A Study of Cognitive Abilities of Class IX Students in Science and Technology in Kachchh District

An Abstract Submitted to
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1. INTRODUCTION

An attempt was made to study the cognitive abilities of class IX students in Science and Technology subject. The research method of the study was normative survey. The variables of study were Gender, Medium of Instruction, Type of School and Students' Achievement scores in Cognitive Ability Test for Science (CATS). There were two tools utilized for the present study. One was Cognitive Ability Test for Science (CATS) which was constructed and standardized by the researcher. Another tool was Creativity Test for Science (CTS) which was constructed and validated before administering on the subjects of the study that was class IX students of Kachchh district. The data were collected from 2443 class IX students selected through multistage cluster sampling. Data analysis of scores of students in CATS was done by Analysis of Variance (ANOVA). Thereafter, the correlation between scores of students in CATS and their academic achievement in science was studies with the help of Pearson Product-Moment correlation. Students' responses for the tool Creativity Test for Science (CTS) was content analyzed and presented in the form of description. The major findings obtained from the data analysis are written in the following part.

2. MAJOR FINDINGS

1. Values of Central tendencies viz., Mean, Median and Mode were 51.91, 48 and 46 respectively. The value of KR 21 Reliability coefficient was 0.89.
2. The mean achievement scores in CATS of Males and Females were 52.08 and 51.73. There was no significant difference in the mean achievement scores in CATS of class IX students with respect to gender.
3. The mean achievement scores in CATS of English medium and Gujarati medium students were 54.34 and 51.35. There was a significant difference in mean achievement scores in CATS of class IX students with respect to Medium of Instruction. English medium students were found to have significantly better Achievement in CATS as compared to Gujarati medium students.
4. The mean achievement scores in CATS of Government, Grant-in-aid and Private schools students were 53.53, 48.60 and 55.22. There was a significant difference in mean achievement scores in CATS of class IX students with respect to Types of School. Private schools students were found to have significantly better Achievement in CATS as compared to Government schools students and Grant-in-aid schools students.

5. There was significant interaction between mean achievement scores in CATS of class IX students with respect to gender and medium of instruction. Students of English medium schools were found to be superior to students of Gujarati medium schools. Further, Female students of English medium schools had higher mean Achievement scores in CATS than Male students of English medium schools.

6. There was significant interaction between mean achievement scores in CATS of class IX students with respect to gender and types of schools. Male students of Government schools were superior in CATS to those of Grant-in-aid schools and Private schools whereas Female students of Private schools were superior in CATS to those of Grant-in-aid schools and Private schools. Male students of Grant-in-aid schools and Female students of Government schools were found to be inferior in CATS.

7. There was no significant difference in the mean achievement scores in Chemistry of class IX students with respect to gender.

8. There was no significant difference in the mean achievement scores in Chemistry of class IX students with respect to medium of instruction.

9. There was a significant difference in the mean achievement scores in Chemistry of class IX students with respect to types of schools. Private schools students were found to have significantly better Achievement in Chemistry as compared to Government schools students and Grant-in-aid schools students.

10. There was significant interaction between mean achievement scores in Chemistry of class IX students with respect to gender and medium of instruction. Students of English medium schools were found to be superior to students of Gujarati medium schools. Further, Female students of English medium schools had higher mean Achievement scores in Chemistry than Male students of English medium schools.

11. There was significant interaction between mean achievement scores in Chemistry of class IX students with respect to gender and types of schools. Male students of Government schools were superior in Chemistry to those of Grant-in-aid schools and Private schools whereas Female students of Private schools were superior in Chemistry to those of Grant-in-aid schools and Private schools. Male students of Grant-in-aid schools and Female students of Government schools were found to be inferior in Chemistry.

12. There was no significant difference in the mean achievement scores in Physics of class IX students with respect to gender.

13. There was a significant difference in the mean achievement scores in Physics of class IX students with respect to medium of instruction. English medium students were found to have significantly better Achievement in Physics as compared to Gujarati medium students.
14. There was a significant difference in the mean achievement scores in Physics of class IX students with respect to types of schools. Private schools students were found to be superior to Government schools students and Grant-in-aid schools students.
15. There was significant interaction between mean achievement scores in Physics of class IX students with respect to gender and medium of instruction. Students of English medium schools were found to be superior to students of Gujarati medium schools. Further, Female students of English medium schools had higher mean Achievement scores in Physics than Male students of English medium schools.
16. There was significant interaction between mean achievement scores in Physics of class IX students with respect to gender and types of schools. Male students of Government schools were superior in Physics to those of Grant-in-aid schools and Private schools whereas Female students of Private schools were superior in Physics to those of Grant-in-aid schools and Private schools.. Male students of Grant-in-aid schools and Female students of Government schools were found to be inferior in Physics.
17. There was no significant difference in the mean achievement scores in Biology of class IX students with respect to gender.
18. There will be no significant difference in the mean achievement scores in Biology of class IX students with respect to medium of instruction. Gujarati medium students were found to have significantly better Achievement in Biology as compared to English medium students.
19. There was no significant difference in the mean achievement scores in Biology of class IX students with respect to types of schools. Government schools students were found to have significantly better Achievement in Biology as compared to Grant-in-aid schools and Private schools students.
20. There was significant interaction between mean achievement scores in Biology of class IX students with respect to gender and medium of instruction. Male students of Gujarati medium were found to have higher mean Achievement scores in Biology than Male students of English medium. Further, Female students of English medium had higher mean Achievement scores in Biology than Female students of Gujarati medium.
21. There was significant interaction between mean achievement scores in Biology of class IX students with respect to gender and types of schools. Male students of Government schools were superior in Biology to those of Grant-in-aid schools and Private schools whereas Female

students of Private schools were superior in Biology to those of Government and Grant-in-aid schools. Male students of Grant-in-aid schools and Female students of Government schools were found to be inferior in Biology.

22. There was no significant difference in the mean achievement scores for Remember level of CATS of class IX students with respect to gender.

23. There was a significant difference in the mean achievement scores for Remember level of CATS of class IX students with respect to medium of instruction. English medium school students had significantly higher mean achievement scores for Remember level of CATS than Gujarati medium school students.

24. There was a significant difference in the mean achievement scores for Remember level of CATS of class IX students with respect to type of school. Private school students were superior at Remember level of CATS than Government and Grant-in-aid school students.

25. There was no significant difference in the mean achievement scores for Understand level of CATS of class IX students with respect to gender.

26. There was a significant difference in the mean achievement scores for Understand level of CATS of class IX students with respect to medium of instruction. English medium students were significantly better at Understand level of CATS than Gujarati medium students.

28. There was a significant difference in the mean achievement scores for Understand level of CATS of class IX students with respect to type of school. Private school students were superior at Understand level of CATS than Government and Grant-in-aid school students.

29. There was no significant difference in the mean achievement scores for Apply level of CATS of class IX students with respect to gender.

30. There was no significant difference in the mean achievement scores for Apply level of CATS of class IX students with respect to medium of instruction.

31. There was a significant difference in the mean achievement scores for Apply level of CATS of class IX students with respect to type of school. Private school students were superior at Apply level of CATS than Government and Grant-in-aid school students.

32. There was a significant difference in the mean achievement scores for Analyze level of CATS of class IX students with respect to gender. Male students were significantly better at Analyze level of CATS than Female students.

33. There was no significant difference in the mean achievement scores for Analyze level of CATS of class IX students with respect to medium of instruction.

34. There was a significant difference in the mean achievement scores for Analyze level of CATS of class IX students with respect to type of school. Government school students were superior at Analyze level of CATS than Grant-in-aid and Private school students.

35. There was a significant difference in the mean achievement scores for Evaluate level of CATS of class IX students with respect to gender. Male students were significantly better at Evaluate level of CATS than Female students.

36. There was no significant difference in the mean achievement scores for Evaluate level of CATS of class IX students with respect to medium of instruction.

37. There was a significant difference in the mean achievement scores for Evaluate level of CATS of class IX students with respect to type of school. Government school students were superior at Evaluate level of CATS than Grant-in-aid and Private school students.

38. Achievement scores in CATS and academic achievement in science of class IX students were found to have positive correlation.

39. Achievement scores in CATS and academic achievement in science of Male students were found to have positive correlation.

40. Achievement scores in CATS and academic achievement in science of Female students were found to have positive correlation.

41. Achievement scores in CATS and academic achievement in science of English medium students were found to have positive correlation.

42. Achievement scores in CATS and academic achievement in science of Gujarati medium students were found to have positive correlation.

43. Achievement scores in CATS and academic achievement in science of students of Government schools were found to have positive correlation.

44. Achievement scores in CATS and academic achievement in science of students of Grant-in-aid schools were found to have positive correlation.

45. Achievement scores in CATS and academic achievement in science of students of Private schools were found to have positive correlation.

46. The percentage of students attempting Create level question was more for Chemistry and Biology which required written responses and least for Physics which required students to draw their response. Students had strong inclination towards writing the response.

47. The correct responses given by students for Create level question of Chemistry; chemically correct compounds; were those which are frequently mentioned in the textbooks. No any student formed the compounds which were chemically correct but not mentioned in the

textbook. This indicates that students could not think beyond Understand level as they did not apply the knowledge of compound formation correctly.

48. The responses given by students for Create level question of Physics were of Remember level or Understand level such as list of machines, definition and explanation of simple and compound machines. The responses of the students were irrelevant to the question asked.

49. The responses given by students for Create level question of Biology were based on their extreme consideration for consequences. The responses written by them were less creative and more imaginative.

3. DISCUSSION

The present study was an attempt to study class IX students' cognitive abilities in science and technology subject. The study was conducted by construction and standardization of Cognitive Ability Test for Science (CATS). The study revealed that there was no significant difference in overall mean Achievement scores of males and females which is in contradiction to the studies previously conducted by SIE (Kerala), 1965; Bhatt, 1971; SCERT, 1971; Sharma, 1975; Sharma, 1976; Ansari, 1984. The probable reason for this contradiction might be the time gap in the previously conducted studies and the present study. However, for each level of cognitive ability the difference between the performance of males and females does not follow the same pattern. The difference between the performance of males and females becomes significant as the complexity of the levels increases. This is again in contradiction to the study of Saido (2018) who found that there was no significant difference between students' level of higher order thinking skills and their gender. For Analyze and Evaluate levels of cognitive abilities, males were superior to females in the present study. While analyzing the data subject -wise, it was found that there was no significant difference between males and females. This is in line with the study by Ghosh (1985) who found that boys did not differ significantly than girls in Achievement Test in Chemistry.

With regard to medium of instruction, it was found that there was significant difference between English medium and Gujarati medium schools students. The findings are in the line of what Raveendranathan (1983) found in his study that English medium students were superior to Malayalam medium students. However, for each level and for each subject of science the findings does not remain same for the present study. For Chemistry, there is no significant difference. English medium students were better in Physics than Gujarati medium students but for Biology the findings are in the opposite order. Furthermore, as the complexity

of the levels increases, the difference with respect to medium of instruction becomes insignificant.

In the light of type of school, it was found that Private school student were better than Government and Grant-in-aid school students. This is also in the line of Pal (1982) and Devi Uma (2009). However, there are some exceptions. For Chemistry and Physics parts of the CATS Private schools students performed better whereas for Biology Government school students performed better than their counterparts. As the complexity of the levels increases, there is shift in the better performer from Private schools students to Government school students.

The correlation between students' scores in CATS and their academic achievement in science was found to be positive. The studies conducted by Sheth (1967), Chatterjee (1978) and Pal (1982) found significantly positive correlation between students' scores in the tools of the studies and their academic achievement. Even the correlation done with respect to each variable in the present study was found to be significantly positive.

With regard to creativity of students Paltasingh (2009) has showed a positive correlation between creativity and science achievement. For the present study, it can be concluded that students performance in Creativity Test for Science (CTS) was poor. The underlying reason can be the lack opportunities to deal with Create level content. Prajapati and Kothari (2019) have found that present textbook of science designed by NCERT does not provide sufficient Create level content either in the form of questions or activities.

4. SUGGESTIONS

Based on the findings arrived at in the present study, following suggestions can be given to policy makers, teachers and researchers.

4.1 Suggestions to Policy Makers

- More weightage should be given to higher order cognitive activities in the science textbooks and the curriculum.
- Assessment practices should allot equal weightage to lower as well as higher order cognition.
- Techers should be given focused orientations and training for higher order thinking skills and their integration into classroom activities.

4.2 Suggestions to Teachers

- Students' imaginations and aspirations should be channelized to realize the expected outcomes of science education.
- Teacher made lower as higher order questions should be utilized in the classrooms.
- Higher order questions should be frequently asked during teaching-learning practices.
- Various practices of assessment other than paper-pencil tests should be adopted for students to express their responses in multiple ways.

4.3 Suggestions for further Research

- Qualitative study on small groups can be conducted for in depth understanding of students' cognitive skills.
- Similar studies can be conducted for subjects of science separately.
- Similar studies can be conducted on students other than class IX.
- Assessment surveys can be conducted with tools constructed based on other theoretical frameworks.
- Two-tier MCQs can be framed to assess students' higher order abilities.