

Validation of Attitudes towards Mathematics Lab Tool among Secondary School Students

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Abstract:

In this study, the Mathematics Lab Attitude Scale consisting of 36 Items is developed for Secondary school students. Scale consisted of Six sub-dimensions such as Self-Efficacy and Mathematics Lab, Mathematics lab and Usefulness, Mathematics lab and teacher perception, Anxiety and Mathematics Lab, Enjoyment and Mathematics Lab and Mathematics lab and its knowledge. The statements of response are given with five levels of agreement. Reliability was established by Test-Retest method, Split Half Method and Cronbach's Alpha method. This scale shows that the mathematical attitudes of Secondary school students can be measured more accurately by using less mathematical attitude items.

Keywords: Attitude, Mathematics lab

➤ Introduction

Mathematics is a challenging and interesting subject. Mathematics teachers have the problem of learners' negative attitudes towards mathematics. Moreover, the declining interest in studying mathematics in university becomes more acute, generating a vicious circle (Holton, 2009). Several studies report different factors that lead to students' poor performance in mathematics. Tudy (2014) studied Filipino students, and discovered that only attitudes towards mathematics manifested significant influence to academic performance of the students. Students with a positive attitude towards the subject tend to perform well. Therefore, developing a positive attitude towards mathematics can improve the mathematics performance of students. In relation to this developing the mathematics lab attitude can be considered as one of the important aspect.

Attitudes are formed by beliefs, emotional reactions and behaviours intended for attitude object (Zan and Di Martino, 2007) and they determine what to think, what to feel and how to behave for an individual about the attitude object (Leder, 1992). The studies conducted show that positive correlations exist between attitude and achievement (Baykul, 1990), and attitudes towards mathematics Lab play an important role in describing the achievement in mathematics. It was established that a mathematically creative environment like the mathematics laboratory will

enhance the teaching and learning of mathematics in schools. (Felix O. Uwaezuoke And Gladys Charles-Ogan,2015). It is also recommended that mathematics teachers should explore the use of laboratory method in teaching various concepts in Junior Secondary School level (Ado, I. B,Nwosu, S, 2016). The need for Mathematics Laboratories in Primary and Secondary schools and it is recommended that adequate training through workshops be given to Mathematics teachers on the effective use of standard laboratory apparatus in the teaching and learning of Mathematics(Charles-Ogan, Gladys Ibibio, Otikor, Mark Sanderson ,2016)

➤ **Rational of the study**

The ideal platform for mathematicalcreativity and enhanced student-student and/or teacher-student collaboration is a mathematicslaboratory. The mathematics laboratory is aunique room or hall, with relevant and up-to-dateequipment and instructional materials,designated for the teaching and learning ofmathematics and other scientific work orresearch whereby professionally trainedpersonnel (teacher) interacts with learners onspecific sets of instructions. Put differently, it is aplace where students can learn and exploremathematical concepts and verify mathematicalfacts and theorems through a variety of activitiesusing different materials (Adenegan, 2014;Central Board for Secondary Education (CBSE),2014).A mathematics laboratory contributes tolearning in the following ways;

- It provides an opportunity for students tointernalize basic mathematics conceptsthrough concrete objects and situations.
- It enables the students to verify ordiscover several geometrical propertiesand facts using models or paper cuttingand folding techniques.
- It helps the students to build interest andconfidence in learning the subject.
- The laboratory provides opportunity toexhibit the relatedness of mathematicalconcepts with everyday life.
- It provides greater scope for individualparticipation in the process of learning and becoming autonomous learners,
- It provides scope for greater involvementof both the head and the hand whichfacilitates cognition.
- The laboratory allows and encouragesstudents to think, discuss with each otherand with the teacher, and assimilateconcepts in a more effective mannerIt encourages the teacher todemonstrate, explain and reinforceabstract mathematical ideas by usingconcrete objects, models, charts, graphs,pictures, posters etc (CBSE, 2014)

➤ **Statement of the Problem:**

"Validation of Attitudes towards Mathematics Lab Tool among Secondary School Students".

➤ Operational definition of key terms:

- **Attitude:** It is referred as the tendency to react favourable/ positive or unfavourable/negative towards use of mathematics laboratory in Secondary School Students. It is used to measure Self-Efficacy and Mathematics Lab, Mathematics lab and Usefulness, Mathematics lab and teacher perception, Anxiety and Mathematics Lab, Enjoyment and Mathematics Lab and Mathematics lab and its knowledge.
- **Mathematics Lab:** The Mathematics Laboratory is a room, rich in manipulative material, to which children have ready access to handle them, perform mathematical experiments, play mathematical games, solve mathematical puzzles and become involved in other activities through proper guidance of teacher.

➤ Objective of the Study:

- To find out the Attitudes towards Mathematics Lab Tool among Secondary School Students.

Procedure Followed for Developing Attitudes towards Mathematics Lab Scale

Step 1: Planning the test.

The Investigator made a through consultation of a wide variety of sources both men and material to gather information related to study habits. Based on this the investigator decided to construct the items for the scale in the following dimensions of Attitudes towards Mathematics Lab Scale, namely

- Self-Efficacy and Mathematics Lab
- Mathematics lab and Usefulness
- Mathematics lab and teacher perception,
- Anxiety and Mathematics Lab
- Enjoyment and Mathematics Lab
- Mathematics lab and its knowledge.

The construction of Attitudes towards Mathematics Lab Scale is for the age group of 14 to 18 years (Secondary and Higher Secondary). Further the investigator decided to construct statements of response are given with five levels of agreement such as follows:

Table 1: Scoring for Positive and Negative items for five levels of agreement.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Positive items	1	2	3	4	5

Negative items	5	4	3	2	1

Step 2: Preparation of the test writing and pooling of test items:

Investigator altogether constructed 48 items on Six dimensions of the Attitudes towards Mathematics Labas shown in the following:

Table 2: Various dimensions wise Study Attitudes towards Mathematics Lab items Constructed

Sl.no	Dimensions	Total number of questions
1	Self-Efficacy and Mathematics Lab	8
2	Mathematics lab and Usefulness	10
3	Mathematics lab and teacher perception	12
4	Anxiety and Mathematics Lab	13
5	Enjoyment and Mathematics Lab	10
6	Mathematics lab and its knowledge	8
Total number of questions		61

Step 3: Preliminary form of the test:

All these items were Pooled in an order and printed in the form of a 5-point response. This inventory was sent to Twenty (20) Research / Educational / Psychological Experts and requesting to opine about each item like its grammatical correctness, Structure of the statements, distracters, appropriateness of students. All the Experts working enough to scrutinize the inventory and returned back. By considering the suggestions made by those experts nearly 18(Eighteen) items out of 61 were dropped as they seen to be weak. Thus only 43 items were retained and considered for pilot study. The distribution of retained items of the test is as under.

Table 3: The dimensions of Attitudes towards Mathematics Lab items retained.

Sl.no	Dimensions	Number of items retained
1	<p>Self-Efficacy and Mathematics Lab</p> <p><i>Ex: I am able to solve mathematics problems without too much difficulty in Mathematics Lab.</i></p> <p><i>I am always under a terrible strain in a mathematics lab</i></p>	8

2	Mathematics lab and Usefulness <i>Ex: Mathematics lab is important to me in my life's work.</i> <i>Learning mathematics through Mathematics Lab can assist me to find an excellent career in the future.</i>	7
3	Mathematics lab and teacher perception <i>Ex: I am interested to learn in Mathematics Lab when my teacher praises me.</i> <i>I have a hard time getting teachers to talk seriously with me about Mathematics Lab</i>	6
4	Anxiety and Mathematics Lab <i>Ex: I feel worried that I will not be able to answer the test in Mathematics Lab</i> <i>I get nervous when taking a Mathematics Lab test</i>	8
5	Enjoyment and Mathematics Lab <i>Ex: Studying through Mathematics Lab is dull and boring</i> <i>I love solving mathematics problems in Mathematics Lab.</i>	6
6	Mathematics lab and its knowledge <i>Ex: I am sure that I can handle materials in Mathematics Lab</i> <i>I don't think I could do advanced math in Mathematics Lab</i>	6
Total number of items		43

Step - 4: Pilot Study:

a) Try out of the Test: The final draft thus prepared was tried out on a sample of 50 English medium students studying in secondary and higher secondary schools in Shimoga town. All 50 Inventories were collected back. Each Inventory was scored referring to the scoring key. Each dimension was scored separately and finally total score from all the five dimensions were considered for further analysis. After the pilot study, items not stable or consistent were modified or deleted.

b) Item Analysis: Cronbach Alpha is a measure of squared correlation between observed scores and true scores. A good analysis of test items should take the whole test into consideration.

Selection of Items:

It also had construct validity as items were selected having the Corrected Item-Total Correlation values more than 0.30 (If this correlation is weak de Vaus suggests anything less than .30 is a weak correlation for item-analysis purposes [de Vaus [2004], *Surveys in Social Research*, Routledge, p. 184]), Corrected Item-Total Correlation was found to be range from 0.392 to 0.891. Finally, the total 36 statements related to six areas of Attitudes towards Mathematics Lab have been indicated in the following table.

Table 4 : Distribution of Items over Six areas of Attitudes towards Mathematics Lab test

Sl.no	Dimensions	Number of items retained
1	Self-Efficacy and Mathematics Lab	6
2	Mathematics lab and Usefulness	6
3	Mathematics lab and teacher perception	6
4	Anxiety and Mathematics Lab	5
5	Enjoyment and Mathematics Lab	6
6	Mathematics lab and its knowledge	7
Total number of items		36

Table 4 shows that, finally 36 items were retained and had taken for further Evaluation process.

Establishing Reliability

Test-retest method:

The reliability co-efficient of the test was established by Test-rest method. The reliability co-efficient of the test was administered to a sample of One hundred students from secondary and another hundred students from senior secondary school. After two weeks interval it was re administrated to the same sample. The Co efficient of correlation between the two sets of scores on each dimensions of the Study habit inventory using Pearson's product moment correlation method and it was shown in the table no 3.6.

Split Half Method:

Reliability refers to the accuracy or internal consistency or internal stability of measurements by a test. In this study the co-efficient of internal consistency has been found by the split half method. The reliability co-efficient of the test was administered to a sample of two hundred students. The test administered only once. The group of the individuals and scores divided into two halves-one relating to odd numbered statements and the other to even numbered statements. The Co efficient

of correlation between the scores on the halves was correlated each dimension of the study habit inventory using by means of Spearman Brown Prophecy formula (Garrett, 1966, p.3393 and it was shown in the table no 3.6.

The group of the individuals and scores divided into two halves-one relating to First 50% of the statements (I halve)and the other to last 50% of the statements (II halve). The Co efficient of correlation between the scores on the halves was correlated each dimension of the study habit inventory using by means of Spearman Brown Prophecy formula and it was shown in the table no 4.

Cronbach's Alpha method:

The reliability test was found to be 0.890 for Self-Efficacy and Mathematics Lab, 0.863 for Mathematics lab and Usefulness, 0.855 for Mathematics lab and teacher perception, 0.834 for Anxiety and Mathematics Laband 0.840 for the Enjoyment and Mathematics Lab,0.865 for the Mathematics lab and its knowledge, 0.8585 for entire items by the use of Cronbach's alpha reliability formula.

Table 5 : Different methods of Reliability Coefficients (for six Components of Attitudes towards Mathematics Lab Scale)

	Test-Retest	Split half (Spearman -Brown Coefficient)		Cronbach's Alpha
		Odd and Even	I half and II half	
Self-Efficacy and Mathematics Lab	0.812	0.845	0.785	0.890
Mathematics lab and Usefulness	0.792	0.785	0.895	0.863
Mathematics lab and teacher perception	0.810	0.820	0.870	0.855
Anxiety and Mathematics Lab	0.789	0.890	0.860	0.834
Enjoyment and Mathematics Lab	0.830	0.875	0.872	0.840
Mathematics lab and its knowledge	0.860	0.840	0.864	0.865
Total	0.815	0.842	0.857	0.8585

Establishing Validity:

Content Validity:

The statements on the scale are all related to the area of study and each on independently focuses on what it claims to measure, this confirms the face validity of the scale. Generally, content validity is established via expert analysis relevant to the target construct. Content validity was established for the study habit inventory by attaching test booklets by giving 20 experts, which included Research Guides, Educational psychology experts and Senior Teacher Educators to decide the content validity of the test. The experts agreed that the statements in the study habit inventory are relevant and worthwhile for collecting the Data and considering the suggestions of the experts, some of the items and responses were modified and rewritten. The experts were satisfied with the relevance of the test items and the scoring procedures. Thus, the content validity of the tool was established. This implies that the Study habit inventory is comprehensive and relevant.

Scoring:

The inventory is a five-point scale. The items can be responded to by choosing from options: Always, Often, Rarely, Seldom and Never. The minimum score on the scale is 36 and the maximum score is 180. The scoring procedure for the positively and negatively keyed Statements is shown in the table number 4.

Table 4 : The scoring is as below for the positively and negatively keyed Statements.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Positive items	1	2	3	4	5
Negative items	5	4	3	2	1

Inventory of the total 36 statements, 26 are in positively keyed items and 10 statements are negatively keyed items. The lists of positively and negatively keyed statements serial numbers are shown in the table no 5

Table 5: Dimensions with positive and negative questions of Attitudes towards Mathematics Lab Scale

Sl no	Dimensions	Response	Item number	Total
1	Self-Efficacy and Mathematics Lab	Positive	1,25,29	6
		Negative	9,14,15	
2	Mathematics lab and Usefulness	Positive	2,12,13	6
		Negative	22,30,33	
3	Mathematics lab and teacher perception	Positive	3,17,26,27	6
		Negative	10,23	
4	Anxiety and Mathematics Lab	Positive	4,8,16,20,35	5
		Negative	0	
5	Enjoyment and Mathematics Lab	Positive	5,24,34,36	6
		Negative	19,32	
6	Mathematics lab and its knowledge	Positive	6,7,18,21,31	7
		Negative	11,28	
Total				36

Conclusion

This study has an influence on the initiation of using mathematics laboratory in teaching of mathematics at elementary level. The mathematics laboratory appeared to be a befitting platform for creating positive interdependence as compared to classroom. The traditional didactic methods of teaching do not facilitate learning by understanding nor providing opportunities to students to relate their knowledge. It is evident that Laboratory method of teaching significantly enhances students' creativity in mathematics. Students' attitude towards mathematics Lab significantly influenced mathematical creativity of students. In conclusion, it is evident that many researches on my math lab has shown its positive influence on teaching practices as well as improving student performance.

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