CONSTRUCTION AND VALIDATION OF MULTIPLE INTELLIGENCES INVENTORY FOR ELEMENTARY SCHOOL CHILDREN

Amitha. V[1] and Dr. A.H.M. Vijayalaxmi[2]
[1]Ph D Research Scholar, [2]Associate Professor,
Department of Human Development and Research Centre,
Smt. VHD Central Institute of Home Science (Autonomous), Seshadri Road, Bangalore, Karnataka

ABSTRACT: Multiple Intelligences theory is a practical approach that is utilized in the educational system to impart education effectively. The theory helps the educators to understand and motivate the pupils of diverse intellectual abilities to learn; creates an interactive classroom with a positive teacher-student relationship with increasing academic achievement of students and also reduces inappropriate classroom behavior. Gardner (1983) stated that "intelligence exists in a number of sensory modalities (styles and abilities), rather than as a single ability." The present study was envisaged to develop a valid and reliable scale to assess the Multiple Intelligences of students. The items were pooled in from various sources and were subjected to statistical procedures of face validity, content validity, construct validity, factor analysis, and reliability and internal consistency. After subjecting to these processes, the final version of the Multiple Intelligences Inventory (MII) consisted of 80 items. This questionnaire was then administered to 400 students to test the reliability and validity, and the tool has emerged as a good reliable and valid scale.

Keywords: Multiple Intelligences, students, intellectual abilities

I. INTRODUCTION

Contemporary educators are facing with the challenge to comprehend and teach the students with diverse intellectual abilities in the classroom. One-fit-for-all-sizes concept has continuously been being employed in the classrooms in most of the schools in India, but it has not gained much effect among the students. In the present scenario, classrooms require an innovative teaching-learning approach. In the developing country like India, the educational system is advancing in creating various educational aids to upgrade the teaching methods in the schools. However, the real question among the educators is, '*how best it can be utilized to meet the needs and face academic challenges among the pupils'?*

VanSciver (2005) stated, "Teachers are now dealing with a level of academic diversity in their classrooms unheard of just a decade ago." In a classroom of students with different intelligences may range from a child being good in mathematical skills to a child being good in drawing or a combination of both. It has been noted that *'no individual is alike and not everyone can learn the same way.'* In such a case, teachers must find ways to understand the hidden abilities of the students, while also accommodating the educational needs of them in the class. Therefore, teaching students with a wide range of aptitudes might make it easier if their intelligences are identified. It requires educators to adopt the modern methods of identifying the intelligences. Dr. Howard Gardner (1983) stated, *'it's not how smart you are, it's how you are smart'!*

Multiple Intelligences theory developed by Gardner (1983) is one such approach that can cater to the educational needs of every child in the classroom and help the teachers in recognizing their diverse intellectual profiles. The Theory of Multiple Intelligence, a brainchild of Dr. Howard Gardner (1983), states that "intelligence exists in a number of sensory modalities (styles and abilities), rather than as a single ability." The theory included eight "modalities" identified as Verbal/Linguistic Intelligence, Logical/Mathematical Intelligence, Musical/Rhythmic Intelligence, Bodily/Kinesthetic Intelligence, Visual/Spatial Intelligence, Intrapersonal Intelligence, Interpersonal Intelligence, and Naturalistic Intelligence.

In view of the above discussion, research was undertaken to construct and validate an inventory to assess Multiple Intelligences of elementary school children.

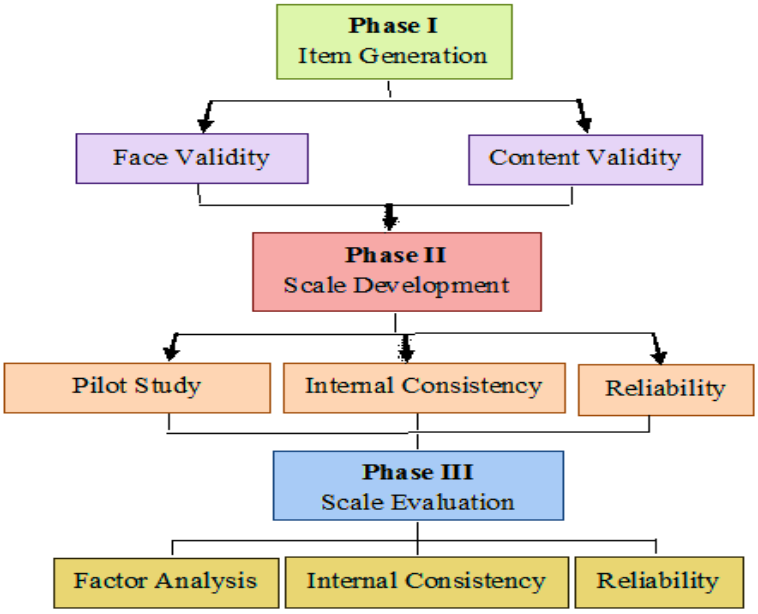
II. MATERIALS AND METHODS

A. Sample

The study sample consisted of 400 children studying in VI standard of various schools located in Bangalore city. The sample for the present study was selected through cluster sampling technique.

B. Procedure

The steps followed to validate the Multiple Intelligences Inventory for elementary school children are depicted in the flowchart presented below:



III. RESULTS AND DISCUSSION

A. Phase I: Item Generation

The first step scale development process begins with the creation of items to assess a construct under examination. It is commonly referred to as "item generation," the researcher provides theoretical support for the initial item pool (Hutz et al. 2015). Methods for the initial item generation can be classified as deductive, inductive, or a combination of the two. A pool of items was generated using the deductive item development approach (Hinkin, 1998). The deductive approach uses an existing theoretical foundation to create a definition, and the definition is then used to guide item generation.

The investigator is concerned with a variety of parameters that regulate the setting of each item and the scale as a whole. For example, suitable scale instructions, an appropriate number of items, adequate display format, appropriate item redaction (all items should be simple, clear, specific, ensure the variability of response, remain unbiased), among other parameters (DeVellis 2003; Pasquali 2010).

Some basic guidelines should be followed to ensure that the items are correctly constructed. Some of the most important and often overlooked practices are presented. Items should address only a single issue; "double-barrelled" items may represent two constructs and result in confusion on the part of the respondents. Statements should be simple and as short as possible and the language used should be familiar to target respondents. Items must be understood by the respondent as intended by the researcher if meaningful responses are to be obtained (Hinkin et al., 1997).

The items for the present scale have been generated based on the above guidelines. The initial pool of items for the Multiple Intelligences detailed inventory was generated through an extensive review of Multiple Intelligences

literature; Karnataka State Board Sixth Standard Text Books; children aptitude test instruments; books and magazines related to children; British Council library, Chennai. After reviewing, the investigator identified, adapted and compiled a total of 216 activities/statements based on a binary scale.

Table 1: Items selected from various sources for face validity

Source	No. of Items	Percentage
Multiple Intelligences Literature	40	18.52
Karnataka State Board Sixth Standard Text Books	50	23.14
Aptitude Test Instruments	35	16.20
Books and Magazines	45	20.84
British Council Library	46	21.30
Total	**216**	**100**

1. ***Face Validity:*** Face validity merely is whether the test appears (at face value) to measure what it claims. Tests wherein the purpose is clear, even to naïve respondents, are said to have high face validity. Accordingly, tests wherein the purpose is unclear have low face validity (Nevo, 1985). It evaluates the appearance of the questionnaire regarding feasibility, readability, consistency of style and formatting, and the clarity of the language used (Haladyna 1999; Trochim 2001; DeVon et al. 2007). Thus, face validity is a form of usability rather than reliability. After pooling in the items, the investigator subjected them to face validity. In this stage the items were checked for the operationalization and whether on its surface meets the criteria for a good version of the tool. Further, the number of items was reduced to 95.

2. ***Content Validity:*** Content validity uses a more formal, statistics-based approach, usually with experts in the field. The experts judge the questions on how well they cover the material (Stephanie, 2015). Content validity addresses the issue of whether all facets of the construct of interest are being measured (Robertson, 2017). Content validity indicates whether the content reflects a complete range of the attributes under study and is usually undertaken by seven or more experts (Polit & Hungler 1999; DeVon et al. 2007).

After face validity, the remaining 95 items were subjected to content validity. The researcher identified ten experts from the different fields viz: Human Development, Psychology, Multiple Intelligences, Education and School Teachers to scrutinize the items on its relevance and rate them on a scale of 10, 10 being highly relevant and 1 being least relevant.

The result obtained from the content analysis was quantified, and 80 items were secured which was over 8 rating indicating good content validity of the measure.

Table 2: Content validity by ten subject experts for developing an MII

DESCRIPTION	NUMBER OF ITEMS	PERCENTAGE
Number of items screened at face validity	216	100.0
Number of items evaluated by experts	95	43.98
Number of items retained	80	37.0
Number of items considered for the pilot study	80	37.0

B. Scale Development

1. ***Pilot study:*** a pilot study is a mini-version of a full-scale study or a trial run done in preparation of the complete study. The latter is also called a 'feasibility' study. It can also be a specific pre-testing of research instruments, including questionnaires or interview schedules. (Polit, et al., 1999). The pilot study thus follows after the researcher has a clear vision of the research topic and questions, the techniques and methods, which

is applied, and what the research schedule will look. It is trying out all research techniques and methods, which the investigator has in mind to see how well they will work in practice. Hence a pilot study was conducted to examine the reliability of the proposed Multiple Intelligences Inventory tool.

When estimating the sample size for the pilot trial, Connelly (2008), discusses that extant literature suggests that a pilot study sample should be 10% of the sample projected for the larger parent study. Isaac and Michael (1995) suggested 10 – 30 participants; Hill (1998) suggested 10 to 30 participants for pilots in survey research; Treece and Treece (1982) suggested 10% of the project sample size. For the present study, a sample of 40 elementary children studying in the sixth standard in Bangalore city was selected for conducting the pilot study. The data obtained was subjected to statistical analysis to check reliability and internal consistency.

2. ***Reliability:*** Reliability is an important concept in research as it is used for enhancing the accuracy of the assessment and evaluation of research work (Tavakol and Dennick, 2011, p.53). It refers to the consistency, stability, and repeatability of results, i.e. the result of a researcher is considered reliable if consistent results have been obtained in identical situations but different circumstances (Twycross and Shields, 2004).
For the present study, Spearman-Brown Spilt –half and Guttman Spilt –half coefficient method was used to assess the reliability of the instrument. The MII tool obtained 0.846 on Spearman-Brown and 0.733 Gutman Spilt –half co-efficient indicating good reliability of the scale.

3. ***Internal Consistency:*** Internal consistency refers to the general agreement between multiple items that make-up a composite score of a survey measurement of a given construct. If the internal consistency is high, that shows the measure of the construct is reliable. However, if an item is poorly worded or does not belong in there at all, the internal consistency of the scale could be threatened. Internal consistency is typically measured using Cronbach's Alpha (α). Cronbach's Alpha ranges from 0 to 1, with higher values indicating greater internal consistency (and ultimately reliability) (Taylor, 2013). The internal consistency of the MII scale was assessed through Cronbach's alpha coefficient. The scale obtained Cronbach`s Alpha of 0.842 indicating good Internal consistency.

C. Scale Evaluation

After assessing the reliability and internal consistency based on Pilot study results, was administered to a larger sample. Again, the scale was evaluated through factor analysis, reliability and internal consistency based on the results obtained from large scale study.

1. ***Factor Analysis:*** Factor Analysis is an exploratory technique applied to a set of observed variables that seeks to find underlying factors (subsets of variables) from which the observed variables were generated. Factor analysis is carried out on the correlation matrix of the observed variables (NCSS Statistical Software).

The exploratory factor analysis was conducted for 80 items using SPSS 18.0. A Principal Component Analysis of 80 binary scale statements from Multiple Intelligences Inventory was conducted on data gathered from 400 participants. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy was conducted.

Kaiser-Meyer-Olkin (KMO) the test measures sampling adequacy and indicates the proportion of variance among variables that might be caused by underlying factors. The lower the proportion, the more suited the data is to Factor Analysis. KMO returns values between 0 and 1. KMO values between 0.8 and 1 indicate the sampling is adequate. KMO values less than 0.6 indicate the sampling is not adequate and that remedial action should be taken. KMO values close to zero means that there are substantial partial correlations compared to the sum of correlations. An examination of Kaiser-Meyer-Olkin (KMO) suggested (Ref table 3) that the sample was factorable (KMO = 0.673).

Bartlett's test by Bartlett (1937) presents a test of homogeneity (equal variance). It is accomplished using the structure of a hypothesis test. Setting up the null and alternative hypothesis, calculating test statistic and comparing to a critical value to conclude. Small values (less than 0.05) of the significance level indicate that a

factor analysis may be useful for the data. Bartlett's test of sphericity for MII suggested significant at 0.000 level of significance (Ref table 3). Hence Factor Analysis is considered as an appropriate technique for further analysis of the data.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.673
Bartlett's Test of Sphericity	Approx. Chi-Square	8235.745
	Degrees of Freedom	3160
	Significance	0.000

2. Internal Consistency and Reliability

The MII tool was administered to 400 samples of elementary school children studying in VI standard. It was again checked for its reliability, and internal consistency and the results are presented in table 5.

Table 5: Internal Consistency and Reliability

	No. of Items	**Cronbach's Alpha**	**Spearman-Brown Coefficient**	**Guttman Split-Half Coefficient**
Part I	40[a]	0.704	0.639	0.638
Part II	40[b]	0.729	0.639	
Total	80			

IV. CONCLUSION

The above results reveal that the Multiple Intelligences Inventory tool consists of 80 items distributed under eighty factors with good reliability and validity. This indicates that the MII tool has emerged as a reliable and valid tool for assessing Multiple Intelligences of elementary school children.

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