



# Construction and standardization of Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale for the secondary school students

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## Abstract:

*Indian Council of Social Science and Research (ICSSR) supported Research project on the research to study Effect of Science, Technology, Engineering and Math (STEM) Learning Techniques on Mathematical Achievement at Secondary School Level, present paper prepared Construction and standardization of Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale for the secondary school students. In 21<sup>st</sup> century STEM was used by a variety of educators in preference to SMET, STEM education research is still in an embryonic state, the field is lacking a scientific evidence base that can inform the development of theory, policy and practice. On the total 1000 sample of the secondary school students from the North Gujarat region, (STEM) Techniques aptitude Scale constructed and standardize, by survey method during the year of 2023-24. Gender wise Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale of male secondary school students was found significantly higher, habitat wise Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale of urban habitat Students are found significantly higher, literature sources that we selected for this survey addressed issues concerning STEM education. Essential needs to draw attention to under researched issues that have a significant impact on the ways in which schools implement integrated STEM programs and the role of mathematics in such programs.*

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**Keywords:** *Indian Council of Social Science and Research (ICSSR), Science, Engineering, and Technology and Mathematics (STEM) Techniques, (STEM) Techniques aptitude Scale, Mathematics*

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## 1. Introduction

Indian Council of Social Science and Research (ICSSR) supported Research project on the research to study Effect of Science, Technology, Engineering and Math (STEM) Learning Techniques on Mathematical Achievement at Secondary School Level, present paper prepared Construction and standardization of Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale for the secondary school students. STEM education is now become has been bring into line with national level economic well-being and worldwide attractiveness ever since the acronym “STEM” was first introduced in 2001 by Judith A. Ramaley, a former director of the US National Science Foundation’s Education and Human Resources Division (Breiner et al., 2012). Tytler (2020) focused main point on that urgings for increasing focus on STEM education are also connected to performance on international comparative assessment administrations such as PISA and TIMSS, organized with apprehensions about a decline in young generation’s involvement in STEM issues in secondary school—often described as “leakage” from the “STEM pipeline”. This kind of policy narrative might influence STEM education practice and research towards boosting student engagement, participation, and aspiration—that is, by emphasising elements of the affective domain that have been a major focus of research on student practices and consequences of assimilated STEM education. Further the most research in the directions, as well as the matters need to aims to “fill the STEM pipeline” and

practice more to be innovation and practical based research informed so that the route of the basic problems it need to deep seek to find the solution to solve, know basics and make more and more possible ways to find the reasons and to know causes of each and surrounding events in the field of STEM Lane et al. (2022) showed that majority of the student attitudes and perceptions of their individual ability in relation to the particular subject and its difficulty can influence participation in secondary school STEM subjects. Mathematics, and experienced mathematics as being more difficult, than subjects in science, technology, and engineering. Although this study needs to investigate the role of mathematics in integrated STEM education, it does suggest that STEM education. In the early 1990s, the acronym STEM was used by a variety of educators in preference to SMET, including Charles E. Vela, the founder and director of the Center for the Advancement of Hispanics in Science and Engineering Education (CAHSEE). The CAHSEE started a summer program for talented under-represented students in the Washington, DC area called the STEM Institute. Based on the program's recognized success and his expertise in STEM education, Charles Vela was asked to serve on numerous NSF and Congressional panels in science, mathematics and engineering education; it is through this manner that NSF was first introduced to the acronym STEM. One of the first NSF projects to use the acronym[citation needed] was STEMTEC, the Science, Technology, Engineering and Math Teacher Education Collaborative at the University of Massachusetts Amherst, which was founded in 1998. In 2001, at the urging of Dr. Peter Faletra, the Director of Workforce Development for Teachers and Scientists at the Office of Science, the acronym was adopted by Rita Colwell and other science administrators in the National Science Foundation (NSF). The Office of Science was also an early adopter of the STEM acronym.

STEM careers (e.g., Department of Education and Skills, Ireland, 2017; Education Bureau of Government of HKSAR, 2016; European Schoolnet, 2017; Honey et al., 2014; Office of the Chief Scientist, 2014). However, as STEM education research is still in an embryonic state, the field is lacking a scientific evidence base that can inform the development of theory, policy and practice (Maass et al., 2019). In addition, although it is common to claim that mathematics is the discipline that underpins STEM, it is not clear how mathematical concepts and practices contribute to a better understanding of the other STEM disciplines; nor do we understand well enough how STEM education experiences enhance students' learning of mathematics (English, 2016; Fitzallen, 2015). Interdisciplinary mathematics education was introduced at ICME-13, the 13th International Congresses on Mathematical Education held in 2016, and this group continued to meet in subsequent ICMEs. In addition, a new Thematic Working Group on mathematics in the context of STEM education was established at CERME-11, the 11<sup>th</sup> Congress of the European Society for Research in Mathematics Education in 2019 (Ubuz et al., 2019) and continued to meet at CERME-12 (Ubuz et al., 2022) and CERME-13. This current special issue of ZDM also complements and builds on the research reported in ZDM 51(6) on twenty-first century skills and STEM teaching and learning. As interest in interdisciplinary STEM education is growing, it is appropriate to identify, synthesise, and critically evaluate current research that focuses on mathematics education within this context.

## 2. Significance of the Study

In today's time the appropriate development of the special aptitude latently lying in students is as much and as fairly required as that of education of all-round development. The future of the school children rests not only upon finding out the extra talent lying in them but also upon giving them proper direction. Accordingly, if the latent aptitude of the students of secondary schools and subsequently it is given appropriate direction, undoubtedly fertile and prolific citizens may be prepared.

The said research-work may be useful in the following way:

- This inventory may be useful in measuring the Science, Engineering, Technology and Mathematics (STEM) aptitude of secondary school Students.
- The familiarity with the Science, Engineering, Technology and Mathematics (STEM) aptitude of secondary school Students may lead to turn the student to the syllabus of his choice.

- The measurement of the Science, Engineering, Technology and Mathematics (STEM) aptitude may lead to guiding the students in a quite better way.
- The measurement of the Science, Engineering, Technology and Mathematics (STEM) aptitude may lead to the study of the educational achievements.
- It may be useful in the study of the relationship between the Science, Engineering, Technology and Mathematics (STEM) aptitude and intelligence.
- Teachers, principal and parents may get familiarized with the Science, Engineering, Technology and Mathematics (STEM) aptitude of secondary school Students.
- Various activities may be pondered over and subsequently be implemented in order to develop the Science, Engineering, Technology and Mathematics (STEM) aptitude.
- Conspicuous directions may be obtained for the future research-works.

### 3. Statement of the Research-Problem

Any of the problems is the indicative of the absence of the attempts of the satisfaction of necessity. When the absence of the prevalent method for the satisfaction of some necessity or the impediments is experienced in it, the problem raised is called the problem. The activity carried out for finding out the solution such a situation is called research. Hence, it may be said in the other words that, the question or problem that is to be found solution of with the help of research is called the research-problem or research-question. The problem accepted to be inspected intimately in the light of the limitations of time, place and the institutional instruments and be presented in such a way as helps in directing towards Solution.

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#### 4. Understanding of Key-words

In the words of John R. Barker, Aptitude tests are employed for the arrangement of the educational and professional career of secondary school Students, the selection and subsequent appointment of the staff in industries and professions and for the choice of trainees. The selection made in the light of aptitude gives satisfaction and success in the task taken to be accomplished. The same leads to the prolific rise in productivity and subsequently to educational or professional adjustment.

In order to understand the given research-problem very clearly the key-terminological words employed by the research-scholar need to be understood, mostly the context of the usage. In order to make sure the given research-problem Whitney explains the significance of the definition of those key-terminological words and states: "The define a problem means to put a fence around it to separate it by careful distinctions from like questions found in related situations of need."

#### Science, Engineering, Technology and Mathematics (STEM) technique Aptitude

The ability to carry out the authentication in the light of the STEM-related characteristics place, direction, volume, shape only through the sensory perceptions, Science, Engineering, Technology and Mathematics (STEM) rationality aptitude means an individual's ability to imagine figures intangibly in space.

#### Science, Engineering, Technology and Mathematics (STEM) Aptitude Test:

The researcher has formed a test of seven segments in order to measure the two-dimensional or three-dimensional rationality such as,

- To Recognize the figures placed sequentially.
- To Recognize the figure with difference.
- To recognize the similar figure.
- To recognize the figure being reflected in the mirror.

- To recognize the figure shown in water.
- To complete the figure by connecting the different parts in the figure.
- Figures created by folding and cutting the given paper.

In addition, the formation of such five situations was made in such a way as students may imagine in intangible situations and questions measuring the Science, Engineering, Technology and Mathematics (STEM) aptitude were constituted which underwent from the pre-primary and primary trials and from values of endurance and discrimination the final test was formed and that was held as Science, Engineering, Technology and Mathematics (STEM) Aptitude Test in the present research-work.

### Standardization

The method of forming the special test for the measurement of distinguished talents and subsequently passing the same from appropriate steps in its final form with the measure-scores having been established is called standardization. A standardized test is one in which the procedure apparatus and scoring have fixed, so that precisely the same test can be given at different times and places. As per the definition mentioned above, it may be finally laid down that the standardized test is the effective and reliable device of measuring the knowledge acquired by the students in the existing situation out of the test given to them in the form of one single score, their skill as well as their ability to carry out any work.

### 5. Objectives of the said Research:

The central part of any research is the objectives of the concerned research. After the final clarification of the objectivities only the research-journey may be taken forward. The research-objectives indicate the types of matters to be taken at hand throughout the research. It is the clarification of the research-objectivities only that makes clear the different sections of the research. The research-objectives need to be clarified because on the basis of them the hypothesis is formed and the research-tools are selected or formed.

- 1.To Construct and standardize the Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale of secondary school students.
- 2.To study the Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale of secondary school students with reference to gender and habitat.
- 3.To study the Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale of secondary school students with reference to gender and habitat.

### 6. Variables of Research:

Sr.	Type of Variables	Variables under the Investigation
1.	Dependent Variable	Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale
2.	Independent Variable	( b ) Student' Perceptions
3.	Moderate Variables	( a ) Gender ( b ) Habitat

### 7. Area of Research

The present research was conducted by taking sample from students of Secondary school students from the North Gujarat Region.

### 8. Type of Research

The present research was Descriptive Survey by its nature.

### 9. Method of Research

In the proposed research, investigation survey method was employed.

## 10. Universe of the Research

The proposed research is to frame the test and to check the effectiveness Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale for the Students of the Secondary school students were considered as the population of the study.

## 11. Selection of Sample

In this present study Students of the Secondary school students were selected from the North Gujarat region students from the secondary school from the secondary school students were selected randomly for the research purpose. By using lottery system schools were selected, 200 students from Arvalli district 200 students from the Mehsana district, 200 students from the Banaskantha district, 200 students from the Sanbarkantha district and 200 students from the Patan district and finally 1000 students were selected.

## 12. Limitations of the Research

In the proposed research, keeping in mind time, energy and expenditure following matters were considered. The area of present study was delimited to the students of North Gujarat studying in the secondary school students, delimited to the students of the selected school from the Gujarati medium studying during the year of 2023-24. Medium of the language of the tool were delimited for the Gujarati medium only. In the proposed research, out of various aptitudes, only STEM logic was selected.

## 13. Research Method: Tools of the Study

To collect the data for the present investigation the investigator will prepare Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale and Lickert Type of Test was prepared by finding the discrimination value of each question/item of the test. Finally, the constructed tool was applied by using the alternative choice-based answer. Reliability and Validity was carried out and norms were prepared for Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale.

## 15. Data Collection and Statistical Treatment

Data for the present research were collected by the investigator by taking permission of principal from the selected colleges and proposed time duration Test were applied by using random sampling technique. Selection and classification of the data of the study with reference to sample were classified as follows.

1. Gender wise sample of the study
2. Habitat wise sample of the study

For the calculation of the data, the researcher was employed the formulas of Mean, Standard Deviation, t-value.

## 16. Effect of Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale on different group of secondary school Students

### 16.1 Effect of Gender group of secondary school Students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale

Effect of Gender group of secondary school Students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale is level of the significance between group of the mean score of different group of male secondary school students and different group of female secondary school students observed by the mean, SD and t-Value calculated.

**H<sub>01</sub>:** There was no significant difference between mean score of total sample of male and female secondary school students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale.

### Observation

Calculated t- value was found to be 2.98, it is found that mean score of total sample of male secondary school students are found significantly higher than the mean score of total sample of female secondary school students on Science, Engineering, and Technology and Mathematics ( STEM ) Techniques aptitude Scale , which is significant at 0.01-level of significance. So, Hypothesis 1 is rejected. Gender wise Science, Engineering, and Technology and Mathematics ( STEM ) Techniques aptitude Scale of male secondary school students are found significantly higher than the mean score of female secondary school students on Science, Engineering, and Technology and Mathematics ( STEM ) Techniques aptitude Scale.

### *16.2 Effect of Habitat on group of secondary school Students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale*

Effect of Gender on group of secondary school Students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale is level of the significance between group of the mean score of different groups of Urban Habitat and different group of Rural Habitat students observed by the mean, SD and t-Value calculated.

**H<sub>02</sub>:** There was no significant difference between mean score of total sample of urban and rural habitat Students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale.

### Observation

Calculated t- value was found to be 2.64, it is found that mean score of urban habitat total sample of secondary school Students is found significantly higher than the mean score of rural habitat total sample of secondary school Students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale, which is significant at 0.01-level of significance. So, Hypothesis 2 is rejected. Habitat wise Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale of urban habitat Students are found significantly higher than the mean score of rural Students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale.

### 17. Conclusion

From the above research it can be conclude that, Gender wise Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale of male secondary school students was found significantly higher than the mean score of female secondary school students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale. Habitat wise Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale of urban habitat Students are found significantly higher than the mean score of rural Students on Science, Engineering, and Technology and Mathematics (STEM) Techniques aptitude Scale. The literature sources that we selected for this survey addressed issues concerning policy, structures, and leadership in STEM education. Despite this thematic cluster being smaller than the other four clusters that organise our survey, we believe it is essential to draw attention to under researched issues that have a significant impact on the ways in which schools implement integrated STEM programs and the role of mathematics in such programs.

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