined to text books and desks	34(15.1)	59(26.2)	48(21.3)	67(29.8)	11(4.9)	3.17	1.172
27.Learning math means remembering what the math teacher has taught	32(14.2)	82(36.4)	37(16.4)	64(28.4)	4(1.8)	3.34	1.103
28.The math teacher's major task is to							

give students knowledge/information and assign them drill and practice, and test their recall	67(29.8)	113(50.2)	17(7.6)	18(8.0)	3(1.3)	4.02	.918
29.During math class it is the good students who keep quiet and follow teacher's instruction in class	59(26.2)	77(34.2)	36(16.0)	33(14.7)	14(6.2)	3.61	1.212
Sub-total						**3.48**	**1.101**
Total						**3.84**	**.983**

More so, over 60 per cent believed that math teacher's task is to correct learning misconceptions of student right away instead of verifying them for themselves (item 19); and expressed the belief that remembering at a much later time what the teacher taught does not mean that learning has occurred (item 23). They also disagreed that it is good students who keep quiet and follow the teacher's instructions during classroom learning (item 29). Over 70 per cent of the pre-service teachers indicated that mathematics teaching goes beyond simply telling, presenting or explaining the mathematics subject matter and that the major role of the teacher should not be to transmit knowledge to students (items 24 & 25). Majority of them also (about 80%) gave a strongly disagree and disagree response to the item statement that stated that the major task of math teachers is to give knowledge, assign drills and practice and test students' recall (item 28).

However, pre-service teachers seemed to equally agree and disagree that in learning mathematics, students must depend on teachers to provide them with accurate and complete knowledge rather than discover it themselves, when it comes to learning mathematics (item 18). Surprisingly, they also believed that effective mathematics teaching must occur in the mist of teacher talk in the classroom (item 15). These responses were expected considering the prevalence of traditional teaching method in the Nigerian mathematics classroom, and their dissatisfaction as expressed in their beliefs for the traditional conceptions to mathematics instruction could be associated with the lack of motivation and interest in mathematics and the inevitable poor mathematics performance the traditional instruction has since produced.

DISCUSSION

The results of the present study have highlighted two main findings. These findings relate to establishing the factor structure of the (mathematics) teaching and learning conceptions questionnaire with Nigerian pre-service mathematics teachers; and determining the level of conceptions expressed among Nigerian pre-service teachers with regards to pedagogical beliefs.

The results of the present study showed that conceptions of mathematics teaching and learning as measured by the teaching and learning conceptions questionnaire is a multidimensional construct. The exploratory factor analysis using the principal components analysis showed a two factor structure underlying the scale. The two interpretable factor structures are subsequently labelled: Constructivist conceptions (with 12 items), and Traditional conceptions (with 17 items) and each subscale had adequate internal consistency reliability. These names and the arrangement of factor are the same as obtained from earlier studies (Chan &

Elliott, 2004a; Lee, Zhang, Song, & Huang, 2013), but was contrary to the findings from Tanzania which factored the traditional conception as factor 1 and constructivist conceptions as factor 2 (Msendekwa, 2015). An item that has consistently measured the traditional conceptions: *Learning primarily occurs from drilling and practice*, loaded significantly on the constructivist conceptions. This was contrary to findings obtained from the original study (Chan & Elliot, 2004a) and other replicating studies. Although the item was removed and the corresponding internal consistency reliability for the entire scale (α = .87) considered very high and conceptually meaningful (Curtis & Singh, 1997), a tenable reason could be because that item was measuring conceptions specific to mathematics teaching and learning; considering the nature of the mathematics subject and how it is taught in the Nigerian classrooms.
Pertaining the level of pre-service teachers' espoused pedagogical beliefs as measured by the TLCQ (as shown in Table 2), Nigerian pre-service mathematics teachers' did not prefer the constructivist conceptions of teaching and learning. The frequency table on constructivist conceptions, as shown in Table 2, indicated that most of the pre-service teachers rated below 3 on the 5 point scale. The less constructivist beliefs of pre-service teachers might be due to the fact that they have not been properly exposed to constructivist teaching practices, and still remember how they were traditionally taught. The pre-service teachers in this study mostly did not prefer nor reject the traditional pedagogical beliefs. In fact, while most of the pre-service teachers' seemed to disagree with the traditional conceptions beliefs, most others seemed to emphatically agree that mathematics couldn't be learnt without total dependence on the teacher to provide students with accurate knowledge, and total confinement to text-books and desk during math lessons. This response was considered typical, considering the fact that these approaches are prevalent in most Nigerian mathematics classes (Awofala, Arigbabu & Awofala, 2013) thereby making teaching effectivenessMin mathematics to be difficult (Awofala, 2012b).

CONCLUSION

The present study was an exploratory study of the conceptions of mathematics teaching and learning in the Nigerian context. Based on the responses obtained from 220 undergraduate pre-service teachers enrolled in mathematics education programme from five public universities in South-West Nigeria, the psychometric properties of the TLCQ (with the inclusion of the term mathematics, notwithstanding) supports the multidimensional construct of two-factor dimensions with high internal consistency reliabilities; interpreted as Constructivist conception and Traditional conceptions, reported in earlier studies (Chan & Elliot, 2004a; Lee et al, 2013; Msendekwa, 2015). Less constructivist beliefs were expressed among pre-service teachers and this might be due to the fact that they have not been properly exposed to constructivist teaching practices in their teacher training. However, it is suggested that pre-service mathematics teachers be exposed to the constructivist teaching practices in the teacher education training programme in Nigeria.

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