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Development, Item Analysis, And Standardization Of University Postgraduate Students' Cognitive Ability Test

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Abstract: The present research study was conducted for the development, item analysis, and standardization of university postgraduate students' cognitive ability. A simple random sampling procedure was followed to select 1110 students from different universities. It consisted of male as well as female university postgraduate students. The objective of the study was achieved in the form of a reliable and valid test intended to provide an insight into those methodologies that can help us measure and restructure human aptitude to enhance cognitive ability among students by filling the gaps, to produce successful and efficient students. The reliability was calculated via the Cronbach alpha method. The main objective of the study was to develop test items by determining the difficulty, discrimination index & reliability. The test would help in the identification, measurement, and analysis of core cognitive ability factors that determine success in teaching.

Keywords: Development and Standardization, Cognitive Ability, Reliability, Validity, Discrimination Index.

INTRODUCTION

Cognitive ability is defined as a general mental capability involving reasoning, problem-solving, planning, abstract thinking, complex idea comprehension, and learning from experience. Also called cognitive functions, cognitive abilities or cognitive capacities, are brain-based skills that are needed in the acquisition of knowledge, manipulation of information, and reasoning. They have more to do with the mechanisms of how people learn, remember, solve problems and pay attention, rather than with actual knowledge.

In this study cognitive ability refers to seven dimensions viz. numerical reasoning, verbal reasoning, abstract reasoning, logical reasoning, non-verbal reasoning, and spatial reasoning. Cognitive ability tests are often used as repeated measures in longitudinal studies although there is an inherent limitation in serial tests, which is called the practice effect (Kaufman, 1990; Temkin et al., 1999). For example, in numerous clinical settings, serial cognitive tests are administered to investigate the effect of treatments on changes of cognitive abilities (Cerulla et al., 2019; Elman et al., 2018; D. M. Jacobs et al., 2017) and to make decisions on disease progress or recovery (Beglinger et al., 2005).

REVIEW OF LITERATURE

Improvement in the goals for knowledge, coupled with shifts in curriculum importance and a deeper empathetic of teacher learning and student thinking, has led to new outcomes about the impact of student development and how best to sharpen students' skills and knowledge. Student quality is the most important university factor for improving student cognitive ability. Researchers have found that variation in student achievement

is explained more by variation in teacher quality than variation in any other university characteristics (Rivkin, Hanushek, &Kain 2005; Rockoff 2004). Although some research has demonstrated that achievement is higher for students with teachers that have the higher cognitive ability, as measured by their presentation on the Praxis or other consistent licensure tests (Goldhaber 2007; Clotfelter, Ladd, &Vigdor 2006), other work finds no relationship between teacher cognitive ability and student achievement (Buddin & Zamarro 2009).

Duckworth, Quinn, and Selgiman (2009) stated that expressive suggestions that some teachers non-cognitive abilities (e.g., grit and life satisfaction) are positively correlated with student gains in cognitive ability. The fostering of these skills is hypothesized to explain the higher levels of educational attainment among Catholic school students, even those from disadvantaged backgrounds (Altonji et al; 2005; Coleman & Hoffer 1987; Evans & Schwab 1995; Grogger& Neal 2000; Neal 1997; Sander &Krautman 1995; Sander 2001). The results, especially those concerning non-test score consequences, are consistent with the research on cognitive skills and their role in strength, crime, and achievement outcomes (Almlund, et al. 2011; Heckman et al. 2006; Heckman & Rubinstein 2001).

MATERIAL AND METHODS

The test consists of 35 objective test questions and is time-bound for 20 minutes which is to be taken by the university postgraduate students. The descriptive survey method was used in the present study. A simple random sampling procedure was followed to select subjects from different universities.

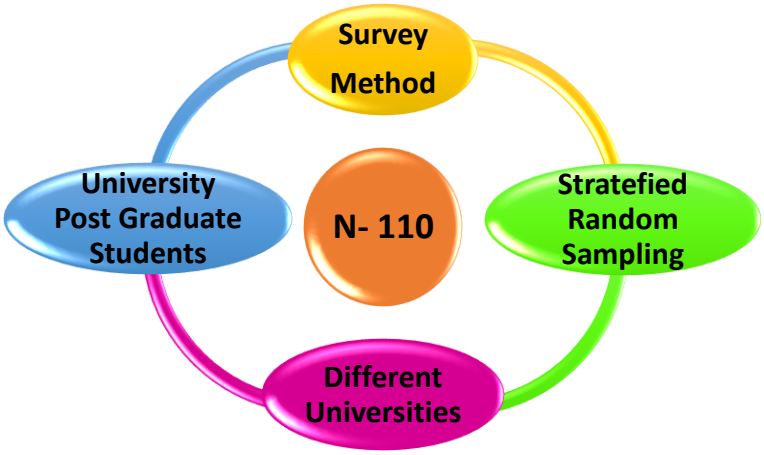

Fig:1 Subjects consisted of sample, method, technique, as well as different universities as illustrated.

PILOT STUDY

The cognitive ability tool was developed by the investigator of university post graduate students. It contains 35 items. Maximum value: 175, Minimum value: 0. Cognitive ability refers to seven dimensions viz. numerical reasoning, verbal reasoning, abstract reasoning, logical reasoning, non-verbal reasoning, spatial reasoning. The estimated reliability of the scale in the present study is high (Cronbach's alpha 0.779).

Numerical reasoning	**Independent variables** (Cognitive Ability)
Verbal reasoning	
Abstract reasoning	
Logical reasoning	

Non-verbal reasoning	
Spatial reasoning	

The validated questionnaire was administrated to 1110 university post graduate students and the data have been collected. The student responses and their reactions while administering the tool were considered for improving the tool and based on the student's opinions, hence few changes to the questionnaire were made.

Procedure and Administration of the test

The test consisted of 40 items. Rapport building was followed by giving the in-length instructions to the subjects. The specific time in which children were required to complete the test was allotted and a stopwatch was used for the purpose. The required material, i.e., Photocopies of test items, paper, pencil, etc. was provided. The test administration procedure was similar for all the students. Tests were marked using a standard procedure in which a score of one was given for each item passed. Thus a total of 40 marks were assigned for each test. Standardization implies regularity of procedures in administrating and scoring the test. If the scores gained by different persons are to be comparable, testing conditions must obviously be the same for all.

The formulation of instructions is a major part of the standardization of a new test. Such standardization extends to the exact materials employed, time limits, oral instructions, primary demonstrations, way of behavior inquiries from test takers, and every other detail of the testing situation. Another significant step in the standardization of a test is the establishment of norms. As its name implies, a norm is a normal or average performance. In the process of standardization, a test is administrated to a large, representative sample of the type of persons for whom it is considered. To estimate and ensure validity, in both cases, i.e., Cronbach alpha scores, the validity was estimated. The reliability was estimated by calculating the reliability correlation coefficient. The Cronbach alpha method was used to estimate the reliability of the test.

DATA ANALYSIS

After collecting the data, it was arranged in tabular form and following mention statistical techniques used for items.

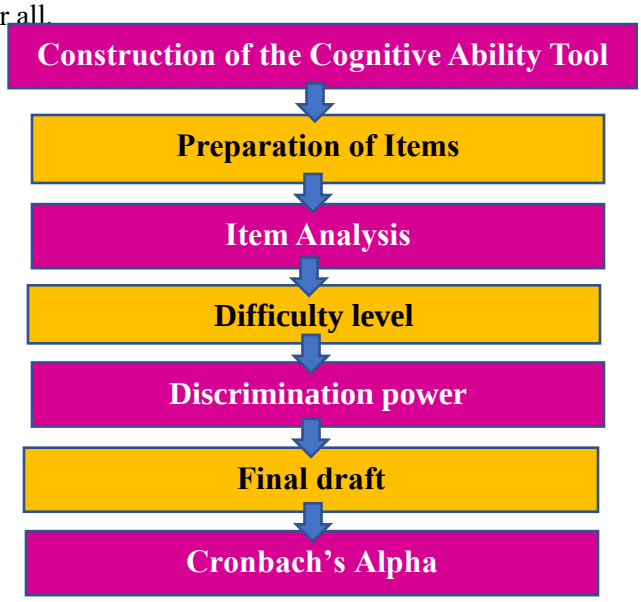

Fig:2 Item Analysis Methods

ITEM ANALYSIS

The cognitive ability scale was constructed in accordance with established measures. In order to test the internal reliability of the cognitive ability scale, a reliability analysis was run. The internal consistency was measured based on an average inter-item correlation. Total inter-item-correlations were used to identify items which were poor discriminators so they could be eliminated. To begin with, all items with negative correlation values were deleted. Then the items that had a correlation coefficient between 0.03 and 0.07 were selected for further analysis. The items that had inter-item correlations of less than 0.30 were deleted items and more than 0.70 were selected items. For the item analysis, the investigator collected data for a sample of 1110 response sheets.

Construction of the Cognitive Ability Tool

Due to the unavailability of the tool to measure the cognitive ability of university postgraduate students. It was necessary to develop a tool to measure cognitive ability.

Preparation of Items

The researcher has adopted multiple-choice items because these items are regarded as the most valuable and most generally applicable to all test forms.

Multiple choice items have wide application in the measurement of various phases of cognitive ability. Multiple choice items are free from many of the limitations of other forms of objective items.

Item Analysis

Item analysis was concerned with the problem of selecting items for the final form of the questionnaire, so that the questionnaire may have certain specified characteristics.

a) Difficulty level
b) Discrimination power

Difficulty Level

After the test was scored, according to the total score values, individuals were placed in order, from a higher level to a lower level. The correct responses were calculated and the total responses of each item were calculated. The difficulty level is computed for each item in the test using the following formula.

Difficulty level = R = Correct Response of the sample, N = Total Response of the sample

Table -1 Table Showing the Difficulty Level – Cognitive Ability

Items	1	2	3	4	5	6
DL	0.623	0.647	0.569	0.515	0.472	0.491
Items	**7***	8	9	10	11	12
DL	0.325	0.736	0.467	0.589	0.480	0.489
Items	13	14	15	16	**17***	18
DL	0.545	0.373	0.632	0.681	0.324	0.665
Items	19	20	**21***	22	23	24
DL	0.379	0.435	0.340	0.591	0.635	0.488
Items	25	26	27	**28***	29	30
DL	0.637	0.730	0.439	0.343	0.680	0.525
Items	31	32	33	34	35	36
DL	0.546	0.570	0.689	0.592	0.647	0.614
Items	**37***	38	39	40		

DL	0.318	0.562	0.687	0.552		

*Rejected items.

The item with the value of 0.3 to 0.7 was accepted. The item number 7,17,21,28 and 37 has been rejected items, since remaining the items has very moderate or high values.

Item Discrimination Power

After the test was scored, according to the total score values, individuals were placed in order from a higher level to a lower level. The top 27% constituted the higher achievers and the bottom 27% constitutes the low achieving group. The discrimination power was computed for each item of the test using the following formula,

Discrimination Power × 100

R_U= the number of pupils in the upper group who got the item right.

R_L = the number of pupils in the lower group who got the item right.

N = One half of the total number of pupils included in the item analysis.

Table – 2 Table Showing Discrimination Power - Cognitive Ability

Items	1	2	3	4	5	6
DP	45.46	54.52	64.63	72.71	54.54	54.55
Items	**7***	8	9	10	11	12
DP	27.28	63.65	45.45	63.64	54.55	45.45
Items	13	14	15	81.82	**17***	18
DP	81.82	54.55	72.73	45.45	27.28	45.45
Items	19	20	**21***	22	23	24
DP	45.45	72.73	27.28	54.55	72.73	63.64
Items	25	26	27	**28***	29	30
DP	45.45	63.64	45.45	27.28	72.73	45.45
Items	31	32	33	34	35	36
DP	72.73	54.55	81.82	72.73	63.64	45.45
Items	**37***	38	39	40		
DP	27.28	72.73	72.73	63.64		

*Rejected items.

If the value of item was found above 40%, then it was good and accepted. The item number 7,17,21,28 and 37 has been rejected items from the tool, since the remaining items has moderate/high values.

Final draft

Table – 3 Table Showing the Reliability Value of Cognitive Ability

Tool	**Statements**	**Formula**	**Reliability Value**
Cognitive Ability	35	Cronbach's Alpha	0.779

The final draft of the test is printed under the title cognitive ability tool. Reliability of the test was 0.779.

CONCLUSION

In the study came out with significant results as the correlation coefficient was found to be significantly high observing the high reliability and validity of the test. It was notified that there are many factors along with ability that have a great impact on the individual. These factors like numerical reasoning, verbal reasoning, abstract reasoning, logical reasoning, non-verbal reasoning, and spatial reasoning must be taken into consideration as being more psychological in nature than statistical. The study aimed in the development & standardization of development, item analysis, and standardization of the university past-student's cognitive ability. The objective of the research was achieved as a product intended to provide an insight into those scientific methodologies that can help us measure and reorder human intelligence to enhance cognitive ability among students by filling the gaps, to produce successful and efficient students.

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