

Design Construction and Validation of A Mathematical Problem-Solving Skill Test for Grade 9 Students Under Kerala State Board

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Abstract

The main intension of the paper is the development and validation of Problem-solving skill test specifically designed to assess mathematics achievement of IX grade students following Kerala state board curriculum. Circle measures, Polynomials and Prisms, three core units are included for the test preparation. The skill test was developed through strict steps: blue printing, item analysis, pilot testing and expert validation. While the initial draft comprised 90 multiple-choice test item was constructed. Difficulty index and discrimination index filtered the final test to 50 items. The final test demonstrates strong face and content validity and effectively measuring learning outcomes across Bloom's cognitive domains. The study progress educational evaluation through an empirical and psychometric validated, educational progress assessment tool. This educational tool offers high utility, dependable classroom aid and a thorough, consistent measure for researchers.

KEY WORDS:

Problem-solving skill test, pilot study, IX Standard Mathematics.

INTRODUCTION:

The educational quality is basically connected to its assessment methodologies. As an essential discipline for science, technology, engineering and critical thinking, mathematics demands rigorous approaches to evaluation. Problem-solving tests are critical apparatus used to measure student's expertise in a specific area, their supreme skill of learning outcomes and their grasp of key mathematical concepts. The necessary feedback supplied allows students, mentors and policymakers to facilitate focused instruction and make curricular decisions. This article details the systematic evidence-based procedure used to construct and validate a specialized mathematics problem-solving skill test. The derivative tool, which is built upon the uncompromising principles of test construction possesses boost scientific features like high validity and reliability, as well as being content-relevant and challenging. Further more the test is mapped to Bloom's Taxonomy to systematically assess the cognitive domains of knowledge, comprehension, application and analysis.

The curricular domain selected are:

- Polynomials
- Circle measures
- Prisms

The blueprint design, pilot testing, and psychometric validation ensures strict content coverage and high technical quality.

METHODOLOGY:

Tool Construction: Predominantly a 90-item multiple-choice test was developed based on the Kerala State Board syllabus and instructional objectives. The blueprint assured stable representation over subject areas and cognitive domains:

Table – 1

WEIGHTAGE GIVEN

TO THE CONTENT OF THE PRELIMINARY DRAFT OF THE ACHIEVEMENT TESTL

Content	Total (Marks)
Polynomials	26
Circle Measures	32
Prisms	32
Total	90

Table – 2

PRELIMINARY DRAFT OF THE CRITERION TEST TOOL (BLOOM'S TAXANOMY)

OBJECTIVES	MARKS
Knowledge	16
Understanding	39
Application	19
Analysis	16
Total	90

Table – 3

BLUE PRINT - TWO DIMENTIONAL CHART OF THE PRELIMINARY DRAFY OF THE CRT TEST

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Content	Knowledge	Understanding	Application	Analysis	Total (Marks)
Polynomials	6 (1)	14(1)	6 (1)	6(1)	32(1)
Circles	6(1)	10(1)	6(1)	4(1)	26(1)

Prisms	4(1)	15 (1)	7(1)	6(1)	32 (1)
Total	16(1)	39 (1)	19 (1)	16(1)	90 (1)

PILOT STUDY

The initial draft of the problem-solving skill test comprised 90 multiple-choice items, each featuring one correct answer and three distractors. Prior to administration, students received explicit instructions regarding the time limit, required response format, and testing procedures. This preliminary 90-item instrument was pilot-tested on a sample of 50 ninth-grade students. Responses were scored dichotomously, with one point awarded for a correct answer and zero for an incorrect response. Data gathered from these 50 completed answer sheets were subsequently subjected to item analysis to evaluate item difficulty and discrimination.

ITEM ANALYSIS

The efficacy of a tool can be better by choosing item of appropriate difficulty value and discrimination index. Item analysis evaluated two fundamentals psychometric properties namely

- Item difficulty and the
- Item discrimination.

Item difficulty is defined as the percentage of students who answer an item correctly, while item discrimination denotes the capacity of an item to differentiate between high- and low-performing students. To assemble the finalized test, a rigorous evaluation of all 90 preliminary items was conducted, allowing for the strategic elimination of suboptimal items. The investigator retained items demonstrating a difficulty index between 0.55 and 0.76, and a discrimination index greater than 0.50. Consequently, 50 items met these criteria and were selected for the final instrument, establishing a maximum total score of 50 marks for the mathematics assessment.

SI NO	Discriminating Power (D.P)	Accepted/ Modified/Rejected	Difficulty Value (DV)	Accepted/Rejected
1	.60	Accepted	.70	Accepted
2	.50	Accepted	.66	Accepted
3	.51	Accepted	.66	Accepted
4	.62	Accepted	.70	Accepted
5	.58	Accepted	.76	Accepted
6	.33	Rejected	.54	Rejected
7	.44	Rejected	.52	Rejected

8	.67	Accepted	.86	Accepted
9	.56	Accepted	.55	Accepted
10	.22	Rejected	.22	Rejected
11	.45	Rejected	.50	Rejected
12	.59	Accepted	.59	Accepted
13	.37	Rejected	.48	Rejected
14	.43	Rejected	.43	Rejected
15	.96	Accepted	.66	Accepted
16	.67	Accepted	.70	Accepted
17	.37	Rejected	.34	Rejected
18	.76	Accepted	.66	Accepted
19	.34	Rejected	.46	Rejected
20	.77	Accepted	.76	Accepted
21	.31	Rejected	.22	Rejected
22	.57	Accepted	.76	Accepted
23	.55	Accepted	.69	Accepted
24	.88	Accepted	.50	Accepted
25	.33	Rejected	.22	Rejected
26	.44	Rejected	.33	Rejected
27	.70	Accepted	.71	Accepted
28	.29	Rejected	.11	Rejected
29	.50	Accepted	.56	Accepted
30	.88	Accepted	.56	Accepted
31	.22	Rejected	.44	Rejected
32	.66	Accepted	.69	Accepted
33	.50	Accepted	.60	Accepted
34	.44	Rejected	.30	Rejected
35	.86	Accepted	.57	Accepted

36	.44	Rejected	.10	Rejected
37	.22	Rejected	.39	Rejected
38	.78	Accepted	.57	Accepted
39	.69	Accepted	.72	Accepted
40	.80	Accepted	.60	Accepted
41	.77	Accepted	.61	Accepted
42	.19	Rejected	.11	Rejected
43	.29	Rejected	.22	Rejected
44	.52	Accepted	.76	Accepted
45	.74	Accepted	.70	Accepted
46	.44	Rejected	.33	Rejected
47	.22	Rejected	.33	Rejected
48	.70	Accepted	.56	Accepted
49	.50	Accepted	.76	Accepted
50	.50	Accepted	.71	Accepted
51	.11	Rejected	.44	Rejected
52	.22	Rejected	.44	Rejected
53	.40	Rejected	.44	Rejected
54	.22	Accepted	.66	Accepted
55	.66	Accepted	.55	Accepted
56	.66	Accepted	.57	Accepted
57	.55	Accepted	.61	Accepted
58	.38	Rejected	.44	Rejected
59	.39	Rejected	.49	Rejected
60	.77	Accepted	.67	Accepted
61	.69	Accepted	.65	Accepted
62	.34	Rejected	.50	Rejected
63	.36	Rejected	.50	Rejected
64	.10	Rejected	.30	Rejected

65	.44	Rejected	.33	Rejected
66	.52	Accepted	.76	Accepted
67	.19	Rejected	.22	Rejected
68	.55	Accepted	.77	Accepted
69	.66	Accepted	.76	Accepted
70	.59	Accepted	.69	Accepted
71	.19	Rejected	.33	Rejected
72	.36	Rejected	.34	Rejected
73	.61	Accepted	.70	Accepted
74	.50	Accepted	.60	Accepted
75	.55	Accepted	.75	Accepted
76	.22	Rejected	.11	Rejected
77	.22	Rejected	.33	Rejected
78	.59	Accepted	.55	Accepted
79	.77	Accepted	.77	Accepted
80	.22	Rejected	.23	Rejected
81	.44	Rejected	.44	Rejected
82	.55	Accepted	.56	Accepted
83	.60	Accepted	.54	Accepted
84	.22	Rejected	.22	Rejected
85	.66	Accepted	.70	Accepted
86	.58	Accepted	.66	Accepted
87	.22	Rejected	.23	Rejected
88	.38	Rejected	.44	Rejected
89	.77	Accepted	.76	Accepted
90	.18	Rejected	.22	Rejected

Table-4

EDUCATIONAL SIGNIFICANCE

- Boost critical thinking
- Through concept formation
- Problem solving skill development
- Absence of rote learning
- Identify and fill cognitive gap
- Reforms based on proofs

Test validity can be defined as does the tool measure what it actually intent to measure. To ensure content validity and face validity the researcher construct the tool using blue print, discriminating index, difficulty index and expert panel opinions. The expert evaluator's satisfaction, approval and support claim the face validity of the tool.

TOOL FOR THE FINAL STUDY

For the better selection of 50 questions the investigator included the items having discriminating index above .50 and Difficulty Index between the range .55 to .75. The remaining test items was excluded from the final draft.

Table – 5

BLUE PRINT TWO DIMENTIONAL CHART OF THE FINAL DRAFT OF THE CRITERION TEST TOOL

Content	Knowledge	Understanding	Application	Analysis	Total Mark
POLYNOMIALS	3(1)	6(1)	3(1)	3(1)	15(1)
CIRCLES	4(1)	4(1)	4(1)	3(1)	15(1)
PRISMS	4(1)	5(1)	7(1)	4(1)	20(1)
Total	11(1)	15(1)	14(1)	10(1)	50(1)

CONCLUSION

The 50-item multiple choice test for 9th grade students is perfectly useful for students, teachers, researchers and even curriculum frame workers. Designed with teachers and researchers in mind, this this tool claims empirical validation, practicality, and clarity objectivity. This instrument perfectly replicate learning outcomes and three levels of domains, and a preassembled tool for classroom assessment.

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