International Journal of Education and Psychological Research (IJEPR) Volume 11, Issue 1, March 2022
Print - ISSN: 2349 - 0853, e-ISSN: 2279 - 0179 Available online at www.ijepr.org
Orignal Research Article Open Access

STEM Approach and 21st Century Skills: Attitude of Secondary School Students of Kerala

Noufal P. [1]

Abstract

The purpose of this study was to investigate the attitude towards Science, Mathematics, engineering and technology, and 21st century skills of secondary school students of Kerala. Normative survey method was used for the study. 140 participants from Malappuram district of Kerala was participated in this study. "High School Student Attitudes toward STEM survey by Friday Institute for Educational Innovation", was the tool used and which is in an five point likerts scale mode. Attitude towards STEM and 21st century skills with respect to gender was studied. Findings showed that girls have higher attitude towards science and mathematics, where as boys have higher attitude in engineering and technology. STEM education approach is becoming popular in India. It can be useful at various levels of education starting from primary level to higher education. Student's attitude and interests will be a crucial factor while implementing these kinds of innovative teaching approaches. They are the ultimate beneficiaries of it and will be useful for their career. Students and teachers should have a positive attitude towards the STEM approach. In addition to the mastery over the content, present generation student's wishes to acquire the necessary 21st century skills also.

Keywords: *STEM Approach, 21st century skills, Attitudes of Secondary School Students*

Article History: *Submitted: 14th March, 2022, Revised: 15th March, 2022, Accepted: 16th March, 2022, Published: 31st March, 2022.*

I. INTRODUCTION

Teachers in the 21stcentury enjoy access to information and resources that their predecessors could not imagine: state of the art information available on the internet 24/7 on the most subjects (Karen E Irving). Information delivery is the paradigm that learning from technology supports. In this way of thinking about learning, the computer (or teacher) provides information to students, students read and understand the information, and achievement occurs when students provide an adequate response to questions regarding the content of this information. The student serves as a passive recipient of knowledge. The teacher/ computer function as an information delivery system (reeves 1998). Knowledge construction is the paradigm for learning with technology. Rather than using technology as a source of information to pour into a passive learner, teachers employ technology to engage students with real world problem solving, conceptual development, and critical thinking (Ringstaff and Kelley 2002.)

Among the 21st century issues and trends in science education, one must acknowledge the fundamental importance of the science curriculum. The curriculum and teaching that matter the most regarding the progress of the learners. Students learn the content they are taught. Means how much students learn is directly influenced by how they are taught.Effective science teachers need a deep understanding of science content and pedagogy (Rhoton and Bowers 2001). Content knowledge can have a positive influence on student achievement especially in secondary science (Blair 2000; Whitehurst 2002).

Student's enthusiasm for science can be shaped by teacher attitude. Successful teachers provide a learning environment in which curiosity is encouraged openly and students have opportunities to explore ideas and physical objects. Accomplished teachers use a variety of instructional approaches to guide learners toward knowledge about the natural world and about how science, as a discipline, gathers knowledge and condenses knowledge about the world. Since the needs and interests of each learner are unique, it is important to provide different kinds of opportunities for students to experience the natural world and test and refine their conceptual frameworks. (Nancy P Moreno, Barbara Z.Tharp). To enhance the student's efforts to learn science, they will require opportunities to participate in guided inquiry, develop the explanations along with the peers, communicate the ideas generated, and obviously interaction with the teachers and experts.

In the 21st century, the importance of education is increasing because we must ensure that students have the skills to learn, to innovate, and, especially, to use technology and information media so that they can work and make a living. The development of science and technology have become part of every aspect of modern life. The development of science and technology can bring easiness and new way to live, but on the other side of the development of science and technology also become new challenge for society. Society is required to have certain ability in order to compete and live properly in the rapid development of science and technology. In the field of job, one must have skills in science and math, creativity, information mastery and communication technology, and able to solve complex problems (Kamaleswaran J, Rohaida M S and Rose 2014).

[1] Research Scholar, Regional Institute of Education (NCERT), Mysore, Karnataka, Email: noufalmrk@gmail.com

The 21stcentury is a technology age and in this age science, technology, engineering and mathematics (STEM) education play an important role in shaping the culture and economic development with a viewpoint of innovativeness, creativity and problem solving (Cooper &Heaverlo, 2013).STEM instruction is defined as an educational system creating connections the disciplines which are science, technology, engineering and mathematics and application-oriented approaches (Bybee, 2010).STEM education provides opportunities for students to be able to solve problems, to be innovators, inventors, self-confident, logical thinkers and technologically literate (Morrison, 2006; Stohlman et al., 2011). While integrated STEM education is an attempt to combine these four disciplines with connections established between topics and real-world problems, it does not always have to involve all these four disciplines. Engineering is becoming more widespread in K-12 schools and can offer students the opportunity to solve problems in the fields of mathematics, science and technology while they work through the design process (Stohlman et al., 2011).

Moore et al. (2015) define it as "the teaching and learning of the content and practices of disciplinary knowledge which include science and/or mathematics through the integration of the practices of engineering and engineering design of relevant technologies." To them, five characteristics distinguish integrated STEM instruction from other teacher pedagogy: (a) the content and practices of one or more anchor science and mathematics disciplines define some of the primary learning goals; (b) the integrator is the engineering practices and engineering design of technologies as the context; (c) the engineering design or engineering practices related to relevant technologies requires the use of scientific and mathematical concepts through design justification; (d) the development of 21st century skills is emphasized; and(e) the context of instruction requires solving a real-world problem or task through teamwork. This conceptualization of STEM is grounded in learning research.

STEM education approach is becoming popular in India. It can be useful at various levels of education starting from primary level to higher education. Student's attitude and interests will be a crucial factor while implementing these kinds of innovative teaching approaches. They are the ultimate beneficiaries of it and will be useful for their career. In this perspective, the present study focused on finding the attitude of secondary school students on STEM education and development of 21st century skills through it. Hence the objectives of the present study were formulated as follows:

- To find out the difference in attitude towards Science, Mathematics, Engineering and Technology among secondary school students of Kerala based on Gender
- To relate the attitude between STEM approach and 21st century skills of secondary school students of Kerala

II. HYPOTHESES

H0: There is no significant difference in the mean attitude score of secondary school students based on Gender

H1: There is no significant relationship in the mean attitude scores between the STEM approach and 21st century skills of secondary school students

III. METHODOLOGY

Normative survey method was adopted for collecting the data from the participants. Participants were selected based on convenient sampling method. A total of 140 Participants, who are currently in 9th standard from two different state government schools of Malappuram District of Kerala, was selected for the study. Gender wise distribution of the participants was as follows:

Table 1: Summary of participants' demographics (N=140)

Gender	Frequency	Percentage
Male	6445.71	
Female	7654.29	
Total	140	100

The instrument used in this study was the "High School Student Attitudes toward STEM survey by Friday Institute for Educational Innovation". The instrument distributed in to four components namely Attitude towards mathematics, Attitude towards science, Attitude towards Engineering and Technology and 21st century skills. The items were coded on a five point likert scale ranging from 1 to 5 (Strongly agree, Agree, Neither agree nor disagree, Disagree, Strongly Disagree). Both positive and negative items were included it. Scoring was done accordingly.

The items wise distribution of the instrument was as follows:

Table 2: Item wise distribution of the Instrument

Items	Number of items
Attitude towards mathematics	8
Attitude towards Science	9
Attitude towards Engineering and Technology	9
21st century skills	11
Total	37

The data collection of this study was done through direct contact with the participants via printed materials. Prior to conduct the survey, permission was taken from the respective authorities. At the beginning of the survey proper and clear instruction was given to the participants. Researcher had clarified the doubts of the participants when it is raised. Sufficient time was given to complete the survey.

IV. DATA ANALYSIS AND INTERPRETATION

Data analysis was done through JAMOVI 2.2.5 software (Open and free statistical software). Appropriate statistical tests such as descriptive statistics, inferential statistics (Independent sample t-test) were used for analysing the data.

Table 3: Group Descriptive of attitude towards mathematics

	Group	N	Mean	SD	SE
Attitude towards Mathematics	Boys	64	24.6	2.90	0.362
	Girls	75	27.0	3.43	0.396

Independent Samples T-Test

		Statistic	P
Attitude towards Mathematics	Student's t	-4.43 □	<□.001

□ Levene's test is significant ($p < .05$), suggesting a violation of the assumption of equal variances

From the above table it is evident that the obtained t value, -4.43 is significant at 0.05 level, which indicates that there is a significant difference in the in the mean attitude scores of sub sample based on gender. Hence the null hypothesis stating that there is no significant difference in the mean attitude scores of boys and girls is rejected, and thus the alternative hypothesis stating that there is a significant difference in the mean attitude scores of boys and girls is upheld. Thus, it can be concluded that there exists significant difference in the mean attitude scores of boys and girls. Further, the mean achievement scores of girls 27.0 is significantly higher than that of boys, 24.6. Thus, it can be concluded that girls having better attitude than boys towards mathematics.

Findings: Girls are having higher attitude towards Mathematics than that of boys.

Table 4: Group Descriptive of Attitude towards Science

	Group	N	Mean	SD	SE
Attitude towards Science	Boys	64	24.4	7.02	0.878
	Girls	75	29.1	5.35	0.618

Independent Samples T-Test

		Statistic	p
Attitude towards Science	Student's t	-4.55	<□.001

From the above table it is evident that the obtained t value, -4.55 is significant at 0.05 level, which indicates that there is a significant difference in the in the mean attitude scores of sub sample based on gender. Hence the null hypothesis stating that there is no significant difference in the mean attitude scores of boys and girls is rejected, and thus the alternative hypothesis stating that there is a significant difference in the mean attitude scores of boys and girls is upheld. Thus, it can be concluded that there exists significant difference in the mean attitude scores of boys and girls. Further, the mean achievement scores of girls 29.1 is significantly higher than that of boys, 24.4. Thus, it can be concluded that girls having better attitude than boys towards science.

Findings: Girls are having higher attitude towards Science than that of boys.

Table 5: Group Descriptive of Engineering and technology

	Group	N	Mean	SD	SE
Attitude towards Engineering and Tech.	Boys	64	32.4	9.77	1.22
	Girls	75	28.4	4.20	0.485

Independent Samples T-Test

		Statistic	p
Attitude towards Engineering and Tech.	Student's t	3.20 □	0.002

□ Levene's test is significant ($p < .05$), suggesting a violation of the assumption of equal variances

From the above table it is evident that the obtained t value, 3.20 is significant at 0.05 level, which indicates that there is a significant difference in the in the mean attitude scores of sub sample based on gender. Hence the null hypothesis stating that there is no significant difference in the mean attitude scores of boys and girls is rejected, and thus the alternative hypothesis stating that there is a significant difference in the mean attitude scores of boys and girls is upheld. Thus, it can be concluded that there exists significant difference in the mean attitude scores of boys and girls. Further, the mean achievement scores of boys 32.4 is significantly higher than that of girls, 28.4. Thus, it can be concluded that boys having better attitude than girls towards engineering and technology.

Findings: Girls are having higher attitude towards Science than that of boys.

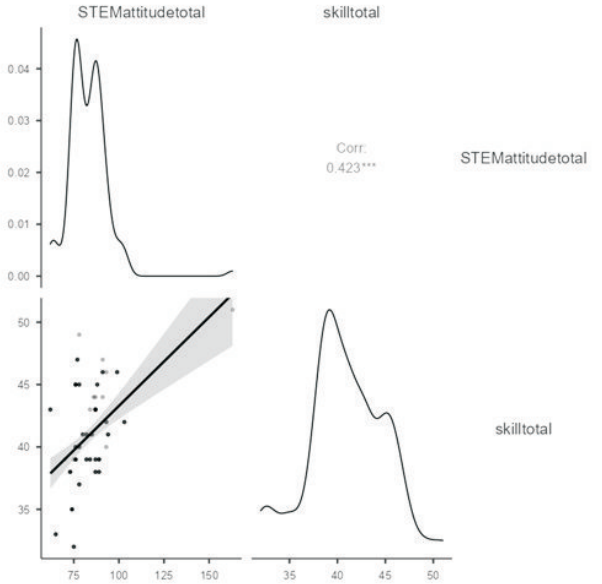
H1: There is no significant relationship in the mean attitude scores between the STEM approach and 21st century skills of secondary school students

Table 6: Correlation Matrix for STEM Attitude and Attitude towards 21st Century Skills

		STEMattitudetotal
21st Century Skill	Pearson's r	0.423 ***
	p-value	<□.001
	95% CI Upper	0.551
	95% CI Lower	0.276

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 1: Correlation plot between Attitude towards STEM and attitude towards 21st century skills



The correlation coefficient between attitude towards STEM approach and attitude towards 21st century skills is found to be 0.423. From the above table is found that the correlation coefficient is significant at0.001 levels of significance only. Hence the formulated null hypothesis stating that, there is no significant relationship in the mean attitude scores between the STEM approach and 21st century skills of secondary school students is rejected at 0.001 level. Thus it can be concluded that there exists significant relationship in the mean attitude scores of boys and girls on STEM approach and 21st century skills.

V. DISCUSSION

The study was designed to find out the secondary school student's attitude towards Science, Mathematics, Engineering and Technology and 21st century skills. Results found that, girls having higher attitude towards science and mathematics compared to boys, where as boys having higher attitude in engineering and technology compared to girls. The instrument used in this study had moderate validity and reliability (Cronbach's alpha coefficient was 0.64)

The present study was in tune with the results of the study conducted by Ozgun-Koca and Sen (2011), whose research results are found that positive attitude towards science and mathematics. Second findings revealed that a moderate correlation occurs between the attitude of student's towards the STEM approach and 21st century skills. Girl student's low level of attitude towards engineering and technology needs to be addressed properly and appropriate measures should be taken from the authorities to bring them up in the field.

VI. CONCLUSION

STEM approach is the need of the hour. Teaching approaches should need a drastic shift traditional subject specific teaching to integrated multi disciplinary teaching. Attitudes and interest plays a major role in educational process. If one have positive attitude towards education and thus teaching and learning, they will enjoy the process. Else it is very difficult for others to make them learn. Students and teachers should have a positive attitude towards the STEM approach. In addition to the mastery over the content, present generation student's wishes to acquire the necessary 21st century skills also. It should be imbibed to them through adopting appropriate teaching approaches starting from primary level through secondary level to finally higher education level.

Acknowledgement: This study is based on the author's Ph.D. thesis. Samples were selected according to the need for the study.

Conflict of Interest: Author has no conflict of interest.

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