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CONSTRUCTION AND STANDARDISATION OF MATHEMATICS ANXIETY SCALE FOR UPPER-PRIMARY SCHOOL STUDENTS

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ABSTRACT

This paper elucidates the process of construction and standardization of the mathematics anxiety scale for upper-primary school students (class8) for which the investigator has collected data from 110 students of upper-primary level from both Govt. and private schools of Nayagarh district, Odisha. It has three stages- pre-try, try out-1 and try out-2 where in the pre-try-out phase, the investigator kept 60 items with 5 dimensions, and after getting the experts opinion and pilot study, the investigator kept 42 items in tryout-1 and in tryout-2, 34 items were selected for final scale by applying t-test for item analysis. The face validity and content validity were tested and reliability was tested by Cronbach's alpha and which is 0.827 which was good in nature.

Keywords: Mathematics Anxiety, Upper-Primary Level, Dimensions, Reliability, Validity

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1. INTRODUCTION

One of the major aims of mathematics education is to the mathematization of a child's thought process (NCF, 2005) and it is possible if we will be able to reduce the student's anxiety towards the subject. Mathematics anxiety is one kind of anxiety that occurs in mathematics subject. It is the students feeling of fear towards mathematics that affect negatively the performance of the students and their minds in learning mathematics. Anxiety towards any subject does not occur due to the nature of that subject but there are so many reasons behind it. S. Mahmood (2011) said, "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 ones most likely to avoid the study of math". It is a state of nervousness and discomfort brought

upon by the presentation of mathematical problems and may impede mathematics performance irrespective of true ability (Aiken, 1970; Ashcraft, 2005; Ashcraft & Moore, 2009). As mathematics plays a vital role in school education, the fear of failure due to anxiety should be reduced as Hadfield and Trujilo stated "It can also be explained as a sense of discomfort observed while working on mathematical problems" (Hadfield & Trujillo, 1999; Ma, 2003).

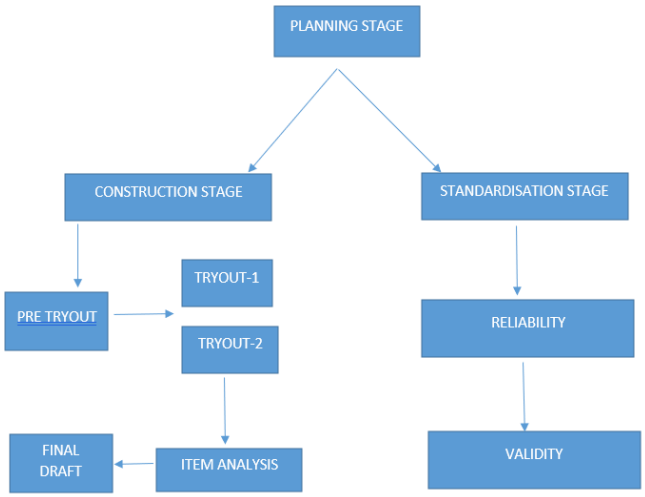
2. THE NEED FOR THE TOOL

There are many mathematics anxiety scale was developed for different levels of students- secondary and adult students also for primary level students, some of those studies are:

Nargis Abbasi and Shilpi Ghosh (2020) has constructed and standardised Examination Anxiety scale for Adolescent students on a large sample 2030 students of age group 13-15years from 19 schools at West Bengal. researcher has taken four dimensions namely Bodily symptoms, Cognitive, Emotional reaction and behavioural reaction. The validity of Examination Anxiety Scale is 0.71 and reliability coefficient was tested using test-retest, split half and Cronbach's alpha methods and found to be 0.801, 0.767, 0.764 respectively. Dominic Petronzi, et al. (2018) has validated further the children's mathematics anxiety scale UK (CMAS -UK) for ages 4-7 years by taking two schools where the researcher has developed 19 item scale and found to be high internal consistency with alpha value 0.88. Factor analysis was conducted to test each items and it has been found that the students who possess high anxiety towards mathematics have perform less well in mathematics. Caterina Primia et.al.(2014) intended to confirm the factor structure of the Abbreviated Math Anxiety Scale (AMAS) and to test the invariance of the scale across educational levels by taking 215 students where 52% were males between the ages 14-19. This scale measured two dimensions- Learning Math Anxiety and Math Evaluation Anxiety having 5 and 4 items respectively. The reliability and validity has been checked by Cronbach alpha test and it was found to be 0.86. S. Mahmood et.al. (2011) described the procedure of construction and standardisation of operational measure of math anxiety scale for secondary and senior secondary school students. A total 14 items were there where 7 positive and 7 negative items and scale was analysed by 5-point Likert scale. The reliability was found to be 0.89 while Cronbach's alpha value was 0.87. Derek R. Hopko et al. (2003) has constructed and abbreviated mathematics anxiety measure to examine its psychometric properties and assessed the generalizability of the model across a large sample of 1239. Researcher used Exploratory factor analysis for analysing the 9 items.

It has been found from the above studies that most of the studies were taken for primary and secondary level students. Now as upper-primary level which includes class 7 and class8 students is becomes a base for the secondary level, in this stage if the anxiety towards the mathematics can be measure then it will be not a big challenge for the students in secondary level. For this reason, this tool is needed to help in measuring the anxiety of upper-primary school students in mathematics.

3. BLUE PRINT OF THE CONSTRUCTION AND STANDARDIZATION STAGE:



4. PLANNING STAGE

In planning stage, researcher has decided about the sample with the techniques which will be adopted and discussed with supervisor to finalize the whole process. Here planning stage has divided into two parts namely construction stage and standardization stage. In construction phase there will be two try-out where tryout 1 and 2 with item analysis will be discussed and in standardization stage, both reliability and validity has been discussed.

Population and sample

All the class 8 students at upper-primary schools of Nayagarh district has been taken as the population and 110 students were taken as sample for the study.

Construction Stage

4.1. PRE TRYOUT

In this phase, investigator and supervisors are decided to keep 12 items each in 5 dimensions- Test anxiety, Classroom anxiety, Content anxiety, Assignment anxiety and Teacher anxiety. Each dimensions contains both equal number of positive and negative items. Investigator has kept in mind about the following rules during construction of items-

1) Each item should be clear and short.
2) Each item should not be ambiguous in nature.
3) Language of each item should be understandable by the students.
4) Each items should be stage specific that is for upper-primary level.
5) Each item should fulfill the objectives of dimensions.

Initially total 60 items were prepared in pre try-out stage, Likert scale was chosen with having five alternatives i.e. strongly agree, agree, undecided, disagree and strongly disagree weighting 5,4,3,2,1 respectively for positive items and for negative items 1,2,3,4,5 respectively. A total 15 experts from different disciplines- education, psychology, language, sociology, tribal study, mathematics etc. were decided for sending the constructed items for checking the content validity. The details of statement numbers with both positive and negative polarity has given below-

Table 4.1 (Dimension wise statements with positive and negative polarities)

Dimensions	Statement numbers with positive polarity	Statement numbers with negative polarity	Total number of statements	%
Test Anxiety	3,7,8,9,11,12	1,2,4,5,6,10	12	20
Classroom Anxiety	18,19,21,22,23,24	13,14,15,16,17,20	12	20
Content Anxiety	27,30,31,34,35,36	25,26,28,29,32,33	12	20
Assignment Anxiety	38,49,42,43,44,47	37,39,41,45,46,48	12	20
Teacher Anxiety	49,50,54,55,57,60	51,52,53,56.58,59	12	20
Total			60	100

4.2. TRY OUT1

In tryout1, out of 15 experts, investigator found 10 experts for their suggestions and opinions. Then the draft was administered on 110 class 8th students of Govt. and private upper-primary school of Nayagarh district, Odisha. According to the expert's opinions and from the pilot study report 18 items were dropped out. Remained 42 items for the next phase. The dimension wise items with positive and negative polarities has shown as below-

Table 4.2 After pilot study (On the basis of expert's opinion and ambiguous nature of the items)

Dimensions	Statement numbers with positive polarity	Statement numbers with negative polarity	Total number of statements	%
Test Anxiety	7,8,9,11	1,4,5,10	8	19.04
Classroom Anxiety	18,19,22,23	13,15,16,17,20	9	21.4
Content Anxiety	27,30,31,35,36	26,29,32,33	9	21.4
Assignment Anxiety	38,42,43,47	37,39,45,46	8	19.04
Teacher Anxiety	49,50,54,55	51,52,53,58	8	19.04
Total			42	100

4.3. TRYOUT2

In this phase, investigator has focused on scoring and item analysis part.

Scoring the answers:

After collecting the data, investigator has scored the data by using 5-point Likert scale. The options are strongly agree (SA), agree(A), undecided(UD), disagree(DA) and strongly disagree(SD). The scoring code for both positive and negative items are given below-

For positive items

Types of rating	SA	A	UD	DA	SD
Score	5	4	3	2	1

For negative items

Types of rating	SA	A	UD	DA	SD
Score	1	2	3	4	5

Item Analysis:

Item analysis is the statistical method which is used for selecting the valid items and discarding the invalid items from the scale. According to Lamark, "The procedure used to judge the quality of an item is called item analysis". The need of item analysis is for many reasons- selecting the required items and rejecting the weak items, each selected items should have representable the whole scale, it helps in determining the appropriate number of items required for the specific scale etc. [1].

Investigator has applied Kelly, the formula of top-bottom 27% where, all the scores were marked and arranged in descending order. Then upper 27% and lower 27% of the groups were taken to consideration. Then t-test applied in both the groups individually for each items. For computing the t value, investigator used following formula-

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

Where,

x1 is Mean of the upper group.

x2 is Mean of the lower group.

S1 is Standard Deviation of the upper group.

S2 is Standard Deviation of the lower group.

N1 is Total number of students in upper group.

N2 is Total number of students in lower group.

According to table value at 0.05 significance level, the items having t value less than 2.02 were rejected and those items having t value more than 2.02 were accepted for the final draft. The t value for each item has been calculated for total 42 items which is shown in following table.

Table 2.1 t values for each item showing rejection and acceptance of items.

Item number	Mean of higher group	Mean of lower group	SD of higher group	SD of lower group	t-value	Status of statements
1	4.366	2.266	0.999	1.142	7.636	Accepted
2	4.266	2.3	1.014	1.149	7.046	Accepted
3	4.666	2.333	0.660	1.295	8.904	Accepted
4	4.633	3.666	0.850	1.372	8.300	Accepted
5	4.8	3.766	0.484	1.304	4.136	Accepted
6	3.666	2.466	1.688	1.502	2.912	Accepted
7	4.333	2.2	1.028	1.399	6.75	Accepted
8	4.2	2.8	1.186	1.399	4.204	Accepted
9	4.4	2.766	1.132	1.546	4.708	Accepted
10	4.033	2.533	1.449	1.455	4.010	Accepted
11	4.033	2.766	1.586	1.524	3.167	Accepted
12	4.333	3.2	1.295	1.689	2.927	Accepted
13	4.666	3.6	0.802	1.499	3.461	Accepted
14	2,866	3.2	1.591	1.399	-0.865	Rejected
15	4.5	3.2	1.042	1.399	3.779	Accepted
16	4.5	3.566	0.861	1.135	3.648	Accepted
17	4.066	3.9	1.311	1.241	0.506	Rejected
18	4.833	2.733	0.746	1.484	6.976	Accepted
19	4.3	3.241	1.441	1.527	2.772	Accepted
20	4.9	2.3	0.305	1.342	10.4	Accepted
21	3.733	2.6	1.387	1.328	3.246	Accepted
22	4.466	4.1	0.860	1.322	1.279	Rejected

23	3	2.333	1.800	1.538	1.547	Rejected
24	4.566	2.466	0.773	1.279	7.777	Accepted
25	4.733	4.1	0.449	1.322	2.511	Accepted
26	4.433	3.4	1.404	1.404	3.258	Accepted
27	3.5	2.5	1.358	1.358	2.61	Accepted
28	3.2	2.8	1.562	1.562	1.033	Rejected
29	4.133	2.666	1.347	1.347	4.264	Accepted
30	3.866	2.833	1.547	1.440	2.690	Accepted
31	4.366	3.433	0.850	1.454	3.049	Accepted
32	3.366	2.966	1.586	1.751	0.930	Rejected
33	4.133	2.8	1.195	1.447	3.920	Accepted
34	3.566	3.633	1.546	1.564	-0.1675	Rejected
35	4.8	3.633	0.610	1.325	4.420	Accepted
36	3.4	3	1.522	1.508	1.028	Rejected
37	4.2	2.533	1.270	1.357	2.042	Accepted
38	3.266	2.366	1.760	1.449	2.168	Accepted
39	4.4	2.2	0.968	1.399	7.119	Accepted
40	4.533	2.933	0.899	1.507	5.047	Accepted
41	4.733	3.3	0.449	1.316	5.732	Accepted
42	4.266	2.7	1.284	1.263	4.774	Accepted

Final draft:

After computing the t value, investigator prepared the selected 34 items for the final draft, where out of 42 items, 8 items were rejected from the draft. The selected items with both positive and negative polarity has shown in the following table.

Dimensions	Statement numbers with positive polarity	Statement numbers with negative polarity	Total number of statements	%
Test Anxiety	4,5,6,8	1,2,3,7	8	23.529
Classroom Anxiety	13,16	9,10,11,12,15	7	20.588
Content Anxiety	19,21,25,26	18,20,24	7	20.588
Assignment Anxiety	30,31	27,29,33	5	14.705
Teacher Anxiety	35,40,41	37,39,38,42	7	20.588

Total	34	100

Standardisation stage:

To standardise any tool, two aspects i.e. reliability and validity should be established. Here investigator administered the tool on 110 sample of upper-primary school students.

1) Reliability

According to Stenbacka, (2001) reliability as "purpose of explaining" in quantitative approach and "generating understanding" in qualitative approach to research [4]. For checking the reliability and internal consistency of tool, Cronbach's alpha was calculated by using SPSS, version 25 and the alpha value was found to be 0.827 which is good in nature according to the Cronbach's alpha values. According to Taber (2018), the alpha value given below-

If alpha> 0.9	Excellent
If alpha>0.8	Good
If alpha>0.7	Acceptable
If alpha>0.6	Questionable
If alpha>0.5	Poor
If alpha<0.5	Unacceptable

2) Validity

Validity has been defined by "the extent to which [a test] measures what it claims to measure" (Gregory, 1992, p.117). According to Lakshmi et.al.(2013) "A measure is valid if it measures what it is supposed to measure, and does so cleanly – without accidentally including other factors" (Lakshmi S., 2013). Mathematics anxiety scale has face validity and according to the suggestions given by experts the content validity shows the tool used for this study has competence of the content validity.

5. IMPLICATION AND CONCLUSION

The purpose of the study was to construct and standardize the mathematics anxiety scale for upper-primary school students of Nayagarh district, Odisha. The tool was constructed with proper planning and proper consultation with experts with the appropriate dimensions required for the study. The tool was subjected to item analysis by t-test and through SPSS, version 25. Cronbach alpha test was applied for reliability and found to be 0.827 and the scale has both face and content validity. The constructed scale will helpful for measuring the mathematics anxiety of upper-primary school students in different schools.

This scale has been used for measuring the anxiety level of students of upper-primary school students especially class 8 students in Mathematics which helps in adopting the appropriate teaching method and will improve the learning outcomes of the students.

CONFLICT OF INTERESTS

None.

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None.

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