British Journal of Arts and Social Sciences
ISSN: 2046-9578, Vol.2 No.2 (2011)

http://www.bjournal.co.uk/BJASS.aspx

Development and Validation of the Mathematics Anxiety Scale for Secondary and Senior Secondary School Students

SADIA MAHMOOD
Department of Education, A.M.U., Aligarh
Mail: sadia.mahmood84@gmail.com
Mob: 08097662650

Dr. Tahira Khatoon
Department of Education, A.M.U., Aligarh
Mail: tahiratech@rediffmail.com
Mob: 09456033381

Abstract

The present paper aims at presenting the procedure of construction and standardization of operational measure of math anxiety scale (MAS). The final form of the test has 14 statements which is design to measure the math anxiety of secondary school and senior secondary school students. MAS as a bi- dimensional and shorter instrument in which 7 items are worded positively and 7 items worded negatively. It is a 5-point Likert type instrument that assesses positive and negative dimensions of math anxiety. MAS has split- half reliability of 0.89 and Cronbach's alpha 0.87. The content validity of the MAS was established along with the criterion validity.

Keywords: math anxiety, tryout, itemanalysis, reliability, validity.

Introduction

Math anxiety often leads to avoidance of math by those who experience it. Often students who are anxious, bored, and fearful towards math or who do not comprehend the importance of math in professional and personal life are the once most likely to avoid the study of math. It cannot be stressed more forcefully, the fact that math is truly the gateway to engineering, scientific, and technological fields. Math anxiety in students has become a concern for our Indian society. Evidence of student's poor attitude and high levels of anxiety toward math is abundant. In the midst of a technological era, declining mathematics scores in 'Scholastic Aptitude Test' as well as poor math scores had been published in the third 'International Mathematics and Science Study'. The other notable consequences of math anxiousness are the inability to do math, the decline in mathematics achievement, the avoidance of mathematics courses, the limitation in selecting college majors and future careers and the negative feelings of guilt and shame (Betz, 1978; Burton, 1979; Donady & Tobias, 1977; Hendel, 1980; Richardson & Suinn, 1972). Furthermore, individuals with math anxiety have shown to avoid environments and careers that require the utilisation of math skills (Ashcraft, 2002). Therefore, it can be inferred that math anxiety greatly impacts math education and students career choice. Hence, the professional and economic gains that will result from changing math anxiety into math confidence cannot be overstated. Not only that the psychological boost that comes with math achievements is also regarded as important for students and others alike (National Research Council, 1989)

Mathematics Anxiety Defined:

Math anxiety is more than a dislike towards math**.** Richardson and Suinn (1972**)** have defined mathematics anxiety is a feeling of tension and anxiety that interfere with the manipulation of mathematical problems in varied situations in ordinary as well as academic life. It can also be explained as a sense of discomfort observed while working on mathematical problems (Hadfield & Trujillo, 1999; Ma, 2003) and is associated with fear and apprehension to specific math related situations (D'Ailly & Bergering, 1992). Smith (1997) characterized math anxiety in a number of ways, including: (a) uneasiness when asked to perform mathematically (b) avoidance of math classes (c) feelings of physical illness, faintness, dread or panic (d) inability to perform on a test and (e) utilization of tutoring sessions that provide very little success. Miller (1981) concluded that math anxiety is directly related to perceptions of one's own mathematical skill in relation to skills in other subject areas.

History of Mathematics Anxiety Scale Development:

Interest in math anxiety started with the observations of the math teachers in the early 1950's. In 1957, Dreger and Aiken introduced math anxiety as a new term to describe student's attitudinal difficulties with math. They define it as the presence of syndrome of emotional reactions to arithmetic and mathematics. Notwithstanding difficulties in defining and measuring math anxiety (Wood, 1988), several attempts have been made to assess it. One of the first instruments developed was the Dutton Scale (Dutton, 1954; Dutton & Blum, 1968) measured feelings toward arithmetic. Unidimensional scales were developed by Gladstone, Deal and Drevdahl (1960) and Aiken and Dreger (1961). Dreger and Aiken (1957) have developed a Number Anxiety Scale for use with eight, ninth, and tenth grade students. Later, Aiken (1974) constructed

a scale designed to measure enjoyment of math and the value of math.

Richardson and Suinn (1972) developed the first comprehensive scale designed specifically to measure math anxiety and validated it first with adults. The Mathematics Anxiety Rating Scale (MARS) consists of a total of 98 items describing situations that could arouse math anxiety. Respondents indicate how much they are affected by the situation described by selecting one of the following options, not at all, a little, a fair amount, much and very much. Since both the shortened and original versions of the MARS were designed for college students, the Mathematics Anxiety Scale for Children (MASC) was developed by Chiu and Henry (1990).

Following the publication of MARS, several revisions were developed. For example, the Mathematics Anxiety Rating Scale for Adolescents (MARS-A) (Suinn & Edwards 1982) and the Mathematics Anxiety Rating Scale for Elementary school students (MARS-E) (Suinn, Taylor & Edwards, 1988) were developed. MARS-A consists of 98 questions with a 5-point Likert Scale. The Cronbach's alphas ranged from 0.89 to 0.96, but no validity information was clearly reported (Mc Morris 2004), and also second shortcoming of the instrument is that the proposed underlying construct of the MARS is unidimensional (Richardson & Suinn, 1972). MARS-E has 26 items with a 5-point Likert Scale and its Cronbach's alpha was 0.88. The two primary factors, Mathematics Test Anxiety and Mathematics Performance Adequacy Anxiety of MARS-E, however, accounted for less than 30% of the variance (Mc Morris, 2004). In his review of MARS, MARS-A and MARS-E, Mc Morris (2004) suggested that additional or revised measures need to be developed to improve the measurement of math anxiety.

The twelve item Fennema – Sherman Mathematics Anxiety Scale (MAS), initially designed for use with high school students, has subsequently been employed with adults (Fennema & Sherman 1976, Wikoff & Buchalter, 1986). This brief scale was intended to assess the feelings of anxiety, dread and nervousness associated with math. However, there was little research about the validity and reliability of the scale, which seriously hindered its use for research purposes (Rounds & Handel, 1980). Later Sandman (1980) designed the Mathematics Attitude Inventory (MAI) to measure attitudes toward math of secondary school students with 48 items. MAI reported six sub-scales measuring the constructs as (a) perception of the math teacher, (b) anxiety towards math (c) value of math in society (d) self concept in math (e) enjoyment of math and (f) motivation in math. The Cronbach's alphas for the six sub-scales ranged from 0.68 to 0.89, but no validity data where reported.

With the exception of MAI, the above mentioned math anxiety measures were all developed unidimensional by representation of negative effect consistent with anxiety. However, more recent studies have revealed that there may be more than one construct in math anxiety (Alexander & Martray 1989, Ferguson, 1986, Satake & Amato, 1995). However, Kazelskis (1988) have identified positive effects towards math as one of the six oblique factors in math anxiety: math test anxiety, numerical anxiety, negative effect towards math, worry, positive effect towards math and math course anxiety. Watson (1988) pointed out that positive effect reflected a degree of pleasure of interaction with the environment, where as negative effect reflected an adverse response to the involvement. Ling (1982) investigated the validity of math anxiety as a multidimensional construct and found six factors (personal effectiveness; assertiveness; math anxiety; outgoingness; success; and dogmatism) that accounted for 76% of the total variance. Bowd and Brady (2002) conducted principal components analysis followed by varimax

rotation on the result of 357 senior undergraduates in education and found three factors that accounted for 73% of the variability in the MARS scores. The three factors were as Mathematics Test Anxiety, Mathematics Course Anxiety and Numerical Task Anxiety.

Purpose of the Study:

In conclusion, of the all math anxiety measures listed above, the MARS (Richardson & Suinn, 1972) has consistently been the most frequently employed math anxiety measure in the literature. The MARS is a longer instrument having 98 items, 5-point, Likert-type instrument that assesses the levels of anxiety in situations involving numbers. There is a lack of shorter instruments in India to measure math anxiety of students. The above review of the existing math anxiety instruments clearly calls for a bi-dimensional measure that would capture both positive and negative effects of the latent construct of the math anxiety. In addition, for an instrument to have adequate measurement efficiency, its test length must be optimized with desirable psychometric quality. Therefore, the purpose of the present study is to develop a theoretically and methodologically sound bi-dimensional instrument of math anxiety with high psychometric qualities, specifically item total correlation, internal consistency, reliability and validity.

Procedure

As a first step towards the development of MAS, 50 statements positive and negative affect expressive of anxiety toward math, on a 5-point Likert scale were written after a careful study of related literature and discussion with several experienced math teachers, expert, parents' opinions. Question included in MAS were intended to identify the bi-dimensional effects, positive (e.g. liking, excitement, pleasant, comfortable) and negative (e.g. fear, dread, nervousness, worry) toward math. Experts were requested to judge the worth of each statement against the following criteria:

- The statement should be in simple and understandable language.
- The statement should be clear and unambiguous semantically so that it is interpreted uniformly by all respondents.
- The statement should not be double barreled; it should express one single idea or issue.
- The statement should be relevant i.e. there should be congruence between the statement and the definition of the concept of MAS as accepted in this study.

As the result of experts' comments some of the statements were modified and some omitted. The revised version of the initial MAS contained 25 statements on a 5-point Likert scale. Instructions to the subjects required them to respond to each of the item on 5-point scale, the response categories being 'Strongly Agree', 'Agree', 'Undecided', 'Disagree' and 'Strongly Disagree'. For construction of MAS scale, Likert technique was preferred to Thurston's technique because the former is simpler and less time consuming. Thurstonian approach lacks good indices of validity of items and requires weighting of responses on a prior basis and not on the basis of item analysis data. Several popular and widely used Mathematics Anxiety and Mathematics Attitude Scales have followed Likert's technique. Mathematics Anxiety Rating Scale (MARS) developed by Richardson and Suinn (1972) is a much utilized instrument for measuring math anxiety, used the method of Likert's technique, and Fennema-Sharman (1976) used

this same method in developing the math attitude scale, and it has become one of the most popular instruments used in research for more than three decades.

Try out

The initial form (25 items) of MAS was administered on 250 students, which included 130(52%) male and 120(48%) female students, randomly sampled from six secondary schools of Aligarh District. Approximately 60% of the sample was IX standard and about 40% X standard students. Nunnally (1970) recommends that the number of individuals for tryout of tests should be three to four times the number of items. Thus, the sample used for tryout of MAS was quite adequate. The ages of the sample ranged from 15-17 years. These schools from which sample were chosen belong to different categories of management and range from good to poor in regard to standard of performance of their pupils. Thus, the sample selected for tryout of the MAS constituted a cross-section of the secondary school students. The investigator was able to collect 100 percent forms duly filled in by making personal visit to each school.

Scoring

The response categories are on a 5-point Likert scale and the scheme of scoring response categories involved differential weighting such that the response category. 'Strongly Disagree', was given of weight 1, 'Disagree', a weight of 2,' Undecided'' a weight of 3, 'Agree', a weight of 4, and 'Strongly Agree', a weight of 5 for negative items and the positive effect items were reversed for scoring so that a high score indicates high anxiety.

Item analysis

An item analysis was done to determine the discriminating power of each item with the total test by using Pearson Product Moment Correlation techniques (Table 1). In addition, Cronbach alpha coefficient of the total scale after each item deleted is also reported. The aim was to make the MAS homogeneous by checking consistency of each item with the total test and discarding all such items as were found inconsistent. To achieve this end, scores on each item of the subjects were correlated with their total test scores. The items found to have a correlation of 0.35 or less with the total test were discarded. Such items were 11 in number. To remove the effect of the eliminated items scores of the subjects on them were deducted from their total score and item total correlation again computed in respect of the remaining 14 items. The reiterative procedure increased the original coefficient such that none of the 14 items were found to have a correlation of less than 0.50 with total test. It was considered sufficiently high size for retaining an item for the final form of the MAS. Out of 14 items, 11 had item total correlations above 0.50, and the highest being 0.69. This suggested that most of the items contributed to the total inventory and only three items had correlations 0.50 with total test. Cronbach alpha correlation of each item with total test was also calculated and given in table 1. High item total correlation indicates that all items measure consistency with the total scale, suggesting a strong item discrimination power. It is of interest to note that overall the positive items tend to have lower item total correlations (from 0.50 to 0.56 with a median of 0.52) than the negative effect items (from 0.56 to 0.69 with median of 0.63). The SD, mean of both dimensions and total test, and average of per item is given in table 2.

The instrument in its finished form consisted of 14 items of which 7 were worded positively and 7 worded negatively. Example of both positive and negative type items are (i) I find math interesting (ii) math is a headache for me. The math anxiety score is calculated by adding the individual scores of all the items together, where possible range can be between 14-70, the higher the score more anxiety of the students towards math. Correlations and Cronbach's alpha for each of the 14 items constituting MAS are reported in table 1.

Table 1: Item total correlation of the 14 items of the MAS

S. No	Statements	Dimension	Correlation Total Test	nbach's pha
1	Math makes me feel comfortable and easy.	Positive	0.55	0.86
2	Math is most dreaded subject for me.	Negative	0.69	0.85
3	I feel worried before entering the math class.	Negative	0.64	0.85
4	I find math interesting.	Positive	0.53	0.87
5	Math is one of my favorite subjects.	Positive	0.50	0.85
6	I am always afraid of math exams.	Negative	0.60	0.85
7	Solving math problems is always pleasant for me.	Positive	0.50	0.86
8	I feel nervous when I am about to do math homework	Negative	0.60	0.86
9	I feel happy and excited in a math class as compared to any other class.	Positive	0.55	0.86
10	I would prefer math as one of my subjects in higher studies.	Positive	0.56	0.86
11	Math is a headache for me.	Negative	0.56	0.85
12	I am afraid to ask questions in math class.	Negative	0.59	0.86
13	Math doesn't scare me at all	Positive	0.50	0.86
14	My mind goes blank when teacher asks math questions	Negative	0.65	0.85

Table 2: Mean, SD of both dimensions and total test

Dimensions	Items	Mean score	Average of per items	SD
Positive	7	16.46	2.37	7.12
Negative	7	17.64	2.49	8.36
Total	14	34.10	2.43	7.14

Reliability

Reliability of MAS was calculated by using the scores of 250 subjects on 14 items of the final form. A split-half reliability coefficient was found by correlating scores of the subjects on odd items of the test with their scores on even items. The correlation coefficient thus obtained was 0.81 which when corrected by Spearman Brown Profecy Formula increased to 0.90. Yet another method i.e. Cronbach's alpha coefficient accessing the internal consistency of the instrument for the total scale was found to be 0.87, indicating a high degree of internal consistency for group analysis, which is acceptable (Anastasi & Urbina, 1998). This result is much better than the 0.72 reported by Dew, Galassi and Galassi (1983) and also better than 0.86 to 0.90 reported by Hackett and Betz (1989) for the original MAS. This high internal consistency of MAS suggests that the 14 items, even though they were bi-dimensionally scaled, turned out to be an internally consistent measure of the math anxiety construct. In other words, it is an indication of the context to which respondents responses agree with one another. The higher the value of, the more reliable the test is, with regard to internal consistency. George and Mallery (2003) provide the following rule of thumb for the values of: > 0.9 excellent, > 0.8 good, > 0.7 acceptable, > 0.6 questionable, > 0.5 poor, < 0.5 unacceptable.

Validity

The method employed for establishing validity of the MAS was based on teachers' judgment method. The mathematics teachers of schools whose students had participated in this study were approached. They were asked to read carefully the descriptions of high anxiety as well as less anxiety behavior towards math, and identify those of the students of their respective schools whose anxiety behavior matched clearly with either of the two descriptions. In this way two groups of students, one having more anxiety behavior and the other less anxiety behaviors toward math were identified. The means of MAS scores of those two groups were compared to test the hypothesis that the mean of MAS scores of the group judged as more anxiety behavior towards math would be significantly higher than the mean of MAS scores of the group judged as less anxiety behavior. For this purpose t-test of the difference of the means of two independent, small sample was applied and the value of t calculated by using one-tailed test. The result of the comparison is contained in table 3

Table 3: Comparison of means of MAS scores of students judged as more and less anxiety behavior toward mathematics

Judged behavior	N	Mean MAS Score	t	P
More anxiety behavior	15	45.51	9.50	<0.01

Less anxiety behavior	15	32.45		

The validation procedure yielded a t-value of 14.50 which was found significant at the 0.01 level indicating, thereby, that the difference in the two means was significant and in the predicted direction. The concurrent validity of the instrument was also tested by comparing it with the Fennema-Sherman Attitude Scale (1976), and negative relationship was found (-0.41) which meant that students who had more favorable attitudes toward math experienced less math anxiety. This result shows that the MAS is a bi-dimensional and valid instrument to measure math anxiety with both positive and negative effects.

Usefulness

This tool has 14- items which cohere to produce a scale of Mathematics Anxiety Scale for use to know the anxiety of students towards math. It appears to be useful for teachers and research scholars. The students of education and psychology can also use it to study the development of anxiety toward math. The data, supporting the reliability, homogeneity, content validity and construct validity of this scale commend the instrument for further use. Further, studies are now needed in order to test the usefulness of this scale in specific research context. MAS seem to represent a promising measure of students' anxiety towards math. This tool will prove a valuable additions to psychometric units of Indian schools and universities and abroad also.

Final Form

The final form of the test has 14 statements which is design to measure the math anxiety of secondary school and senior secondary school students. MAS as a bi-dimensional and shorter instrument in which 7 items are worded positively and 7 items worded negatively, 5-point Likert type instrument that assess positive and negative dimensions of math anxiety. This tool produced two factors, the first representing concerns about doing well in math and second representing strong negative effective reactions to math. The range of scores was from 14-70 with 42 mean and high scores would indicate high math anxiety.MAS has split- half reliability of 0.89 and Cronbac's alpha 0.87.Math anxiety can be measured on this bi-dimensional scale with positive and negative affect items which will be more accurate to measure the math anxiety on sample of students with negative and positive affect. In other words, both high anxiety and low anxiety students can respond well to this bi-dimensional scale. There was no time limit but generally student took 20 minutes.

Some findings using this scale

This math anxiety scale was administered 1652 secondary school students, males 863 and females 789. Table- 3 shows a significant difference between math anxiety score of males and females ($df=1650$, $t=6.92$, $p<0.01$). More specifically, female students scored significantly higher ($M= 41.06$, $SD=11.81$) than males ($M=37.16$, $SD= 11.04$). Comparison of mean attitude score of different management types of school, table 4, shows that mean score varies on a continuum of high (govt. & govt. aided, 45.61 & 41.82

respectively) to low (Missionary and AMU, 33.77 & 35.61) with Hindu and Muslim managed schools sliding in between (40.65 & 39.8 respectively).

Table4: Comparison of Mean Anxiety Scores of Male and Female Students

Groups	N	Mean	SD	df	t-value	P
male	863	36.16	11.04			
female	786	40.16	11.81	1650	6.92	< 0.001

Table-5: Comparison of mean anxiety score of different management types of school

Management Type		N	Mean	SD	t-values				
					1	2	3	4	5
Govt.	1	138	44.61	9.86					
Govt. aided	2	432	40.82	11.28	3.53**				
Hindu	3	212	39.65	11.01	4.21**	1.25			
Muslim	4	3O9	38.18	11.33	5.77**	3.14**	1.48		
Missionary	5	236	34.61	10.30	9.19**	7.01**	5.00**	3.78**	
A.M.U	6	325	32.77	11.30	9.72**	6.97**	6.97**	6.02**	1.98*

*p<0.05, **p<0.001

References

[1] Aiken, L. R. (1974). Two scale of attitude toward mathematics. *Journal for Research in Mathematics Education*, 5, 67-71.

[2] Aiken, L. R., & Dreger, R. M. (1961). The effect of attitudes on performance in learning mathematics. *Journal of Educational Psychology*, 120(2), 224-237.

[3] Alexander, L., & Martray, C. (1989). The development of an abbreviated version of the Mathematics Anxiety Rating Scale. *Measurement and Evaluation in Counseling and Development*, 22, 143-150.

[4] Anastasi, A., & Urbina, S. (1998). *Psychological Testing*, 7th edition, Prentice-Hall International. Upper Saddle River, New Jercy

[5] Ashcraft, M. N. (2002). Math anxiety: Personal, educational and cognitive consequences. *Directions in Psychological Science*, 11, 181-185.

[6] Betz, N. E. (1978). Prevalence, distribution and correlates of math anxiety in college students, *Journal of Counseling Psychology*, 25, 441-448.

[7] Bowd, A. D., & Brady, P. H. (2002). Factorial structure of the Revised Mathematics Anxiety Rating Scale for undergraduate education majors. *Psychological Reports*, 91, 199–200.

[8] Burton, G. M. (1979). Getting comfortable with mathematics. *The Elementary School Journal*, 79, 129-135.

[9] Chiu, L. H., & Henry, L. L. (1990). Development and validation of the mathematics anxiety scale for children. *Measurement and Evaluation in Counseling and Development*, 23, 121-127.

[10] D'Ailly, H., & Bergering, A. J.(1992). Mathematics anxiety and mathematics avoidance behaviour: a validation study of two factor. *Educational and Psychological Measurement*, 52(2), 369-378. Retrieved April 10, 1999 from EBSCO database.
[11] Dew, K. M. H., Galassi, J. P., & Galassi, M. D. (1983). Mathematics anxiety: some basic issues. Journal of Counseling Psychology, 30, 443-446.
[12] Donady, B., & Tobias, S. (1977). Math anxiety. *Teacher*, 95(3), 71-74.
[13] Dreger, R. M., & Aiken, L. R. (1957). Identification of number anxiety. *Journal of Educational Psychology*, 47, 344-351
[14] Dutton, W. H. (1954). Measuring attitudes toward arithmetic. *Elementary School Journal*, 54, 24-31.
[15] Dutton, W. H., & Blum, M. P. (1968). The measurement of attitudes toward arithmetic with a likert-type test. *Elementary School Journal*, 68, 259-264.
[16] Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman mathematics attitude scale. Instruments designed to measure attitudes toward the learning of mathematics by males and females. *JAS Catalog of Selected Document of Psychology*, 6(31), Ms. No. 1225.
[17] Ferguson, R. D. (1986). Abstraction anxiety: A factor of mathematics anxiety. *Journal for Research in Mathematics Education*, 17(145), 145-150.
[18] George, D., & Mallery, P. (2003). *SPSS for windows step by step: A simple guide and reference 11.0 update* (4th ed). Boston, MA: Allyn and Bacon.
[19] Gladstone, R., Deal, R., & Drevdahl, J. E. (1960). Attitudes toward mathematics. In M. E. Shaw & J. M. Wright (1967). *Scales for the measurement of attitudes*. NY: Mc Graw Hill. 237-242.
[20] Hackett, G., & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. *Journal for Research in Mathematics Education*, 20, 261-273.
[21] Hadfield, O. D., & Trujillo, K. M. (1999). Tracing the roots of mathematics anxiety through in depth-interviews with preservice elementary teachers. *College Students Journal*, 33(2).
[22] Hendel, D. D. (1980). Experimental and affective correlations of math anxiety in adult women. *Psychology of Women Quarterly*, 5, 219-230.
[23] Kazelskis, R. (1998). Some dimensions of mathematics anxiety: A factor analysis across instruments. *Educational and Psychological Measurement*, 58, 623–63.
[24] Ling, J. L. (1982). A factor analytic study of mathematics anxiety. Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University.
[25] Ma, X. (2003). Effect of early acceleration of students in mathematics on attitude toward mathematics and mathematics anxiety. *Teachers College Record*, 105(3), 438-464.
[26] Mc Morris, R.F. (2004). Review of Mathematics anxiety rating scale, mental measurements. Year book (Accession No: 11080864), Fort Collins, Co: Rocky Mountain Behavioral Science Institute.
[27] Miller, S. F. (1991). A study of the relationship of mathematics anxiety to grade level. Gender intelligence, and mathematics achievement. *Proquest Dissertations and Theses*, 52(04) DAI (Publication No. AAT 9127651)
[28] National Research Council. (1989). *Everybody counts: A report to the nation on the future of mathematics education*. Washington, DC: National Academy Press.

[29] Nunnally, J. C. (1970). *Introduction to psychological measurement.* New York: Mc Graw Hill.
[30] Richardson, F. C., & Suinn, R. M. (1972). The mathematics anxiety rating scale: psychometric data. *Journal of Counseling Psychology*, 19, 551-554.
[31] Rounds, J. B., & Hendel, D. D. (1980). Measurement and dimensionality of mathematics anxiety. *Journal of Counseling Psychology*, 27, 138-149.
[32] Sandman, R. S. (1980). The mathematics attitude inventory: Instrument and user's manual. *Journal of Research in Mathematics Education*, 11(2), 148-149
[33] Smith, S. S. (1997). *Early Childhood Mathematics*. Boston: Allyn & Bacon.
[34] Suinn, R. M., & Edward, R. (1982). The measurement of mathematics anxiety. The Mathematics Anxiety Rating Scale for Adolescents-MARS-A. *Journal of Clinical Psychology*, 38(3), 576-580.
[35] Suinn, R., Taylor, S., & Edward, R. (1988). Suinn Mathematics Anxiety Rating Scale for elementary school students (MARS-E). Psychometric and normative data. *Educational and Psychological Measurement*, 48, 979-986.
[36] Watson, D. (1988). The vicissitudes of mood measurement: Effects of varying descriptors, time frames, and response formats on measures of positive and negative affect. *Journal of Personality and Social Psychology*, 55, 128-141.
[37] Wikoff, R. L., Buchalter, B. D. (1986). Factor analysis of four Fennema-Sherman mathematics attitude scales. *International Journal of Mathematical Education in Science and Technology*, 17 (6).
[38] Wood, E. F. (1988). Math anxiety and elementary teachers: What does the research tell us? *For the learning of Mathematics*, 8, 8-13.