DOCUMENT RESUME

ED 433 235		SE 062 762
AUTHOR	Ikegulu, T. Nelson	
TITLE	An Empirical Development of an Instrument To Assess Mathematics Anxiety and Apprehension.	
PUB DATE	1998-12-15	
NOTE	40p.	
PUB TYPE	Reports - Research (143)	
EDRS PRICE	MF01/PC02 Plus Postage.	
DESCRIPTORS	Cognitive Measurement; Elementary Secondary Education; *Mathematics Anxiety; *Psychometrics; *Surveys	

ABSTRACT

The development and psychometric properties of the Mathematics Anxiety-Apprehension Survey (MAAS), a measure of instructional and/or classroom mathematics phobia are discussed. This instrument was designed to assess levels of mathematics anxiety and apprehension in students with varying levels of education and socio-demographic factors. The highly apprehensive students are those for whom their anxiety about mathematics overshadows their gains from engaging in mathematics and/or mathematics-related activities. Discussions with a number of high school mathematics teachers and fellow college professors revealed that students with mathematics anxiety and apprehension do exist--the problem was in determining who they are through an efficient means that would be accessible to administrators, counselors, and educators, and at the same time be reliable and valid in assessing the trait. The development of such an instrument was the objective of this study. Statistical findings support the instrument's reliability and construct and factorial validity. (Contains 42 references.) (Author/CCM)

An Empirical Development of an Instrument to Assess Mathematics Anxiety and Apprehension

T. Nelson Ikegulu,
Assistant Professor
Department of Mathematics & Computer Science
Phone: (318) 274-2729
Internet: IKEGULUTN@ALPHA0.GRAM.EDU

P.O. Box 237
Grambling State University
Grambling, LA 71245-0237

December 15, 1998

An Empirical Development of an Instrument to Assess Mathematics Anxiety and Apprehension

Abstract

The development and psychometric properties of the Mathematics Anxiety-Apprehension Survey (MAAS), a measure of instructional and/or classroom mathematics phobia are discussed. This instrument was designed to assess levels of mathematics anxiety and apprehension in students with varying levels of education and socio-demographic factors. The highly apprehensive students are those for whom their anxiety about mathematics overshadows their perceptual gains from engaging in mathematics and/or mathematics related activities.

Discussions with a number of high school mathematics Teachers and fellow college professors revealed that students with mathematics anxiety and apprehension do exist. The problem was in determining who they are through an efficient means that would be accessible to administrators, counselors, and educators; and at the same time be reliable and valid in assessing the trait. The development of such an instrument was the objective of this study. Statistical findings support the instrument's reliability and, construct and factorial validity.

An Empirical Development of an Instrument to Assess Mathematics Anxiety and Apprehension

Introduction

Mathematics instructors at all levels should "**never mistake activity for achievement**." Most educators engaged in the teaching of mathematics at any level have recognized in their classes students who seem to be unduly apprehensive and anxious about mathematics. From my personal needs assessment surveys in my Mathematics and Statistics courses, the majority of the students, when asked why they enrolled in the course, would simply reply: "It's in my major, I have to take it to graduate, or it's in my curriculum." Such statements reflect a negative attitude towards mathematics and have the tendency to retard the students' mental models about the subject matter. An antecedent to helping these students is discovering exactly who they are and, designing the instruction to meet their needs and background characteristics. Simple observations or need assessment are not enough. Incorrect and/or inadequate impressions or inferences may easily be formed through misinterpretation of the students' classroom or instructional behaviors. It seems reasonable to suggest that a more effective and efficient way of determining anxious and apprehensive mathematics students would be through a reliable and an empirically based, standardized, and validated instrument.

This article discussed the initial development of such an instrument as well as rationale and implications for future research endeavors that may be taken in ascertaining the role, effects, and treatment of what is heretofore termed "Mathematics Anxiety-Apprehension."

Pedagogical Roots of Anxiety and Apprehension

The literature on the relationships between mathematics anxiety and apprehension and, scholastic achievement can hardly be considered encouraging. Evidence abounds on general and state anxiety but not on mathematics anxiety-apprehension and its correlates. After several decades of research, most widely recognized measures of mathematics anxiety-apprehension have been found to correlate with academic achievement only in an inconsistent manner, but the correlation never exceeded 0.50 (Boli, Allen, & Payne, 1985; Green, 1990; Handel, 1986; Ma & Kishor, 1997). While there are many reasons for the lack of substantial and consistent relationships in the education literature, one potential explanation is the almost exclusive reliance on the assessment of mathematics anxiety-apprehension which operationalized anxiety traits as generalized dispositions rather than situational dispositions (Dew, Galassi, & Galassi, 1983, 1984; Fennema & Sherman, 1976, 1978; Stage & Kloosterman, 1995; Zyl & Lohr, 1994). Operationally, this means that earlier measures of mathematics anxiety-apprehension were developed to apply across many situations rather than in a single situation and/or content. The present investigation focused on two dimensions in educational settings. Specifically, these dimensions are: (1) Mathematics Anxiety and (2) Mathematics Apprehension. Both dimensions are discussed within the pedagogical underpinnings of instructional and/or classroom anxiety as they relates to communication and writing apprehension and anxiety and, general and state anxiety as they relate to mathematics anxiety-apprehension (Dandato & Dieber, 1986).

Communication and Writing Apprehension and Anxiety

Mathematics is not the only discipline to recognize anxiety and its detrimental effects on students' performance. Anxiety and apprehension have plagued students' written composition and essays for the past six decades. Within the past four decades, a number of investigators (e.g., Clevenger, 1959; Friedrich, 1970; Phillips, 1968; Phillips & Metzger, 1973; Wheeless, 1974) in the field of speech communication have examined the role of anxiety and apprehension as they relate to interpersonal communication and human interaction. The conclusion from these investigations is that communication apprehension is a pervasive trait that seriously affects a large number of individuals.

Phillips (1968) offered the best definition of this phobia. The highly apprehensive individuals are those for whom their anxiety about communication out-weighs their projection of gains from such situations. That is, the highly apprehensive individuals have the tendency to avoid communication situations or react in some anxious manner if compelled because they foresee primarily negative consequences from such engagements. Specific research findings have indicated that highly apprehensive individuals have the potential to be less motivated to achieve and generally engage in less self-disclosure (Giffin & Gilham, 1971; Hayes, Hatch, & Silk, 1996). Furthermore, they also tend to select occupations that they perceive to have minimum communication and are likely to chose housing and seating positions that require less communication (Daly & Shamo, 1976, 1978). High communication apprehensives seldom engage in group dynamics and when forced to, contribute very little to the group (Daly, 1981; Daly & Shamo, 1976, 1978). As one would expect, research has also demonstrated that individuals who have such apprehension tend to exhibit low self-concept, which in turn is often reflected and reinforced by those they interact with and ratings they received (Karst & Most, 1973; Shrewsbury, 1995).

Writing is one of the means of communication and has been of national concern, particularly since the writing skills of students have diminished. The decline in college students' writing quality can be attributed to the presence of communication apprehension and the absence of verbal precision in television, advertising, and political language. It is also due to the lack of writing practice in high school English courses, underprepared English Teachers, and the difficulties involved in evaluating students' writing. In addition, writing instructors who detected a decrease in the writing skills of entering freshmen indicated that students had decreased in communication of logical ideas, development and construction of grammatical sentences, spelling, organization and coherence of the total composition, and punctuation (Cullum, 1991; Daly, 1978a, 1978b; Daly & Shamo, 1978; Dandato & Dieber, 1986; Hayes, 1981; Hayes, et al., 1996; Thompson, 1979, 1981).

For the past 30 years, the psychosocial construct writing apprehension has been of particular interest to researchers, writing instructors, and educators at-large. Consequently, an abundance of empirical studies have examined writing apprehension to determine its impact on the writing skills of students. Studies have revealed that writing anxiety is a consequence of high writing apprehension. John Daly, one of the major proponents leading the field of research on writing apprehension, is responsible for coining the term writing apprehension: "A situation and subject specific individual difference associated with a person's tendencies to approach or avoid situations perceived to potentially require writing accompanied by some amount of perceived evaluation" (Daly, 1981, p. 10).

With regards to writing, students are labeled as either high or low apprehensives. High apprehensives tend to find writing unrewarding and punishing while low apprehensives find it rewarding and enjoyable. More specifically, high apprehensives tend to avoid situations requiring writing, which to a large extent reduces their opportunities for practice which is crucial to the development of writing skills. In general, high apprehensives perform lower on standardized tests of writing skills and abilities than do low apprehensives; and are less likely to succeed in a variety of academic subject areas than their low apprehensive counterparts. While low apprehensives write more and use more qualifications, high apprehensives tend to write less, use fewer qualifications, usually choose a lower level of vocabulary, and lack creativity (Clifford, 1978, 1981; Connors & Lunsford, 1993).

Literature abounds on the relationships of writing apprehension to self-esteem (Daly, 1977, 1978b); message intensity, sex differences, and SAT scores (Daly & Miller, 1975b; Daly & Shamo, 1976); success expectations, and willingness to take advanced courses (Daly & Miller, 1975a, 1975b; Daly & Shamo, 1978); and academic and occupational choices, decisions, and preferences (Daly & Shamo, 1976, 1978). However, much of the research has focused on writing apprehension and students' writing performance in terms of writing aptitude, writing ability, and language intensity (Clifford, 1981; Faigley, Daly &

Witte, 1981; Hayes, 1981). Few of these studies were devoted to writing apprehension and anxiety.

Anxiety about writing is perhaps the most common form of writing deficit that both experienced and inexperienced students will encounter when composing. The causes of writing anxiety vary from neurological problems that underlie language processing, poor skill development, and inadequate role models to lack of an understanding of the composing process and an authoritative, teacher-centered, product-based mode of teaching. Overall, researchers argue that writing anxiety stems from a student's previous academic success. Although the symptoms are all too familiar, a number of studies have examined the causes and predictable effects of writing anxiety in order to help improve the writing skills of college students (Clifford, 1978, 1981; Connors & Lunsford, 1993; Schultz & Meyers, 1981; Shrewsbury, 1995). Writing apprehension-anxiety is related to test anxiety in ways that mathematics apprehension-anxiety is to state anxiety.

General and State Anxiety

Mathematics anxiety is considered to be related to test anxiety, and worry and emotionality are considered the most stable component of general and state anxiety (Dew, et al., 1983/84). Contemporary anxiety-apprehension theory and research have posited and maintained that apprehension is a perceptual disposition, that apprehension is antecedent to anxiety, and that anxiety is a multifaceted emotion that has the potential to disrupt cognitive activities at several stages of the information processing (Clevenger, 1959; Daly, 1977, 1981; Daly & Miller, 1975b; Daly & Shamo, 1976, 1978; Deffenbacher, 1982; McKeachie, Pintrich, & Lin, 1985; Meyers & Martin, 1974; Sarason, 1985).

Anxiety may affect test performance (and ability) by interfering with test preparation and study habits. Students who are generally anxious about taking a test may fail to use appropriate test-taking strategies and study skills to: (1) direct their attention to relevant information, (2) integrate information in memory, (3) assess their learning state through self-evaluation, and (4) believe in their mental models (Culler & Holahen, 1980; McKeachie, et al., 1985). Another theoretical account of the relationship between anxiety-apprehension and performance proposes that anxiety-apprehension interferes with cognitive activities at the time of the evaluation. Anxious students may become preoccupied with and apprehensive and/or worry about their performance and these intrusive thoughts may undermine the students' self-esteem, interfering with their ability to sustain attention to task-relevant instructional materials; thereby, preventing the students from engaging in cognitive operations (e.g., following instructions, use of a variety of logical rules, and recall) that would facilitate test performance (Deffenbacher, 1982; Sarason, 1985). Mathematics is a cognitive process that requires attention-to-details and perseverance. Students with high mathematics apprehension are likely to be high in mathematics anxiety.

Instrument Development, Methodology, and Results

The content validity of the initial item-pool for the Mathematics Anxiety-Apprehension Survey (MAAS) was derived from two activities: (1) A review of the literature was conducted to ascertain how anxiety- apprehension and their correlates were defined and operationalized. (2) One hundred twelve students enrolled in six College Algebra courses during the Fall semester 1997 were asked to write ten statements (each) that they like and dislike about mathematics. These activities afforded the basis for generating 105 items. During the Spring semester 1998, these 105 items were presented to 550 students in an Agree-Disagree continuum: 1, Strongly Agree; 2, Agree; 3, Uncertain or Unsure; 4, Disagree; and 5, Strongly Disagree.

Participation and inclusion into the study was strictly voluntary; however, there were no refusals. Only students who were currently enrolled in mathematics of any kind from two four-year institutions in Northern Louisiana were included and students with more than twenty percent of the items missing were discarded. The resulting number of participants was 382 (191 males and 191 females). These 382 students, representing several states in both institutions, came from a variety of socioeconomic and family backgrounds and, have different levels of academic ability and aptitude. Participants were also required to sign a Consent Agreement. The selected 13 classes, different in content and composition, included courses in Basic/Developmental Mathematics, College Algebra and Trigonometry, Elementary and Business Statistics, Integral and Differential Calculus, Mathematics Logic, Discrete Mathematics, Linear Algebra, graduate Courses in Theory of Numbers and Real Analysis, and graduate courses in Statistics and Research Methods. Class size ranged from eight to 35 students. The instructors teaching these courses were judged by their respective institutions as competent in their chosen fields with terminal degrees in their content areas. Their ages ranged from 30 to 58 with an average length of service (longevity) of 12.5 years (Median = 14 years).

Preliminary Item Analysis

Table 1 summarizes the results of the initial analyses. The result of an initial item analysis revealed that the item-pool consisted of "**Like**" and "**Dislike**" statements about mathematics. The like statements denoted positive attitudes toward mathematics (PATM) while the dislike statements connoted negative attitudes toward mathematics (NATM). Duplicate statements were omitted. This yielded a total item-pool of 71. These 71 items were subjected to a polyserial correlation and items with less than

Table 1

Result of the Principal Component Factor Analysis

Construct/Indicator	FL	FR	FS	h^2_{ij}	$\bar{x}$
Negative Attitude Toward Mathematics (NATM) Subscale					
2. Taking a math test is a frightening experience for me	0.822	0.774	0.140	0.803	3.28
12. I am nervous about mathematics	0.795	0.749	0.121	0.742	3.13
6. I make low scores on most of my math tests	0.775	0.745	0.119	0.770	3.34
21. I feel a lot of pressure taking a math course	0.765	0.719	0.109	0.685	3.08
4. My mind seems to go blank during math tests	0.753	0.714	0.099	0.701	3.07
36. Mathematics is one of my worst subjects	0.747	0.648	0.067	0.745	3.09
7. I am afraid to submit my math tests or assignments	0.738	0.737	0.119	0.822	3.57
8. Math formulas are difficult for me to remember during tests	0.724	0.654	0.067	0.768	2.89
33. It is difficult for me to grasp math concepts	0.712	0.636	0.063	0.719	3.11
15. I have a special dislike for mathematics	0.699	0.639	0.063	0.738	3.34
5. I make low scores on my math assignments	0.687	0.650	0.079	0.687	3.22
39. It takes me a while to solve a math problem	0.677	0.588	0.052	0.722	2.75
26. I feel a lot of stress taking a math test	0.666	0.592	0.060	0.634	3.15
23. It is difficult for me to understand math instructions	0.651	0.612	0.066	0.652	3.34
18. I don't want my math tests or assignments to be evaluated	0.643	0.570	0.060	0.676	3.53
1. I avoid mathematics courses	0.623	0.571	0.044	0.644	3.21
17. I depend on my tutors for help in math	0.615	0.554	0.058	0.614	3.26
14. I am no good at solving math problems	0.595	0.511	0.045	0.536	3.42
25. Mathematics is a boring subject	0.574	0.485	0.033	0.578	3.07
22. I generally cram a lot of information before a math test	0.543	0.454	0.024	0.515	2.97
32. I blame myself for my poor performance in mathematics	0.543	0.374	0.038	0.367	2.87
3. I do my math homework alone	-0.251	-0.254	-0.013	0.367	2.39
Positive Attitude Toward Mathematics (PATM) Subscale					
27. Mathematics is one of my favorite subjects	0.810	0.776	0.227	0.828	3.25
28. I am fond of mathematics logic	0.805	0.762	0.146	0.718	3.14
19. Mathematics is an exciting course	0.796	0.721	0.127	0.615	2.95
34. I like answering math questions in class	0.765	0.702	0.109	0.730	2.99
29. Learning and understanding math can be fun	0.753	0.691	0.103	0.665	2.63
16. I enjoy showing others how to solve math problems	0.731	0.671	0.108	0.594	2.98
30. I always do well on math exams	0.726	0.620	0.118	0.742	3.19
38. It is a joy to transform word problems into math expressions	0.711	0.599	0.089	0.687	3.29
13. I feel confident in my ability to solve math problems	0.696	0.581	0.078	0.675	2.70
10. I enjoy mathematics	0.686	0.566	0.103	0.692	2.90
35. I volunteer myself to solve math problems on the board	0.671	0.560	0.092	0.714	3.25
20. Most of my courses are math related	0.665	0.560	0.070	0.554	3.17
11. I like seeing the steps I used to arrive at my solution	0.659	0.557	0.051	0.500	2.30
9. I learn math by solving problems	0.651	0.543	0.041	0.499	2.39
40. Doing workbook exercises help improve my math scores	0.645	0.532	0.028	0.490	2.44
24. Mathematics comes easy for me	0.631	0.475	0.039	0.482	3.18
37. Mathematics is a great challenge for me	0.606	0.463	0.043	0.397	2.59
31. My peers seem to understand me better than the teacher	0.560	0.378	0.029	0.365	2.84

Note.
FL = Factor Loading, FR = Factor Rotation, FS = Factor Score, and $\bar{x}$ = item (indicator) mean.

±0.20 intercorrelation with other items were deleted. A total of 31 items did not meet this criterion; resulting in a final number of indicators of 40.

These 40 indicators were subjected to a principal component factor analysis with orthogonal rotation as determined by Kaiser's maximum variance (VARIMAX) criterion (Pedhazur & Schemlkin, 1991). The number of iterations for termination was set at 10 for the factor extractions. To retain a factor, it was established that there be at least seven indicators with satisfactory factor loadings (±0.60 or higher) on that factor with no secondary loadings of above 0.40 in magnitude (Duncan, Duncan, & Fuzhong, 1998; Pedhazur & Schmelkin, 1991). Consequently, these 40 indicators were regrouped into two categories and standard item analysis procedures were then used to construct the subscales. Using an item total correlation of less than ±0.20 as a criterion for elimination, I reduced the number of positive and negative attitudes toward mathematics (PATM and NATM) subscales to 18 and 22 respectively.

<u>Instrument Reliability</u>

A two-factor model appeared as best given the considerations noted above. However, examination of the indicators and their respective loadings, variability of the indicator means, and the means ($\bar{x}$) and standard errors of the mean (SEM) for the subscales and the overall instrument indicated that the apparent multidimensionality was a function of the valences of the indicators. These item valences were a measure of the degree of attractiveness possessed by the participants' responses to the MAAS as a behavioral goal in their perceived mathematics apprehension and anxiety. That is, all of the positive indicators loaded on one factor while the negative indicators loaded on the other factor. Both factors are the subscales (PATM and NATM).

The VARIMAX rotation converged after three iterations. The factor loadings were at least 0.5 except for item #3 which has a loading of -0.251. The indicator means ($\bar{x}$) ranged from a low of 2.39 to a high of 3.57 and, SEM in the neighborhood of 0.060 (for item #11) and 0.12 (for item #24). This is indicative that these item means are within their population true means. Each indicator was highly correlated with its respective subscale and the correlation between both subscales was 0.535. These 40 indicators accounted for 46.1% of the total variance. For clarity, items with positive (or negative) statement or had a positive (or negative) connotation reflected in the factor loadings, rotation, and scores. That is, indicators loading on PATM had positive loadings on it and negative loadings on NATM and vice versa. This indicated a bi-polarity of both factor-scales. A copy of the instrument as well as directions for its completion can be found in the Appendix.

Cronbach's alpha was used to assess the internal consistency of the instrument and its subscales. Guttman's procedure computed the lower and upper bounds for true reliability, Parallel form assumed equal inter-item variability across all replications, and Strict-Parallel form assumed both the equality of the item variances and their means. Together, these methods of reliability estimates constituted the instrument's reliability. Table 2 summarizes the results of the different reliability estimates, the eigen-values, ant the percent of variance explained by the instrument and its factor-scales. The consistency of these reliability estimates indicated that a reliable instrument that assesses students' mathematics anxiety-apprehension has been developed.

For this instrument, the global (overall) internal consistency estimate was 0.728 (unstandardized), 0.740 (standardized), and 0.738 (if item #3 was deleted). This means that about 53% of the total variance was accounted for in students' perceptions about their mathematics anxiety-apprehension. The estimated alphas for the overall instrument were smaller than the subscales'. In all instances, the reliability estimates for the NATM subscale were consistently higher than the PATM subscale and the overall instrument. This indicates that the NATM subscale consistently measured (about 86% of the variance) in students' perceived mathematics apprehension while the PATM assessed (about 72% of the variance)in their perceived mathematics anxiety.

Table 2

Comparative Summary of Different Reliability Estimates

Type/Eigen-value	Overall	PATM	NATM
Cronbach's Alpha	0.728	0.8536	0.9272
Standardized	0.7401	0.864	0.9253
If Item #3 Deleted	0.738	0.851	0.937
Mean ($\bar{x}$)	3.03	2.90	3.14
Variance (σ^2)	0.098	0.104	0.070
Guttman's Split-Half	0.6052	0.7950	0.8976
Spearman-Brown's	0.6079	0.7988	0.8989
Part I	0.6839	0.7599	0.8831
Mean ($\bar{x}$)	3.05	2.87	3.17
Variance (σ^2)	0.14	0.12	0.10
Part II	0.5277	0.7672	0.8562
Mean ($\bar{x}$)	3.01	2.93	3.11
Variance (σ^2)	0.06	0.10	0.05
Corr. Between Parts	0.4367	0.665	0.8164
Guttman's Bounds			
Lower Bound	0.7098	0.8062	0.8851
Upper Bound	0.8870	0.8893	0.9517
Parallel Form			
Inter-item Corr.	0.0615	0.2447	0.3666
Unbiased Estimate	0.7294	0.8544	0.9276
Strict Parallel Form			
Unbiased Estimate	0.7138	0.8439	0.9229
Eigen-value		13.044	5.39
Percent Eigen-value	46.10	32.61	13.49
Number of Indicators	40	18	22

The deletion of item #3 from the scale would not adversely affect the construct validity of the subscales. Recall that students were required to respond on a Likert scale continuum from 1, strongly agree to 5, strongly disagree. The indicator (item) means, variances, and standard errors of the mean (See Tables 1 and 2) suggest a global sample response convergence to between 2, agree and 4, disagree. This concordance in response pattern was expected considering the nature of the instrument, the bi-polarity of its factor-scales, and the variances in the estimated global and subscale means. For example, consider the mean ($\bar{x}$ = 3.14) and the standard deviation (σ = 0.264) for the NATM subscale with 22 indicators. Applying the standard normal distribution to the response patterns for the NATM indicates that the overall response would fall between ($\bar{x} \pm 3\sigma$) or (2.348, 3.932). For the overall instrument and the PATM subscale, the result of this application would give (2.09, 3.969) and (1.933, 3.867) respectively. Whence, students responded more positively (1 and/or 2) on the PATM items than on the NATM items and, the resultant effects of these response patterns were the observed differences in the estimated reliabilities.

Scoring Procedures

Scoring the MAAS instrument is both simple and fast and, could be done by hand, a calculator, or any of the software with spread-sheet (e.g., Lotus, EXCEL, MINITAB, SPSS, etc.). There are 40 items in this instrument. The lower the rating scale, the stronger the agreement between the students' perception of the item(s) and their mathematics anxiety-apprehension score. The highest possible score for any of the 40 items is 5; and the minimum and maximum scores are 40 and 200. The overall mean for the entire sample was 100.19 (Md = 100.00, SD = 26.11, and SEM = 1.34). The range of the scores is 160 (200 - 40) and the mid-range is 80. The formula for scoring the 40-item instrument is given by (the PATM and NATM items are as shown in Table 1):

$$\boxed{\text{MAAS Score} = 120 + \text{PATM} - \text{NATM}}$$

Instrument Validity

A necessary and sufficient condition antecedent to instrument reliability is testing its validity in assessing the construct it purports. Certainly, there are issues about the instrument's face and content validity. The most direct evidence of the face validity and content validity of the instrument lies in the indicators themselves. Moreover, these items are similar to Fennema-Sherman's 12-item Mathematics Anxiety subscale of their Mathematics Attitude Scales (MAS), Sandman's six-item Anxiety Toward Mathematics Scale (ATMS), and Suinn's 98-item Mathematics Anxiety Scale (MARS). This leads to the construct validity. The 40 items represent the constructs realized in the two-factor model. This has also been established by virtue of the PATM and NATM subscales: NATM for mathematics apprehension and

PATM for mathematics anxiety (Dew, et al., 1983, 1984; Zyl & Lohr, 1994). The next logical question is the instrument's predictive validity. An instrument's predictive validity attempts to ascertain the predictive nature or future utility of the instrument. This requirement would be satisfied with an empirical study on developmental students (Barham & Ikegulu, 1998).

The purpose of the pilot study by Barham and Ikegulu (1998) was to determine the differential effects of developmental students' gender and their perceived levels of mathematics anxiety-apprehension (Low, Moderate, and High) on their academic performance and likelihood to persist. Two hundred forty-four developmental students completed the Mathematics Anxiety-Apprehension Survey during the Fall semester 1998. Students' cumulative GPAs were obtained from the institution's Registrar at the end of the Fall semester 1998.

Two one-way analysis of variance (ANOVA) and a two-way ANOVA were employed to test for the hypothesized differences in gender and the three levels of mathematics anxiety-apprehension (trait). The grand mean for the GPA ($\bar{x}^{GPA}$) was 2.55. The sample consisted of 111 (45.5% and $\bar{x}^{GPA} = 2.49$) male and 133 (54.5% and $\bar{x}^{GPA} = 2.60$) female developmental learners. Students scoring one standard deviation below the mean score on the anxiety-apprehension trait were classified as low-anxious-apprehensives (n = 43 and $\bar{x}$ = 3.22); those scoring one standard deviation above the mean were classified as high-anxious-apprehensives (n = 39 and $\bar{x}$ = 2.47); and those within both extremes were classified as moderate-anxious-apprehensive (n = 162 and $\bar{x}$ = 2.18).

The one-way ANOVA with gender as the fixed factor effect and college cumulative GPA as the outcome variable revealed a non-significant gender effect ($F(1, 242) = 1.935$, $p > 0.1$). The one-way ANOVA with mathematics anxiety-apprehension as the fixed factor resulted in a significant effect for the trait ($F(2, 241) = 44.856$, $p < 0.001$) and accounted for 27.1% (Eta-squared) of the variance in predicting the mean differences in students' academic performance. There was no significant interaction between gender and anxiety trait in the two-way ANOVA. The main effects due to gender ($F(1, 238) = 5.181$, $p < 0.05$) and the trait ($F(1, 238) = 47.135$, $p < 0.01$) were significant. The results of this pilot study are consistent with previous studies that demonstrated the existence of significant relationships between mathematics anxiety-apprehension and ACT/SAT composite scores (Dew, et al., 1983, 1984; Green, 1990; Zyl & Lohr, 1994) and marginal gender effect (Boli, et al., 1985; Handel, 1986; Ma & Kishor, 1997; Stage & Kloosterman, 1995; Tocci & Engelhard, 1991). Table 3 provides a summary of the analysis.

Table 3

Two-Way ANOVA Results: Gender-by- Mathematics Anxiety-Apprehension

Source	SS	df	MS	F	Eta²	Power
Model	1616.07	6	269.345	951.98**	0.960	0.999
Gender	1.47	1	1.47	5.18*	0.021	0.621
TRAIT	26.67	2	13.34	47.14**	0.284	0.998
GENDER-by-TRAIT	0.186	2	0.093	0.327	0.003	0.102
Error	67.337	238	0.283			
Total[a]	1683.41	244				

Note.
[a] Uncorrected Total.
TRAIT is the mathematics anxiety-apprehension with three levels.
** $p < 0.01$ and * $p < 0.05$.

Given the significant F-ratios, the mean differences (M.D.) for gender and anxiety-apprehension trait were explored through Tukey's pairwise and Bonferroni's multiple comparisons respectively. Students with high mathematics anxiety-apprehension were found to be significantly different in their academic performance than the moderate anxious-apprehensives (M.D. = 0.29, $p < 0.05$); and the low anxious-apprehensives (M.D. = 0.751, $p < 0.01$). Significant differences were also observed between low-anxious-apprehensives and the high-anxious-apprehensive (M.D. = 1.041, $p < 0.01$), as well as between male and female developmental students (M.D. = -0.193, $p < 0.05$) (Dew, et al., 1983, 1984; Ma & Kishor, 1997).

Discussion, Conclusion, and Implications

The overall predictive ability of the model in Table 3 was 0.96 with an observed power of 0.999. This indicates that about 92.2% of the total variation in the prediction of students' academic performance was explained by their gender and perceived levels of mathematics anxiety-apprehension. Mathematics anxiety-apprehension accounted for much of this variance (Eta^2 = 27.1% for the one-way and 8.1% for the two-way ANOVAs). Students' gender contributed very little of this variance. In light of the non-significant gender-by-trait interaction, this means that all possible combinations of levels of gender with those of the trait would not affect the inferences, thereof, in the application of this instrument in a classroom or an instructional environment. Thus, both male and female developmental students would be expected to exhibit about the same level of mathematics anxiety-apprehension (Stage & Kloosterman, 1995). That is, low-anxious-apprehensive, moderate-anxious-apprehensive, and high-anxious-apprehensive males would be expected to have similar academic performance with their female counterparts. However, when considered individually, female developmental students would be more likely to out-perform male developmental students. In addition, students with low mathematics anxiety-apprehension have the tendency to achieve better, academically, than those with moderate mathematics anxiety-apprehension, who in turn would be more likely to have higher mean GPA than the high-anxiety-apprehensives.

I have often wondered and questioned myself about the nature, characteristics, and future of the students who exhibit mathematics anxiety and apprehension: "Are these students branded for life? Was this apprehension and/or anxiety about mathematics in their blood or, was it something else, a learned trait (or behavior) that would go way over time or could be corrected with intervention programs?" I leaned more on the latter, hoping that my fellow educators would follow suit.

The research reported above and the discussions, therein, suggest that an empirically reliable and valid instrument that assesses mathematics anxiety and apprehension has, in deed, been developed. Its utility and benefits to the education community at-large could be explored if one understands the underlying problem that mathematics anxious and apprehensive students face. Knowing and understanding these problems would aid administrators and educators in developing student-centered curricula and programs that would foster openness to diversity, reduce the effects of mathematics phobia, and propose alternative career paths and academic disciplines that are congruent and homeostatic with the students' expectations, previous academic backgrounds, and future occupational preferences.

Basic mathematics at both the pre-postsecondary and the postsecondary levels place emphases on computational skills, pedagogical principles, and concept acquisition and mastery of content. The new era in technological advancements demands rigor and expertise, as well as, conceptualization and the ability to encode/decode information within a short period of time. Individuals are often required to process information in nano-seconds. Naming an occupation where the least mathematical skills are not required is difficult. Although it may not be a differential or an integral calculus or, the derivation of a theorem that is required, most individuals do face the demands of computational skills daily.

Given the limited research on mathematics anxiety and apprehension and, the abundance of empirical studies on anxiety and their daily effects on mankind, I suppose there might reasonably exist a general anxiety and/or apprehension about mathematics. It is quite possible that there may be a very large number of the population who fail miserably in an environment where mathematics competencies are in demand because of their apprehension and/or anxiety about the subject. In a very general sense, these are the individuals who fail because they find mathematics very frightening. For instance, students who are high in communication apprehension would likely be unwilling to speak in the public, would have difficulty comprehending and deciphering information, and would also have expression anxiety and receiver apprehension (Daly, 1981; Daly & Shamo, 1978; Hayes, 1981; Shrewsbury, 1995; Wheeless, 1974).

By the same token, students who are apprehensive about mathematics are likely to be mathematics anxious. Students who are high in their apprehension about mathematics are likely to fear the evaluation of their tests and/or assignments because of an expectant negative rating. Thus, they would avoid mathematics and mathematically related courses and when compelled, would more likely exhibit high levels of mathematics anxiety. These students expect to fail, and logically they should (and often do) since they seldom engage in the practice of mathematics. In instructional or classroom environments, these are the students who are likely to procrastinate, fail to turn in their assignments, copy their home works in class during class periods on the due dates, always want a take-home test, do not attend class regularly, are always sick during a math test, perform poorly on standardized tests, and enroll involuntarily in courses directly related to mathematics. Outside of the instructional or classroom environments, it would not be expected that students who are high in mathematics anxiety-apprehension would engage in extra-curricula activities where computational skills are required. They would tend to seek academic majors and career paths that require the least amount of computational skills; and if per chance, they find themselves in highly structured and mathematically-oriented occupational environments, would resort to truancy, seek alternative occupations or career paths, report being unhappy about their present job, and complain. Students who are high in mathematics anxiety-apprehension are also likely to chose non-technical academic minors; and their career choices and/or occupational preferences are also likely to be non-technical. They are likely to be found in occupations that are both action-driven and service-oriented.

Discussions with a number of high school mathematics Teachers and fellow college professors revealed that such students do exist. A constant problem, however, was in determining who they are through an efficient means that would be accessible to administrators, counselors, and educators; and at the same time be reliable and valid in assessing the mathematics anxiety-apprehension trait. The development of such an instrument was the objective of this research endeavor. In retrospect to the underlying problems with mathematics anxiety and apprehension, a necessary and logical consequence of the present investigation is finding alternative avenues to reduce mathematics anxiety and apprehension in students. Such avenues may be found amidst counselors and educators at all levels (Zyl & Lohr, 1994). Mulicultural education that focuses on teaching-learning processes could be of help. Teaching in a pluralistic and linguistically diverse educational setting can be difficult. There are as many different types of learners as there are students in any classroom environment. Different learning styles have their corresponding teaching strategies; and higher education faculty members should embrace this diversity by incorporating new and diversified teaching and learning modalities in their classrooms (Dandato & Dieber, 1986; Ikegulu, 1997; Sarason, 1985).

Implications for Future Research

Knowledge acquisition and transfer have both developmental and curricula implications for both globally and analytically oriented individuals. The cognitive learning styles -- field dependence status and abstract-concrete continuum -- which constitute important aspects of individualization among students with regards to the way they acquire, process, and interpret information, seems to have potential impacts on students' "**cognitive circumflex**" (cognitive and metacognitive abilities, attitudes, awareness, and motivation). Cognitive circumflex is the quality of a student's metacognition that is often characterized by his or her ability to decipher, read, recognize, translate, understand, and recall information in his or her mental reservoir; and aids information formation and processing. The lack of cognitive circumflex in a student would compel that student to resort to excessive (but temporary) memorial loads in the form of rote-memory, cramming, and sometimes, cheating.

Despite the growing interest in educational arenas to address individual differences in conveyors of instructional materials, little has been done to incorporate cognitive and motivational factors into the curricula and instructional design. Motivational style (curricula and instructional contexts) are likely to be more a product of situational (subject-matter content) than individual (age, gender, ethnicity, or noncognitive) factors.

The multicultural pedagogical implications and classroom activities should be based on information about instructional strategies and learning styles. To bridge the gap between theory and practice, several applications, the most important of which is "culture sensitive pedagogy/andragogy -- ethnocentrism and pluralism," of instructional strategies, classroom management, and learning styles research would help in planning an instructional sequence or lesson in a linguistically diverse multicultural classroom environment. Such culturally and linguistically congruent and homeostatic teaching and learning techniques would provide students with conditions for effective learning and language development as students are motivated in positive affective learning environments. It would also help educators in knowing and understanding their students, help the students to form social bonds with their peers, and reduce students' expectancy of failure as a result of apprehension and/or anxiety about the course.

The literature is limited on the ethnicity effects of cognitive learners. The current growth in the use of mediated instruction, both in education and communication, suggests that computer-mediated instructional presentation strategies deserve the attention of educational and instructional technologists. Continued research on how different learners use windows in mediated instruction and tutorial environments would help educators and instructional technologists shape the future of literacy in America.

Further investigations should examine how learning styles may be "GOOD" predictors for successful performance in mathematics, particularly, with regards to specific learning tasks. In addition, a comparison of the effect of students' knowledge or lack of knowledge of their learning style on performance should be conducted. Another investigation, a combination of learner characteristics (such as gender and ability) and their level of mathematics anxiety/apprehension, may yield additional information about how students learn and process information. Finally, how learning styles and other learner characteristics influence performance in other instructional and non-instructional environments might be investigated as well. The differential effects of style-shifting for the at-risk students is also desirable. The classification of developmental learners within their cognitive circumflex and the cogno-abstract-concrete continuum is highly needed (Ikegulu, 1997). This research should focus on the combination of cognitive styles of field dependence status and the three levels of mathematics anxiety-apprehension to determine students' academic and occupational preferences. Research efforts that investigate this classification would provide missing information about the "TRUE NATURE AND CHARACTERISTICS" of students. A potential comparison of this `new' study with the literature on learning styles dimensions will bridge the gap between "WHAT IS KNOWN" and "WHAT NEEDS TO BE KNOWN" about this population of students in America's multiculturally and linguistically diverse classrooms.

Reference

Barham, W. A. & Ikegulu, T. N (1998). The differential effects of gender and mathematics anxiety-apprehension on developmental students' academic performance: A pilot study. Manuscript pending review. Research and Teaching in Developmental Education.

Boli, J., Allen, M. L., & Payne, A. (1985). High-ability women and men in undergraduate mathematics and chemistry courses. American Educational Research Journal, 22, 605-636.

Cavallaro, D. M & Meyers, J. (1986). Effects of study habits on cognitive restructuring and study skills training in the treatment of test anxiety with adolescent females. Techniques, 2, 145-155.

Clevenger, T. R. (1959). A synthesis of experimental research in stage fright. Quarterly Journal of Speech, 55, 124-145.

Clifford, J. P. (1978). An experimental inquiry into the effectiveness of collaborative learning as a method for improving the experiential writing performance of college freshmen in a remedial writing class. *Dissertation Abstracts International* AAI7808455.

Clifford, J. P.(1981). Composing in stages: The effects of a collaborative pedagogy. *Research in the Teaching of English, 15*,37-53.

Connors, R. & Lunsford, A. (1993). Teachers' rhetorical comments on students' papers. *College Composition and Communication, 44* (2), 200-223.

Culler, R. E.& Holahan, C. J.(1980). Test anxiety and academic performance: The effects of study-related behaviors. Journal of

Educational Psychology, 72, 16-20.

Cullum, C. (1991). *Collaborative learning, phase two: Experimental research*. Paper presented at the Annual Meeting of the Conference on College Composition and Communication, Boston, MA. (ERIC Reproduction Document Services No. ED 322 216).

Daly, J. A. (1981). Writing apprehension and writing competency. The Journal of Educational Research, 10-14.

Daly, J. A. (1978a). *Writing apprehension in the classroom: Teacher role perceptions of the apprehensive writer*. Research in the Teaching of English, 13(1), 37-44.

Daly, J. A. (1978b). Writing apprehension and writing competency. *Journal of Educational Research, 72,* 10-14.

Daly, J. A. (1977). The effects of writing apprehension on message encoding. *Journalism Quarterly, 54*, 566--572.

Daly, J. A. & Miller, M. D. (1975). Further studies in writing apprehension: SAT scores, success expectations, willingness to take advanced courses, and sex differences. *Research in the Teaching of English, 9,* 250-258.

Daly, J. A. & Shamo, W. (1976). Writing apprehension and occupational choice. *Journal of Occupational Psychology, 49,* 55-58.

Daly, J. A. & Shamo, W. (1978). Academic decisions as a function of writing apprehension. Research in the Teaching of English, 12, 119-126.

Deffenbacher, J. (1982). Cognitive psychological components of test anxiety in real-life exams. Cognitive Therapy and Research, 10, 635-644.

Dendato, K. M. & Dieber, D. (1986). Effectiveness of cognitive/relaxation therapy and study-skills training in reducing self-reported anxiety and improving the academic performance of test-anxious students. Journal of Counseling Psychology, 33, 131-135.

Dew, K. M. H., Galassi, J. P., & Galassi, M. D. (1984). Math anxiety: Relation with situational test anxiety, performance, psychological arousal, and math avoidance behavior. Journal of Counseling Psychology, 31, 580-583.

Dew, K. M. H., Galassi, J. P., & Galassi, M. D. (1983). Mathematics anxiety: Some basic issues. Journal of Counseling Psychology, 30, 443-446.

Duncan, T. E., Duncan, S. C., & Fuzhong, L. (1998). A comparison of model - and multiple imputation - based approaches to longitudinal analyses with partial missingness. Structural ~Equation Modeling, 5(1), 1-21.

Faigley, L., Daly, J. A. & Witte, S. P. (1981). The role of writing apprehension in writing performance and competence. *Journal of Educational Research, 75(1)*, 16-21.

Fennema, E. H. & Sherman, J. A. (1978). Sex related differences in mathematics achievement and related factors: A further study. Journal of Research in Mathematics Education, 9(3), 189-203.

Fennema, E. H. & Sherman, J. A. (1976). Fennema-Sherman mathematics attitude scales. JSAS Catalog of Selected Documents in Psychology, 6(31),. Manuscript No. 1225.

Friedrich, G. W. (1970). An empirical exploration of a concept of self-reported speech anxiety. Speech Monographs, 73, 67-72.

Giffin, N. & Gilham, S. M. (1971). Relationship between speech anxiety and motivation. Speech Monographs, 38, 70-73.

Green, L. T. (1990). Test anxiety, mathematics anxiety, and teacher comments: Relationships to achievement in remedial mathematics classes. The Journal of Negro Education, 59, 320-335.

Handel, R. D. (1986). Achievement attitudes in mathematics and science: Relationships between self-perception, aspiration, and extra-curricula activities. Paper Presented at the Annual Meeting of the American Educational Research Association. San Francisco, CA.

Hayes, C. G. (1981). Exploring apprehension: Composing processes of apprehensive and non-apprehensive intermediate freshmen writers. Paper presented at the Annual Meeting of the Conference on College Composition and Communication Dallas, TX. (ERIC Reproduction Document Services No. ED 210 678).

Hayes, J. R., Hatch, J. A, & Silk, C. M. (1996). Experimental approaches to evaluating writing. Study 1: In search of writing ability: Exploring consistency of student performance on holistically scored writing tasks. Final Report. National Center for the Study of Writing and Literacy, Pittsburgh, PA. (ERIC Reproduction Document Services No. ED 397 424).

Ikegulu, T. N. (1997). Effectiveness of Mediated Instructional Strategies and Learning Styles in Muticulturally linguistic Environments: Implications for Developmental Educators. ERIC Clearinghouse and Journal of Resources in Education (ERIC Document Reproduction Service No. ED 409 757).

Ma, X. & Kishor, N. (1997). Assessing the relationship between attitude towards mathematics and achievement in mathematics: A meta-analysis. Journal for Research in Mathematics Education, 28(1), 26-47.

McKeachie, W. J., Pintrich, P. R., & Lin, Y. G. (1985). Learning to learn. In G. D'Ydwelle (Ed.). Cognition, information processing, and motivation. Amstadam: Elserver

Meyers, J. & Martin, R. (1974). Relationships of state and trait anxiety to concept-learning performance. Journal of. Journal of Educational Psychology, 66, 33-39.

Sarason, I. G. (1985). Test anxiety, worry, and cognitive interference. In R. Schwarzer (Ed.), Self-related cognitions in anxiety and motivation. Hillsdale, N. J.: Erlbaum.

Schultz, L. M. & Meyers, G. D. (1981). *Measuring writing apprehension in required freshman composition and upper-level writing courses*. Paper presented at the Annual Meeting of the Conference of College Composition and communication, Dallas, TX. (ERIC Reproduction Document Services No. ED 203 326)

Shrewsbury, M. B. (1995). The effects of collaborative learning on writing quality, writing apprehension, and writing attitude of college students in a developmental English program. *Dissertation Abstracts International.*

Stage, F. K. & Kloosterman, P. (1995). Gender, beliefs, and achievement in remedial college-level mathematics. Journal of Higher Education, 66, 294-311.

Tocci, C. M. & Engelhard, G. (1991). Achievement, parental support, and gender differences in attitude towards mathematics.

Journal of Educational Research, 84, 280-286.

Thompson, M. O. (1979). *Writing anxiety and freshman composition.* Paper presented at the Annual Meeting of the Northeastern Conference on English in the Two Year College, Pittsburgh, PA. (ERIC Reproduction Document Services No. ED 183 235)

Thompson, M. O. (1981). *The returning students: Writing anxiety and general anxiety.* Paper presented at the Northeast Regional Conference on English in the Two Year College, Baltimore, MD. (ERIC Reproduction Document Services No. ED 214 558).

Zyl, T. V. & Lohr, J. W. (1994). An audiotaped program for reduction of high school students' math anxiety. School Science and Mathematics, 94, 310-313.

Appendix

Mathematics Anxiety-Apprehension Survey (MAAS)

DIRECTIONS:
Below are a series of statements about mathematics. There are no **right** or **wrong** answers to these statements. Please think about each statement by itself and answer with the number of the response that truly **applies to you**, and not what you would like to be true. While some of these statements may seem repetitious, take your time, try to be as '**honest**' as possible, and indicate the degree to which each statement applies to you by circling (o) whether you:
[1] Strongly Agree, [2] Agree, [3] Uncertain or Unsure, [4] Disagree, or [5] Strongly Disagree.

1. I avoid mathematics courses	[1]	[2]	[3]	[4]	[5]
2. Taking a math test is a frightening experience for me	[1]	[2]	[3]	[4]	[5]
3. I do my math homework alone	[1]	[2]	[3]	[4]	[5]
4. My mind seems to go blank during math tests	[1]	[2]	[3]	[4]	[5]
5. I make low scores on my math assignments	[1]	[2]	[3]	[4]	[5]
6. I make low scores on most of my math tests	[1]	[2]	[3]	[4]	[5]
7. I am afraid to submit my math tests or assignments	[1]	[2]	[3]	[4]	[5]
8. Math formulas are difficult for me to remember during tests	[1]	[2]	[3]	[4]	[5]
9. I learn math by solving problems	[1]	[2]	[3]	[4]	[5]
10. I enjoy mathematics	[1]	[2]	[3]	[4]	[5]
11. I like seeing the steps I used to arrive at my solution	[1]	[2]	[3]	[4]	[5]
12. I am nervous about mathematics	[1]	[2]	[3]	[4]	[5]
13. I feel confident in my ability to solve math problems	[1]	[2]	[3]	[4]	[5]
14. I am no good at solving math problems	[1]	[2]	[3]	[4]	[5]
15. I have a special dislike for mathematics	[1]	[2]	[3]	[4]	[5]
16. I enjoy showing others how to solve math problems	[1]	[2]	[3]	[4]	[5]
17. I depend on my tutors for help in math	[1]	[2]	[3]	[4]	[5]
18. I don't want my math tests or assignments to be evaluated	[1]	[2]	[3]	[4]	[5]
19. Mathematics is an exciting course	[1]	[2]	[3]	[4]	[5]
20. Most of my courses are math related	[1]	[2]	[3]	[4]	[5]
21. I feel a lot of pressure taking a math course	[1]	[2]	[3]	[4]	[5]
22. I generally cram a lot of information before a math test	[1]	[2]	[3]	[4]	[5]
23. It is difficult for me to understand math instructions	[1]	[2]	[3]	[4]	[5]
24. Mathematics comes easy for me	[1]	[2]	[3]	[4]	[5]

25. Mathematics is a boring subject	[1]	[2]	[3]	[4]	[5]
26. I feel a lot of stress taking a math test	[1]	[2]	[3]	[4]	[5]
27. Mathematics is one of my favorite subjects	[1]	[2]	[3]	[4]	[5]
28. I am fond of mathematics logic	[1]	[2]	[3]	[4]	[5]
29. Learning and understanding math can be fun	[1]	[2]	[3]	[4]	[5]
30. I always do well on math exams	[1]	[2]	[3]	[4]	[5]
31.My peers seem to understand me better than the teacher	[1]	[2]	[3]	[4]	[5]
32. I blame myself for my poor performance in mathematics	[1]	[2]	[3]	[4]	[5]
33. It is difficult for me to grasp math concepts	[1]	[2]	[3]	[4]	[5]
34. I like answering math questions in class	[1]	[2]	[3]	[4]	[5]
35. I volunteer myself to solve math problems on the board	[1]	[2]	[3]	[4]	[5]
36. Mathematics is one of my worst subjects	[1]	[2]	[3]	[4]	[5]
37. Mathematics is a great challenge for me	[1]	[2]	[3]	[4]	[5]
38. It is a joy to transform word problems into math expressions	[1]	[2]	[3]	[4]	[5]
39. It takes me a while to solve a math problem	[1]	[2]	[3]	[4]	[5]
40. Doing workbook exercises help improve my math scores	[1]	[2]	[3]	[4]	[5]

SE062762

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
Educational Resources Information Center (ERIC)

ERIC®

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: An Empirical Development of An Instrument to Assess Mathematics Anxiety and Apprehension

Author(s): T. Nelson IKEGULU, Assistant Professor

Corporate Source: Department of Mathematics and Computer Science
College of Science and technology, P.O. Box 237
Grambling State University, Grambling, LA 71245-0237

Publication Date: December 1998

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic/optical media, and sold through the ERIC Document Reproduction Service (EDRS) or other ERIC vendors. Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following two options and sign at the bottom of the page.

[XX]

Check here
For Level 1 Release:
Permitting reproduction in microfiche (4" x 6" film) or other ERIC archival media (e.g., electronic or optical) *and* paper copy.

The sample sticker shown below will be affixed to all **Level 1** documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

Level 1

The sample sticker shown below will be affixed to all **Level 2** documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

Level 2

[ ]

Check here
For Level 2 Release:
Permitting reproduction in microfiche (4" x 6" film) or other ERIC archival media (e.g., electronic or optical), but *not* in paper copy.

Documents will be processed as indicated provided reproduction quality permits. If permission to reproduce is granted, but neither box is checked, documents will be processed at **Level 1**.

"I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic/optical media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries."

Sign here→ please

Signature: T. Nelson Ikegulu

Printed Name/Position/Title: T. Nelson IKEGULU, Assistant Prof.

Organization/Address: P. O. Box 237
Grambling, LA 71245-0237

Telephone: (318) 274-2244

FAX: (318) 274-6041

E-Mail Address: IKEGULUTN@GRAM.EDU

Date: 12/15/98

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, *or,* if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Not Applicable

Address:
Not Applicable

Price:
None

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Not Applicable

Address:
Not Applicable

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
1100 West Street, 2d Floor
Laurel, Maryland 20707-3598

Telephone: 301-497-4080
Toll Free: 800-799-3742
FAX: 301-953-0263
e-mail: ericfac@inet.ed.gov
WWW: http://ericfac.piccard.csc.com

Department of Mathematics and Computer Science
College of Science and Technology
P.O. Box 237
Grambling State University
Grambling, LA 71245-0237
December 15, 1998

Dr. Carla Kreppein, Administrative Associate
ERIC CLEARINGHOUSE ON HIGHER EDUCATION
One Dupont Circle, NW
Suite 630
Washington, DC. 20036-1183

Dear Dr. Kreppein:

RE: Manuscript for Publication in the ERIC

Enclosed find two (2) copies of my manuscript, **"An Empirical Development of an Instrument to Assess Mathematics Anxiety and Apprehension,"** for your review and publication in the next issue of ERIC.

I understand that ERIC operates on a 'blind review' principles and that all articles submitted to the editor are subject to review(s). In light of your quality publications and with the understanding that ERIC publishes articles and research works of significant interest and importance to the education community at-large, I hope this article meets your publication criteria. Please, feel free to communicate with me if I could be of further assistance to you and the readers of ERIC.

Thank you for your consideration and I look forward to hearing from you at your earliest convenience.

Sincerely,

T. Nelson Ikegulu

T. Nelson Ikegulu,
Assistant Professor