Standardization Of A Scientific Knowledge And Aptitude Test

Dr. Chandra Mukherjee

Assistant Professor

Departmant of Education, Seth Anandram Jaipuria College. (Under Calcutta University). Kolkata, India.

ABSTRACT

The main objective of this research is to develop a standardized evaluation for Scientific Knowledge and Aptitude. A total of 100 items were given to 226 students (99 boys and 127 girls, N=226) from classes X, XI, and XII. The study employed Purposive Sampling. To determine reliability, the KR-21 formula was used, resulting in a reliability of .93614 for Life Science, .81553 for Physical Science, .85806 for Mathematics, and .88750 for the overall test. Validity was assessed through inter-item consistency using the inter-correlation method across all subgroups and subtests, with correlations ranging from .488 to .729, and the inter-correlation between subtests and the full test ranged from .773 to .940. For External Validity, the scores from the Madhyamik Examination (class X school leaving certificate examination conducted by the West Bengal Board of Secondary Education) in Life Science, Physical Science, and Mathematics were correlated with the standardized test scores, with correlations ranging from .266 to .663. The study suggests that more randomization is needed in the sampling process.

Keywords : Scientific knowledge, Aptitude, Purposive sampling ,Life science ,Physical science, Mathematics, Reliability, validity ,correlation.

Introduction

The word "Science" is defined in the New Encyclopedia Britanica (Vol. 10) as "Any of various disciplines or intellectual activities concerning the physical world and its phenomena and entailing unbiased observations and systematic experimentation. It is a structured endeavor that develops and arranges knowledge through explanations that can be tested and predictions about the universe. Generally, science is the quest for understanding.

"Modern science is a discovery as well as invention. It was a discovery that nature generally acts regularly enough to be described by laws and even by mathematics and required invention to devise the techniques abstraction, apparatus and organization for exhibiting the regularities and securing then low like description" (J.L. Heilbron, 2003).

"Aptitude refers to an individual's natural or learned capacity to acquire or enhance knowledge or skills in a particular domain. According to Freeman (1962:43), aptitude is described as "A combination of characteristics that are especially indicative of a person's potential to gain (with training) specific knowledge, skills, or a set of organized responses, such as the ability to speak a language, become a musician, perform mechanical tasks, etc."According to Freeman "It is the capacity or ability to acquire skill or knowledge in a particular knowledge or area on the basis of which the future performance of the child is it as one designed to measure a person's potential ability in an activity of a specialized kind within a restricted range".

A standardized assessment is defined as any evaluative instrument that is executed and assessed in a uniform manner to guarantee Legal defensibility is a key consideration. Standardized assessments are commonly employed in a wide range of areas, such as education, professional certification, psychological testing (like the MMPI), military uses, and many other anticipated fields.Freeman 1962 defined aptitude test as "One designed to measure a person's potential ability in an activity of a specialised kind within a restricted range".

A standardized test that is given and scores consistently to guarantee legal defensibility is considered a standardized test. Standardized tests are frequently utilized in psychology, education, and professional certification. (e.g., MMPI), the military, and many other fields. For instance, the Educational Testing Service (ETS), a nonprofit organization focused on educational testing and assessment, created standardized exams like the SAT. The SAT and GRE serve as examples of standardized tests.

Review of Related Literature

Paramita Ghosh investigated the gender disparity of class12th students' scores in physics among whom 248 boys and 159 girls (N=407) of Science Stream of Kendriya Vidyalayas of Kolkata and suburbs. First, samples were randomly selected from seven Kendriya Vidyalayas of Kolkata from class XII science students. Second, a socio-economic – status – scale (SESS) was administered to these pupils to screen and include only those who belonged to middle SES families in the final sample. A standardized tool was administered to the students in the final sample to assess their final attributes. The students"exam scores were analyzed analysed using the school records. Multiple Regression Analysis and ANOVA Results revealed that there was a significant gender disparity of Physics scores was predicted on the basis of students' attributes.

Rajib Mukhopadhyay (2014) has emphasized the aptitude of Physics within the board framework of Scientific Aptitude. The related tools have been critically reviewed which indicated the inadequacy in the number of available tool and suggested the scope of further investigation of the aptitude of physics. Inoperatoinalizing the construct psychometrically, the researchers should design the tools in view of all issues.

In January 2016, a study conducted by P. Pandia, R. Sridhar, and B. Mohon Kumar focused on developing and standardizing a Scientific Aptitude Test (SAT) for science students in grades 9 and 10. The researchers crafted 30 test items that assessed comprehension, logical reasoning, numerical aptitude, scientific reasoning, and analogy. Data was gathered from six schools in selected districts of Tamil Nadu, India, using multiple-choice questions. Microsoft Excel (2007) was utilized for statistical analysis and score recording. Item analysis was performed using the Chronbach Alpha method with IBM and SPSS software. The findings revealed reliability coefficients of 0.672 (Guttman, Split Half) and 0.874 (Spearman-Brown). The report indicates that the Scientific Aptitude Test can help secondary students cultivate a scientific mindset and prepare for future competitive exams. In July 2016, Pandia and Sridhar conducted initial research to assess the Scientific Attitude, Scientific Aptitude, and Scientific Knowledge of secondary school students in two districts of Tamil Nadu, India. They established six null hypotheses based on gender, class level, medium of instruction, board of affiliation, locality, and type of management, employing a normative survey approach. The sample comprised seventy-six secondary school students from seven different schools in the Chennai and

Thiruvallur areas. Data was collected using a standardized tool, recorded, and analyzed with IBM Corporation's SPSS 19.0 edition. The Normal Probability Curve method was applied to generate measurement scores (low, average, and high). All selected factors showed statistically significant results, except for the board of affiliation (State and Central Board of Secondary Education) concerning scientific knowledge and attitude. The study concluded that the samples from the selected schools were standardized for further experimental research.

Pandian and Sridhar (2016) carried out a preliminary investigation to assess the Scientific Attitude, Scientific Aptitude, and Scientific Knowledge among secondary school students in selected schools across two districts in Tamil Nadu, India. They utilized the Normative Survey Method and developed six null hypotheses, taking into account variables such as gender, class level, medium of instruction, board of affiliation, locality, and type of management. The research included 76 secondary school students from seven different schools located in the Chennai and Thiruvallur districts. Data collection was conducted using standardized tools, and the information was subsequently recorded and analyzed with the help of IBM Corporation's Statistical Package for the Social Sciences (SPSS version 19.0). The Normal Probability Curve (NPC) method was employed to classify measurement scores into categories of low, average, and high. Significant statistical outcomes were noted for all the variables studied, except for the board of affiliation (State and Central Board of Education). Objectives The aim of the study was to standardize a scientific knowledge and aptitude test.t.

Design

Considering the objectives of the present study a correlational design was deemed most suitable.

Descriptive analysis was done for the whole sample(boys and girls)

Sampling

The test was finally administered on99 boys 126 girls (N=226) of Urban English Medium Secondary & H.S. Schools and is shown in Table-1 below :

Table 1Standardization Sample

Area	Class	Boys	Girls	Total
Urban Area	X XI XII XII XII	24 75 - - -	42 30 55	24 75 42 30 55
Total	99	127	226	

Results

Reliability

Reliability of Scientific Knowledge and Aptitude Test was found out by Kunder Richardson Formula KR-21 to reported in Table-2 below :

Table 2. Reliability of Scientific Knowledge and Aptitude Test by KR-21 formula.

Sub Tests	Kunder Richardson Reliability
Lice Science Physical Science Mathematics	0.93614 0.81553 0.85806
Total	0.8875

The obtained reliability coefficients are considered as high and Satisfactory.

Scoring

One score was given to each correct answer and zero for one wrong answer and total score was 100, no negative marking had been applied.

Time Limit

When the Scientific Knowledge and Aptitude test was administered, a tentative time limit of 150 minutes (two and half an hour) was set for completion of the test. It was found to be adequate after actual listing as about 80% of the testees required this time. About 10% could not have finished within that time about the same percentage of the students finished earlier.

Norm

Norm was determined in terms of mean and standard deviation is reported in Table-3 below :

Table – 3 Mean and Standard Deviation of the Standardized Sample (N-226)

Habit	Gender	No. of Samples	Mean	Standard Deviation
Urban Urban	Boys Girls	99 127	51.24 47.425	16.913 48.213

Scoring Key

Scoring Key was also prepared considering the right response of each item.

Validity

To determine the validity, inter -correlation of scores of Life Science, Physical Science and Mathematics for two subgroups – boys (urban) and girls (urban) and the Total Sample has been computed. The correlation of the sub tests with the full test was also computed.

Table-4. Inter Correlation of Life Science, Physical and Mathematics

	Subtests	Life Science	Physical Science	Mathematics
Urban Boys	Life Science Physical Science Mathematics	1	0.6 1	0.488 0.55 1
Urban Girls	Life Science Physical Science Mathematics	1	0.797 1	0.641 0.737 1
Urban Total	Life Science Physical Science Mathematics	1	0.729 1	0.603 0.633 1

Table-5 Inter Correlation of the Subtests and the full test

	Life Science	Physical Science	Mathematics
Boys	0.773	0.89	0.828
Girls	0.896	0.94	0.868
Total	0.865	0.909	0.855

The above presented intercorrelations was presented above indicated that in case of all the subgroups and all the sub tests correlated moderately high with each other and in case of Grand Total all the subtests correlated very high with each other. This is an index of Internal Validity of the test.

For determining the External Validity, the scores of Life Science, Physical Science and Mathematics of Scientific Knowledge and Aptitude Test, it had been correlated with the scores of Life Science, Physical Science and Mathematics of Madhyamik Examination (i.e.10+ School leaving Certificate Examination, conducted by the West Bengal Board of Secondary Education). The results are presented in Table-6 below :

Table-6. Coefficient of Correlation between the scores of Scientific Knowledge and Aptitude Test and the scores of Madhyamik Examination in Science and Mathematics.

Subjects	Life Science	Physical Science	Mathematics	Total Test
Life Science Physical Science Mathematics	0.315 0.33 0.266	0.355 0.347 0.327	0.426 0.46 0.515	0.49 0.527 0.513
Total Test	0.356	0.396	0.561	0.663

From the above results it can be interpreted that the correlations are moderate and in some cases a bit low. This ensures the external validity of the newly constructed and standardized Scientific Knowledge and Aptitude Test.

Interpretation

Kuder Richardson Formula KR-21 iinterpreted that the inter item consistency is moderate in Scientific Knowledge and Aptitude Test so that test is reliable.

Results of intercorrelation of the scores with other sub tests and the sub tests with the total test, indicate that the index of internal validity is high and satisfactory.

The findings related to external validity suggest that the correlation ranges from low to moderate. This indicates that the newly developed Scientific Knowledge and Aptitude Test is indeed valid.

Limitations

Any other type of Reliability could not be determined (for e.g. by the formula of Cronback) to compare the reliability. The Reliability was determined by KR-21 formula only.

Though the external validity is low to moderate, so further study was suggested in this field.

In case of sampling more randomization is required because sampling done for this study is purposive sampling.

Conclusion

It can be concluded that the newly constructed Scientific Knowledge and Aptitude Test was Standardised.

Author's Declaration

The corresponding author hereby declares that this work is solely original and out of the extension of Doctoral research and this is considered as the continuation of the first phase (second phase) of research on standardization of scientific knowledge and aptitude test. Dr. Chandra Mukherjee, Department of Education, Assistant Professor, S.A. Jaipuria College.

Reference

1. Aicken Frederich. The Nature of Science, London, Heinemann Educational 1984, viii, 136p illus., plan chart, table diagrams. 22 cm. "Suggession for further reading". P. [130]-133.

2. Chinnawar, Dr. Sonali, N. (2018), Principal, Dept. of Education, Mahatma Gandhi College, Raipur, India. "A study of Scientific Aptitude Among Government High School students of Raipur." International Journal of Creative Research. Thoughts (IJCRT) vol. 6, Issue 2, April, 2018. ISSN:2320-2882. P p.230-233. www.ijert.org.

3. Frederich, Aicken. The Nature of Science, London, Heinemann Educational 1984, viii, 136p illus., plan chart, table diagrams. 22cm. "Suggestions for further rending" : p(130)-133

4. Joshi, Bhumika. Subhaschandra. (Research Scholar, Ganpat University, Vidyanagar, Gujrat, Kherva, Gujarat) and Patel, Sombabhai. A, (Ex. Profesor and Head, Department of Education, Ganpat

University, Vidyanagar, Kherva, Gujarat). (2026) "Construction and Standardization of Scientific Aptitude Test for 12+ Age – Group Students". International Journal for Research in Education (IJRE). Volume 5, January 2016. IJRE p) 2347-5412. ISSN 0) 2320-091x. Pp.16-21

5. Manpreet, Kaur., Ram, Niwas., Rai, V.K., and V.K. Rai (2015). "A study of Achievement in Science in relation to Sex, Habitation and Scientific Attitude of Higher Secondary School students." International Journal of Scientific Research, vol. 4 (7). Pp. 7-10.

6. Mukhopadhyay, Rajib., (2013). "Some Psychometric Considerations with Special Emphasis to Aptitude in Physics". Education Confab.vol.2 (1). Pp.90-97. Index.php/IJSSM/issue/archive

7. Mukhopadhyay, Rajib. Education Confab Vol 2, No., January 2013, Scientific Aptitude – Some Psychometric Considerations with Special Emphasis to aptitude in Physics. ISSN :2320-009X.

8. Pandia, Vadivu, Pandian., and Sridhar (July, 2016). CJoE 13 "Measuring Students' Scientific Attitude, Aptitude and Knowledge at the Secondary School Level : What intended to study and why?" Conflux : Journal of Education. Vol.4, Issue 2, July 2016. P ISSN : 2320-9305 Eissn 2347-5706.pp 13-20. Retrieved from http://cjoe.naspublishers.com

9. Vadivu, P. Pandia, Sridhar, R., and Kumar, B.Mohon (Jan.2016). "Construction and Standardization of Scientific Aptitude Test" (SAT) for Secondary School Students – A Pilot Study. International Journal of Social Science and Management. 3(1) : 17. DOI : 10.3126 / ijssm.v 3i1. 13958 Vol. 3, issue – 1 : 17-21. Licence – cc BY4.0. www.ijssm.org & http://nepjol.info