

AN INVESTIGATION INTO SENIOR SECONDARY STUDENTS' PREFERENCE FOR NUMERICAL INFORMATION IN RELATION TO NUMERACY AND ACHIEVEMENT IN MATHEMATICS IN NIGERIA

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Abstract: In this study, the attempt was made to investigate senior secondary school students' preference for numerical information as associated with numeracy and achievement in mathematics in Lagos, Nigeria. The participants were 350 students carefully chosen from eight public senior secondary schools in which the study adopted the quantifiable research methodology within the scheme of the descriptive survey design. The collected data were analysed using the descriptive statistics of percentages, mean, and standard deviation and inferential statistics of factor analysis and multiple regression analysis. Results showed that preference for numerical information measured by the preference for numerical information scale was a unidimensional construct with very high-reliability index. Senior secondary school students showed a low preference for numerical information. Numeracy in everyday life, numeracy in mathematical tasks, numeracy in workplace tasks and preference for numerical information made statistically weighty contributions to the prediction of students' achievement in mathematics. In line with this study results, it is hereby recommended that teachers of mathematics should not only teach number sense to pupils right from the primary school but should employ learner-centred teaching strategies capable of positively influencing students' penchant for numerical information. Future studies in Nigeria and elsewhere should endeavour to investigate the confirmatory factor analysis of the preference for numerical information scale amid students at all levels of education.

Keywords: Preference for numerical information, numeracy, achievement in mathematics, senior secondary school students

1. Introduction

Literacy is to language as numeracy is to mathematics. Literacy and numeracy skills are two sides of a coin that provide the basis for lifelong learning, worthwhile and gratifying work, and an enjoyable personal and social life. For people who are not literate or numerate, the lifetime impact can be great and can include such negatives as lack of civilized life, low self-worth, societal exclusion, lack of education and loss of job opportunities, and lack of earnings. Being numerate is the capability to meet daily mathematical needs of an individual and at the same time comprehending the application of numerical and mathematical information (Cockcroft, 1982). The term numeracy originated from the United Kingdom 60 years ago (Crowther Report, 1959) and has been used interchangeably with mathematical literacy (Mathematics Council of the Alberta Teachers' Association, 2004; Clarke and Clarke, 2002; Wright, Martland, Stafford, & Stanger, 2002). Numeracy as a construct is mostly adopted in Nigeria, Europe and the United Kingdom (Awofala & Anyikwa, 2014; Hoogland, 2003), and the construct mathematical literacy is mostly deployed in South Africa, Australia, Canada and the United States (Department of Education (South Africa), 2003; Clarke, Cheeseman, Sullivan, & Clarke, 2000). Numeracy taken to mean the capacity for quantitative thought and expression is generally described as mathematical literacy (De Lange, 2003) which involves a person's capability to recognize and apprehend the practical importance of mathematics in the global milieu and to create rational decisions

that enable mathematical sustainability for the enhancement of the person critical, productive, and insightful skills (OECD, 2000).

Numeracy is the practical and functional deployment of mathematics to settle life challenges and for making informed decisions when participating in civil activities (The Ministerial Council for Education, Employment, Training and Youth Affairs [MCEETYA], 1997). Numeracy enhances the aptitude to close the cavity between the real world and mathematics, to deploy academic mathematics to real-life scenarios, and a person is numerate in as much as he/she can deploy functional mathematics in addressing life challenges (Willis, 1998). In Australia, numeracy is defined as the inclination to utilize, in situation, an amalgamation of: sustaining exact science conceptions and competencies embedded in such subjects as (arithmetical, trigonometrical, graphical, geometrical and statistical); scientific philosophy and stratagems; common rational skills; and embedded synthesis of milieu (The Australian Association of Mathematics Teachers, 1997). In Great Britain, the construct of numeracy is used to mean the capability to synthesize, deduce and converse arithmetical, statistical, computable, geometrical, algebraic, even exact data, in varied situations, which will engender citizens' effective participation in cherished activities (Evans 2000). In Holland, numeracy is the competency needed to efficiently cope with the mathematical requirements at every facet of life, in amalgamation with the capability to house and regulate malleably to innovative demands in an uninterrupted fast mutable culture that is exceedingly controlled by numerical data and technical know-how (Van Groenestijn, 2002). In Nigeria, numeracy is the capability to comprehend, utilize, compute, deploy, infer results, and converse calculated and exact data (Awofala and Anyikwa, 2014). While there are varied definitions of numeracy as put forward by experts in different countries, the crux of the definitions is unambiguous. All consider the functional use of mathematical information in diverse situations. In recognizing the multifaceted feature of numeracy, the Human Resources and Skills Development Canada developed Numeracy Self-Assessment Scale (NSAS) as a tool that assesses three phases of numeracy. One facet of the assessment tool focuses on numeracy in everyday life, yet another assesses numeracy in workplace tasks. The last subscale measures numeracy in mathematical tasks. While Awofala and Anyikwa (2014) had validated the NSAS for Nigerian use, they equally established through exploratory factor analysis the three interpretable dimension configuration of the assessment tool with Nigerian adult learners showing average numeracy strength. They equally found that the last two subscales of numeracy predicted the arithmetic performance of adult learners. Although the NSAS is documented as an ample assessment of diverse phases of individuals' numeracy skills (Awofala and Anyikwa, 2014); Viswanathan (1993) proposes a new concept that has for long been ignored. The Preference for Numerical Information (PNI) has been disputed to be different from the construct of numeracy (Viswanathan, 1993) despite the argument that numeracy captures disposition and capability concerning numerical information and everyday functional utilization of mathematics (Evans, 1989). According to Viswanathan (1993), preference for numerical information is a proclivity toward using numerical information and engaging in thinking involving numerical information. While it is replete in the extant collected works to see assessments of both ability to use mathematics and disposition concerning mathematics/numeracy, Viswanathan (1993) contended that the simple proclivities for mathematical info in day-to-day life have been overlooked. The veracity of this assertion must be made as PNI relates to learners' experience in mathematics (Williams, 2014), thus we assume to see near association between PNI and numeracy.

In essence, the central objective of the present research is to investigate the association between numeracy and PNI in connection to achievement in secondary school mathematics. In a series of studies conducted by Viswanathan (1993), a strong association was found between PNI and attitude to mathematics and attitude to statistics. This strong relationship according to Viswanathan (1993) could be explained by the fact that proclivities concerning numerical or mathematical information can have a causative effect on mathematical and statistical attitude. This assertion remains only speculation until it is empirically verified.

The PNI is not a construct of intense research like numeracy as only six published studies are available during the time of this investigation since 1993 that the construct had been unravelled in the literature. The first study was carried out by two Arab researchers in which the PNI assessment tool was translated from English into Arabic involving 157 secondary school students (Alkhateeb and Abed, 2000). It was

reported that the PNI among Arab students was positive with the students showing greater mean score but not statistically significant in comparison with their counterparts in America as researched by Viswanathan (1993). In 2002, the same authors reported the factorial validity of the Arabic version of the PNI instrument with the conclusion that the instrument was unidimensional (Alkhateeb and Abed, 2002) as first mooted by the original developer (Viswanathan, 1993). In a 2004 study, Smith and Drumming established a positively meaningful association between PNI and computational achievement questions whereas there was no meaningful association between PNI and non-computational achievement questions amongst 236 Black Americans. These findings corroborated the finding that PNI scores had a statistically meaningful association with students' grades in statistics (Viswanathan, 1993). During the same year, Bornstein (2004) explored the effect of varied kinds of proof on adjudicators' judgements with 141 university students as simulated adjudicators and established that the undergraduates were affected variedly via the admittance of investigational data as proof contingent upon the state of their PNI. Adjudicators with a greater PNI tended to take the argument hook line and sinker while those with lesser PNI took to the conflicting view. This finding corroborated the claim that PNI might be particularly important in contexts wherein merely a marginal level of capability is required to infer mathematical information (Viswanathan, 1993).

However, Bornstein (2004) declared that utilization of numerical information was more of a function of preference rather than ability. In a study that examined the association amongst PNI, gender, perceived success, annual compensation and education, De'Armond and Durband (2011) established that while females recorded greater level of PNI than males, the associations were statistically not meaningful. In a more recent study, Williams (2014) investigated the relationship between PNI, mathematics self-concept, and dimensions of anxiety towards statistics in agreement to the PNI nomological soundness. The results showed that four out of the six dimensions of anxiety towards statistics were strongly correlated with PNI and two were not. Self-concept in mathematics was similarly and robustly correlated with PNI. Also, findings suggested that greater PNI was linked with greater self-concept in mathematics and reduced anxiety towards statistics among graduate students and this indicated strong agreement to the PNI nomological soundness.

Consequent upon the extant review of related literature, it is pertinent to note the paucity of studies regarding preference for numerical information worldwide while numeracy seems not to enjoy popularity in Nigerian literature. Though theoretical assertion had been made regarding the association between numeracy and preference for numerical information, no study had empirically investigated this claim. So the present study is on hand to assess the association between PNI, numeracy and senior secondary school students' achievement in mathematics in Nigeria.

1.1. Purpose of the study

The present study investigated senior secondary school students' PNI relative to numeracy and achievement in mathematics in Nigeria.

1.2. Research Questions

Precisely in the present study, four research questions were answered:

1. What is the level of Nigerian senior secondary school students' preference for numerical information?
2. What is the factor structure of the Nigerian senior secondary school students' preference for numerical information?
3. What are the relationships among preference for numerical information, dimensions of numeracy and senior secondary school students' achievement in mathematics?
4. What are the joint and marginal contributions of preference for numerical information and dimensions of numeracy to the prediction of senior secondary school students' achievement in mathematics?

2. Methods

2.1. Research design

In the present study, a numerical research methodology situated in the scheme of descriptive survey design was adopted. This research design was utilised because it expresses thoughts, opinions, and feelings (Awofala, Akinoso & Fatade, 2017).

2.2. Population of the study

The study population consisted of all senior secondary school year three (SSS III) students in eight public senior secondary schools in Education District IV of Lagos State, Nigeria.

2.3. Participants

The study participants were 350 SSS III students (175 males and 175 females) randomly selected from eight public senior secondary schools in Education District IV of Lagos State, Nigeria with age ranging from 15 to 20 years and mean age of 16 years 2 months. The participants were from the low socioeconomic status group.

2.4. Research instruments

Three research instruments were used for the collection of primary data in this study and consisted of Numeracy Self-Assessment Scale (NSAS), Preference for Numerical Information Scale (PNIS), and Mathematics Achievement Test (MAT).

Numeracy Self-Assessment Scale: Primary data connected to students' numeracy skills were collected in this study using the NSAS adopted from the Human Resources and Skills Development, Canada and consisted of 24 items anchored on a 5-point Likert scale: Strongly Disagree-1, Disagree-2, Undecided-3, Agree-4, and Strongly Agree-5. The scores could range between 24 and 120.

Preference for Numerical Information Scale: The PNIS adopted from Viswanathan (1993) was deployed for the collection of primary data connected to students' preference for numerical information. The scale consisted of 20 items anchored on a 5-point Likert scale: Strongly Disagree-1, Disagree-2, Undecided-3, Agree-4, and Strongly Agree-5. The scores could range between 20 and 100.

Mathematics Achievement Test: The MAT developed by the researchers is a structured-response type of multiple-choice test using one key and three distracters and consists of two parts: A and B. Part A sought demographic data in respect of the participants' age, gender, and school name. Part B contained thirty (30) test items and each item has four options (A—D) wherein the participant is anticipated to choose the correct option. Test contents covered the course content of algebraic processes, number and numeration, probability and statistics, trigonometry, and calculus in the three phases of intellectual domain of Thinking (analysis, synthesis, & evaluation), Understanding (comprehension & application) and Remembering (knowledge) (Awofala, 2010; Awofala, 2016a). Remembering means ability to recall facts and information which is motivated by increased concentration and repetition. Understanding here implies the power of comprehending especially ability to comprehend certain relationship between something or mental process of a person who comprehends. Thinking connotes any rational or logical activity encompassing person's idiosyncratic consciousness. This is because thought triggers practically the entire human engagements and communications. Table 1 below showed the items specification or test blueprint.

Table1. Item Specification for Mathematics Achievement Test (MAT)

Content	Intellectual Levels			Total
	Remembering	Understanding	Thinking	
Number and numeration	6	1	3	10
Algebraic processes	5	-	2	7
Trigonometry	2	1	-	3
Probability and statistics	4	1	2	7
Calculus	1	2	-	3
Total	18	5	7	30

2.5. Validity and reliability of research instruments

Three experts in measurement and evaluation subjected the three assessment tools (NSAS, PNIS, & MAT) to face validity. The NSAS has been adjudged a consistent assessment tool for measuring numeracy skills. Awofala and Anyikwa (2014) implemented the NSAS with a cohort of Nigerian adult learners and established a Cronbach alpha coefficient of 0.87. Using the NSAS on 32 adult learners, it was reported that the NSAS possessed three interpretable factor structure namely as numeracy in everyday life ($\alpha=.72$), numeracy in workplace tasks ($\alpha=.78$) and numeracy in mathematical tasks ($\alpha=.83$) with high reliabilities (Awofala and Anyikwa, 2014) considered to be theoretically significant (Awofala, Akinoso & Fatade, 2017). Alkhateeb and Abed (2000) determined the Cronbach alpha coefficient of PNIS among 157 tenth graders in the United Arab Emirates and a value of 0.80 was computed. Viswanathan (1994) examined the test-retest of the PNIS over a 12-week interval to determine its stability and a correlation coefficient of 0.73 was computed and this showed that the scale is moderately stable over time.

Aside the Table of Specification, which served to validate the MAT items and to ensure that the research instrument was situated within the selected contents, the initial draft of the MAT that composed of 40 test items was face validated by two measurement and evaluation experts. Two mathematics educators and two English lecturers at a University in Ogun State, Nigeria similarly authenticated the MAT based on three guidelines: (a) Linguistic intelligibility to the target population (b) Applicability of drafted items to objectives of the study (c) Content coverage. Thereafter, the items were reduced to 35 in line with the recommendation of the experts. Later, the 35-items MAT, PNIS and NSAS were administered to a sample of 80 students from one school different from the study schools in education District II of Lagos State, Nigeria for 1 hour 20 minutes. Item analyses of the MAT involving difficulty index (of 0.40-0.60) and discrimination power (of more than 0.40) were engaged (Akinsola and Awofala, 2009). Eventually, five items of the MAT were knocked off thereby reducing the MAT to 30 items which formed the final assessment tool. A Kuder–Richardson's formula 20 was adopted for computing the reliability estimate of the MAT and a value of 0.87 was calculated. In the present study, the Cronbach alpha coefficients for PNIS and NSAS were 0.92 and 0.80 respectively. Hence, the three assessment tools were consistently reliable and so they could be adopted in the study.

2.6. Procedure for data collection

The collection of data for the study involved the researchers and the eight research assistants. The NSAS, PNIS, and MAT were administered to the whole sample in that order in a habitually planned class in the eight senior secondary schools chosen for the study.

2.7. Method of data analysis

The collected data were condensed and analysed via percentage, mean, standard deviation, principal components factor analysis, multiple regression analysis, and Pearson's product-moment correlation at $\alpha =0.05$ significant level.

3. Results

3.1. Research question one: What is the level of Nigerian senior secondary school students' preference for numerical information?

In the PNIS, the score vacillated from 20 to 100 in which the middle score is 60 with higher scores pointing towards high PNI. From the 350 students, 267 (76.29%) pooled scores lower than 60 ($M=51.41$, $SD=6.27$, score range: 30-59, 95% $CI= 50.65-52.16$), 19 (5.43%) had scores equalled 60 ($M= 60$, $SD=0$, score range: 60, 95% $CI=60$) whereas 64 (18.29%) pooled scores greater than 60 ($M=64.33$, $SD=2.77$, score range: 61-73, 95% $CI= 63.64-65.02$). In essence, the majority of the participants had a low preference for numerical information. Relatedly, the total $M=54.24$, $SD=7.61$, score range: 30-73, and 95% $CI= 53.44-55.04$ for the entire sample showed low preference for numerical information of senior secondary school students.

Table 2. Mean and standard deviation and summary of factor loadings by principal components analysis for the unrotated one-factor model.

PNI statement	M	SD	Factor loading	h ²
1. I enjoy work that requires the use of numbers	2.73	1.09	.965	.931
2. I think quantitative information is difficult to understand	2.67	1.07	.938	.879
3. I find it satisfying to solve day-to-day problems involving number	2.69	1.04	.963	.928
4. Numerical information is very useful in everyday life	2.72	1.04	.987	.975
5. I prefer not to pay attention to information involving number	2.68	1.03	.959	.919
6. I think more information should be available in numerical form	2.69	1.07	.963	.927
7. I do not like to think about issues involving Numbers	2.71	1.07	.977	.955
8. Numbers are not necessary for most situations	2.73	1.07	.986	.973
9. Thinking is enjoyable when it does not involve quantitative information	2.76	1.14	.936	.875
10. I like to make calculations using numerical Information	2.74	1.09	.964	.929
11. Quantitative information is vital for accurate decisions	2.76	1.10	.940	.884
12. I enjoy thinking about issues that do not involve numerical information	2.75	1.11	.932	.869
13. Understanding numbers is as important in daily life as reading or writing	2.68	1.12	.926	.858
14. I easily lose interest in graphs, percentages and other quantitative information	2.80	1.10	.957	.915
15. I do not find numerical information to be relevant for most situations	2.78	1.11	.937	.878
16. I think it is important to learn and use numerical information to make well-informed decisions	2.75	1.10	.950	.903
17. Numbers are redundant for most situation	2.67	1.07	.970	.941
18. It is a waste of time to learn information containing a lot of numbers	2.69	1.08	.956	.914
19. I like to go over numbers in my mind	2.75	1.09	.967	.936
20. It helps me to think if I put down information as numbers	2.81	1.16	.928	.861
Total	2.71	1.52		

3.2. Research question two: What is the factor structure of the Nigerian senior secondary school students' preference for numerical information?

The data collected with the PNIS were screened and no missing value was obtained regarding the 350 respondents. The data in respect of the PNI were normally distributed and there was no worry regarding singularity and multicollinearity. Skewness fell within the range 0.13 to -0.36 and kurtosis fell within the range -0.47 to -.02 and these values were acceptable according to Kline (1998). The overall item correlation matrix as depicted by the Bartlett's test of sphericity, $\chi^2 = 2.124E4$; $df=190$; $p<.001$ was statistically significant and this showed the identity matrix of the correlation matrix. The value of the Kaiser-Meyer-Olkin measure of sampling adequacy (MSA) was .915 and this was adequate. The value of each item was greater than the threshold value (.60) of MSA which vacillated from .858 to .979. The anti-image correlation matrix showed that the partial correlations were low. Based on the aforementioned measures, it was concluded that the 20 items of PNIS was good for principal components factor analyses (PCA) and in as much as there was no hypothesis regarding the number of dimensions to be retained the benchmark was

put to the default eigenvalue in the SPSS which is greater than one (Tabachnick and Fidell, 2007; Kaiser, 1960).

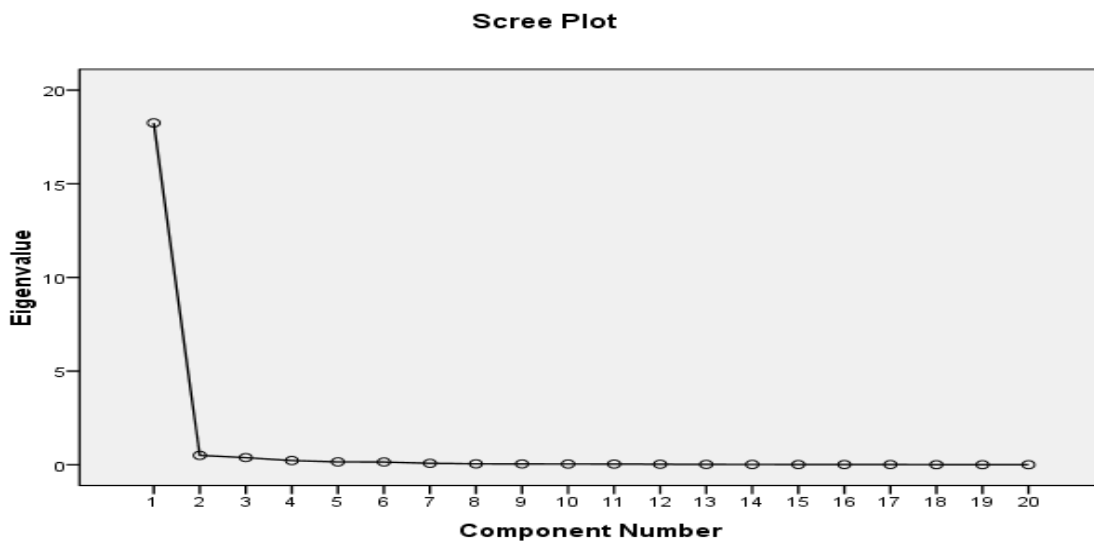


Figure 1. Cattell scree plot showing the number of components and eigenvalues of the correlation matrix.

The first un-rotated principal components factor analyses produced a dimension archetypal of one factor as depicted by the eigenvalues > 1. More so, the scree plot indicated a dimension model of one factor. Attempt was made to rotate factor but this was not possible since only one factor appeared. So, there was no need to rotate the factor either orthogonally or obliquely as the one-factor model showed a modest and hypothetically more significant result. The communalities (h^2) for the PCA ranged from 0.858 to 0.975 and these were within acceptable range of being higher than 0.50. The scree plot is depicted in figure 1 above and is reminiscent of the one-factor model. As indicated in Table 2 all items loaded .926 and above on the principal dimension and no minor loading was greater than .30. The one factor pooled 91.25% of the total variability with eigenvalue of 18.25 and consisted of all 20 items of PNIS. The Cronbach alpha coefficient for the PNIS is ($\alpha = 0.98$) and this was considered very high and theoretically significant (Awofala, Akinoso & Fatade, 2017).

3.3. Research question three: What are the relationships among PNI, dimensions of numeracy and senior secondary school students' achievement in mathematics?

Table 3. Mean, standard deviation, and intercorrelations among dimensions of numeracy, preference for numerical information and achievement in mathematics of senior secondary school students for total sample (n=350)

	Variables				
	1	2	3	4	5
1. Score	1.00				
2. Numeracy in mathematical tasks	.558**	1			
3. PNI	.570**	.722**	1		
4. Numeracy in everyday life	.294**	.222**	.399**	1	
5. Numeracy in workplace tasks	.257**	.609**	.462**	.215**	1
Mean	21.81	25.83	54.24	16.48	22.82
Standard deviation	5.22	4.98	7.61	4.84	4.89

**Correlation is significant at the 0.01 level (2-tailed)

Table 3 showed the relationships amid dimensions of numeracy, preference for numerical information and senior secondary school students' achievement in mathematics. The results in Table 3 indicated that

there were meaningful and positive associations amid numeracy dimensions, preference for numerical information, and achievement in mathematics.

3.4. Research question four: What are the joint and marginal contributions of PNI and dimensions of numeracy to the prediction of senior secondary school students' achievement in mathematics?

Table 4 depicted that the predictors (numeracy in mathematical task, numeracy in everyday life, numeracy in workplace tasks and preference for numerical information) compositely added a coefficient of multiple regression of .628 and a coefficient of determination of .394 to the explanation of variance in senior secondary school students' achievement in mathematics. By way of inference, 39.4% of the entire variability of achievement in mathematics was made up by the amalgamation of the four predictors. These predictors statistically meaningfully predicted achievement in mathematics, $F_{(4, 345)} = 56.04$; $p < .001$. The marginal contributions of the predictors to the explanation of variance in achievement in mathematics was that numeracy in mathematical tasks was the greatest strong weighty positive contributor to the explanation of variance in achievement in mathematics ($\beta = .412$, $t = 6.026$, $p < .001$), while preference for numerical information made the subsequent weighty positive contribution to the explanation of variance in the criterion variable ($\beta = .298$, $t = 4.598$, $p < .001$). Numeracy in workplace tasks ($\beta = .157$, $t = 2.954$, $p = .003$) and numeracy in everyday life ($\beta = .118$, $t = 2.548$, $p = .011$) made the next meaningfully positive contributions to the explanation of variance in achievement in mathematics in that order.

Table 4. Model summary, coefficient and t-value of multiple regression analysis of numeracy dimensions, preference for numerical information and the outcome measure (achievement in mathematics)

Multiple R = .628; Multiple R² = .394; Multiple R² (adjusted) = .387; Standard error estimate = 4.090
 $F_{(4, 345)} = 56.04$, $p < .001$

Model	Unstandardised coefficient		Standardised Coeff Beta	t	Sig
	B	Std Error			
(Constant)	1.289	1.621		0.795	.427
NIMA	.432	.072	.412	6.026	.000
PNI	.204	.044	.298	4.598	.000
NIWP	.167	.057	.157	2.954	.003
NIEL	.127	.050	.118	2.548	.011

4. Discussion

This study indicated that PNI, as measured by the PNIS, is a unidimensional construct. The investigative factor analysis via the principal components analysis revealed a one-factor structure for the scale and it consisted of all the 20 items with acceptable coefficient of internal consistency ($\alpha = 0.98$). This agrees with Viswanathan (1993) the original developer of the scale who determined a uni-dimensional structure for the scale with acceptable coefficient of internal consistency of 0.94 and test-retest reliability of 0.91. The high-reliability index also supported the works of Alkhateeb and Abed (2000) ($\alpha = 0.80$) and Williams (2014) ($\alpha = 0.91$).

In the present study, the senior secondary school students showed a low level of preference for numerical information (Mean=2.71, SD=1.52). This ran contrary to the finding of Alkhateeb and Abed (2000) that Arab students showed positive and high PNI. The result of low PNI recorded in this study did not support Viswanathan's (1993) study on American students. More so, the result was at variance with that of Williams (2014) which showed high level of preference for numerical information among American students. This low preference for numerical information can be partly attributed to the negative attitude of students toward mathematics (Awofala, 2016b) and the high level of mathematics anxiety in Nigerian students (Awofala, 2017a) which most often culminated in their poor performance in mathematics (Awofala, Arigbabu & Awofala, 2013).

The finding of a significant positive relationship between numeracy and PNI recorded in this study confirmed the assertion made by Viswanathan (1993) that there is a positive relationship between numeracy and PNI. Both numeracy and PNI maintained a positive and significant relationship with

achievement in mathematics. This direct association between numeracy and achievement in mathematics in one hand and the direct relationship between PNI and achievement in mathematics, on the other hand, showed that students who are numerate and possess high PNI will succeed in mathematics class.

The results shown in Table 4 indicated that the four predictor variables (numeracy in mathematical tasks, numeracy in workplace tasks, numeracy in everyday life and preference for numerical information) taken together explained 39.4% of the variability of the senior secondary school students' achievement in mathematics while the present data revealed that 60.6% of the variability in achievement in mathematics could not be described. This showed that other predictors may influence the prediction of students' achievement in mathematics. Agreeing to the unstandardized coefficients, the equation to predict achievement in mathematics from numeracy and PNI is as follows: predicted Achievement in mathematics = $1.289 + 0.432$ numeracy in mathematical tasks + 0.204 preference for numerical information + 0.167 numeracy in workplace tasks + 0.127 numeracy in everyday life.

5. Conclusion

This study has shown the need for the Nigerian students at senior secondary school level to have more penchant for numerical information as this could partly solve their poor performance in mathematics and partly remedy their negative attitude towards mathematics. Preference for numerical information is as important as numeracy as both predicted senior secondary school students' achievement in mathematics in the present study. Neglecting these two constructs may spell doom for students' achievement in mathematics. Thus, it will not be a wasted effort for teachers of mathematics to have a first-hand information regarding their students' numeracy skills and attitudes towards numerical information as this could help teachers to partly understand the poor performance of students in mathematics. The PNIS can be utilized to validly and reliably measure senior secondary school students' penchant for numerical information. The low preference for numerical information showed that Nigerian senior secondary school students may be caught in the web of low number sense. Teachers of mathematics need to provide a non-threatening environment for students to gain efficacy in number sense and this should start from the primary school. Helping students gain number sense right from the primary school will help them develop ingenuity in mathematics at the secondary school level thereby solving the problem of incompetence in mathematics. For students to be numerate and cultivate attitude toward numerical information, teachers of mathematics need to make mathematics teaching more meaningful by promoting in students ability to develop meaning for numbers and operations; identify relationships among numbers and operations; comprehend computational schemes and utilize them accurately and effectively; and intellectually make meaning of arithmetical and quantitative circumstances.

6. Recommendation

The present study showed low or negative attitudes of students towards numerical information in addition to the Nigerian adult learners displaying middling numeracy strength (Awofala & Anyikwa, 2014). This is indicative of the need to provide effective programmes to improve support for mathematics teachers to further enhance their inclination to develop numeracy and numerical information teaching pedagogies. Increasing students' penchant for numerical information might mean promoting students' attitudes towards mathematics which may result in students' improved achievement in mathematics. The significance of mathematical proficiency has been emphasised (Awofala, 2017b) for economic growth (OECD, 2010) and individual mathematics skills that showed a causal influence on employment market outcomes (Schrøter Joensen & Skyt Nielsen, 2010) with countries not doing enough to support children in accomplishing higher mathematical achievement. It is recommended that teachers of mathematics and educators alike should test the efficacy of various teaching pedagogies on students' preference for numerical information. Prototypes of pedagogy which are heavily dependent on 'chalk and talk', training in memorisation techniques, or self-unearthing, produce very minimal confidence for students who are struggling with school mathematics. Teachers of mathematics at primary school level should do more by teaching number sense to students as this could be one of the

surest ways to increasing students' PNI. Since there is a paucity of research on PNI and numeracy in Nigeria, stakeholders in the research community should endeavour to investigate PNI and level of numeracy skills among Nigerian students. More so, a confirmatory factor analysis can be conducted on the PNIS with the Nigerian cohort.

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