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Research Article

STEM Knowledge Awareness among Higher Secondary School Students

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Abstract
Educators in the twenty-first century need to think of innovative ways to engage and prepare students for current and future challenges while cultivating an interest among students in STEM disciplines. This study sought to investigate students' STEM knowledge awareness and the level of STEM knowledge awareness among higher secondary school students. Only higher secondary level students which engaged in imparting higher secondary school education in the class of twelfth included. The study focused on the higher secondary level education with Tamil Nadu state board education. This study main objectives were to find out the level of STEM knowledge awareness among higher secondary school students, to find out whether there is any significant difference in STEM knowledge awareness of higher secondary school students owing to differences in Parents' Educational status and to find out whether there is any significant difference in STEM knowledge awareness of higher secondary school students owing to differences in Type of school. This study employed a survey measure design and a simple random sampling technique. An instrument such as standardized tool STEM knowledge awareness was used for data collection from the sample of 204 higher secondary school students around Karaikudi in Sivaganga. Data were taken using Questioner. Data were analyzed using descriptive analysis. The tool comprises 2 sections such as the demographic profile, and STEM knowledge awareness (16 statements). Raw data from the questionnaires was digitised, manually coding them using SPSS statistical analysis software. The statements under the usage of the Internet were measured using a 5-point Likert scale consisting of 5 Strongly Agree, 4 Agree, 3 Neutral, 2 Disagree, and 1 Strongly Disagree. The study's findings reveal no significant difference and a favourable level of awareness of STEM knowledge among higher secondary school students.

Keywords: Education Awareness, Green Innovation, Green Technology, Higher Secondary, STEM Awareness

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1. INTRODUCTION

The main goal of STEM education is to provide students with the knowledge and skills they will need to apply what they learn in the lab and classroom to real-world occupations in the twenty-first century (Stark, 2016). Additionally, the term "STEM" was created in the 1990s by the National Science Foundation and has since been applied to any activity, policy, programme, or occasion that incorporates one or more STEM disciplines (Bybee, 2010). Once more, the education world has jumped on a phrase without actually delving into the meaning of the term when used in contexts beyond simple labelling. The majority of people use the term STEM to imply whatever they used to mean. Thus, STEM is typically understood to refer to math or science. It hardly speaks of engineering or technology. Demirtaş & Ekşioğlu, (2020) states that scientific and technological developments occurring in the world have affected people's lives remarkably. Today being called as information age, science, technology, mathematics and engineering knowledge and skills must be integrated to understand and interpret the developments in the world, to communicate using the technologies introduced to make scientific evaluations and to develop innovations.

1.1. Literature Review

The importance of STEM awareness varies among different groups including teachers, students, and professionals. While most people define STEM as Science, Technology, Engineering, and Mathematics, researchers debate about the level of integration of these disciplines as a definition of STEM literacy or the exclusion of one or more disciplines within a STEM curriculum or program. Many studies include an introduction about STEM awareness, indicating the author's understanding of the subject and suggesting a need to operationalize STEM (Bybee, 2010). These initial statements often imply that perceived definitions shape the implementation of STEM programs in school settings (P. L. Brown et al., 2016).

Even if technology and engineering goods have had a significant impact on daily life, for most people, it still means simply science and math. Students' comprehension of how things function and their use of technology should both improve with a true STEM education. Engineering should be taught more in STEM courses before college. Students should study engineering and acquire some of the skills and abilities related to the design process, given its economic significance to society. STEM classes help students at various stages in life to gain knowledge and learn ways to apply that knowledge. Starting in pre-school, young children learn the basics; then, in high school, older students can apply basic skills; finally, in college and graduate school, students study further and master their skills. However, this knowledge can also be disbursed through the Internet courtesy of improved technology. Children and adults alike can learn STEM skills online. Videos, journals, books, courses, and other learning materials are online and accessible to anyone who needs them. Classes under STEM revolve around the following areas discussed in the subsequent sections. STEM Science, STEM Technology, STEM Engineering, STEM Math. According to Acar & Directorate, (2021), one of the main goals of STEM education is to develop 21st-century skills such as problem-solving, critical thinking, creativity, and collaboration. Skills are acquired at a young age and improved at later ages. Because it is incumbent on teachers who implement STEM education to develop these skills, it is of key importance for teachers to know the four disciplines.

1.2. General Education and Vocational

The STEM agenda includes a clear vocational strategy that is primarily focused on science and engineering. Although the UK government discusses expanding the flow of qualified individuals into the STEM workforce and takes a broad approach to vocational goals, its primary concern is the large number of engineering graduates from the Pacific Rim and India and the concurrent decline in UK engineering graduate numbers (Williams, 2011). STEM education, according to many technology education studies, can lead to a career in engineering Wicklein, (2006). Its recent successor, STEAM, also incorporates the arts, which have the "ability to expand the limits of STEM education and application," according to the Stem Education Guide. STEAM is designed to encourage discussions and problem-solving among students, developing both practical skills and appreciation for collaboration, according to the Institution for Art Integration and STEAM. According to Kennedy and Odel (2014), STEM Education has become an international topic of discussion over the past decade. Science and Technology Education calls upon all involved in research, policy development, and the teaching of STEM disciplines to recognize the need to better prepare students for their future lives as global citizens.

1.3. Innovative Path

Whether students are drawn to traditional STEM programs or tend to gravitate toward other subjects, the skills they strengthen through STEM learning can be carried over into art, sports, baking, communication, entrepreneurship and so much more. Concepts of STEM are creative, problem-solving, innovative way of thinking, and fun exploring a multitude of interests. It is more crucial than ever for our country's students to be equipped with the knowledge and abilities to solve issues, make sense of information, and acquire and assess data to make decisions in a world that is always changing and becoming more complex. Students who study computer science and other STEM (science, technology, engineering, and math) subjects acquire these kinds of skills. It includes building students' abilities, content knowledge, and literacy in STEM fields. It is crucial for a country where our future workers, neighbours, and leaders can comprehend and solve some of the difficult challenges of today and tomorrow, as well as fulfil the needs of the dynamic and evolving workforce.

Further, Aini et al. (2020) the 21st century is a century of globalization marked by advances in science and technology, and the application of science and technology has shown revolutionary changes in many countries. To stay in global competition, everyone is required to have superior competence and skills. Some countries have established scientific literacy as a goal of science education. Science literacy in the modern era is currently very much influenced by technology so it requires an understanding of science and mastery of technological issues. The role of science and technology is needed in the era of globalization to improve the competitiveness and prosperity of the nation. Every country needs the readiness to face the era of globalization in various fields, especially education. The field of education is at the forefront of a country. Education needs to provide the best facilities. Especially, Science learning with the STEM approach has the potential for the development of learning oriented to the provision of students' higher-order thinking skills, thus the classroom climate must be able to actively involve students in the learning process (Aini et al., 2020).

1.4. Concerns With Stem Education

According to Gonzalez & Kuenzi, (2014), stakeholders who are interested in STEM education improvement provide Congress with a diverse range of policy alternatives. Concerns with the governance of federal programme administration are addressed by a few of these recommendations, such as eliminating duplication and enhancing programme coordination within and between departments. Other policy alternatives concentrate attention on components of the elementary and secondary education systems, such as bolstering school accountability mechanisms and increasing the number and quality of math and science instructors. Further suggestions focus on post-secondary education, such as increasing undergraduate STEM major retention and fortifying incentives to seek higher STEM education. Enhancing the STEM education results of underrepresented communities is the focus of many options.

1.5. Defining Success

According to the statement of Beatty, (2011), the committee was asked to identify schools that have been highly successful at K - 12 STEM education and to draw lessons for schools across the country, committee chair Adam Gamoran explained, but he stressed that this is a more complex challenge than it might seem. STEM encompasses many disciplines and kinds of education, and there are many ways to define it. Because of limits to the time and resources available for this project, the committee focused on mathematics and science. The bulk of the research and data concerning STEM education at the K-12 level relates to mathematics and science education. Research in technology and engineering education is less mature because those subjects are not as commonly taught in a K-12 context, but the committee fully recognizes the importance of engineering and technology education, of conceptual connections among STEM subjects and of other stages and types of schooling including informal STEM learning.

1.6. Integrative STEM Education

Sanders, (2009) discussed that the four STEM education communities have engaged in massive and ongoing educational reform efforts over the past 20 years (e.g. Abet Inc, 2010) is convincing evidence of the serious STEM education challenges to be addressed. The STEM education establishment has long believed STEM education hasn't been working as well as it should, and has been toiling steadfastly to make improvements. But instead of praising their successes, public concern has escalated. In recent years, the "STEM pipeline" problem the decrease in the number of students pursuing STEM fields, particularly those from historically underrepresented populations has been widely publicized. Much of the attention has focused on addressing the shortage of qualified science and mathematics teachers, a problem the No Child Left Behind Act (2001) has targeted. The NCLB legislation has resulted in increased attention to science and mathematics teacher education, alternative routes to licensure, and new avenues for attaining "highly qualified" teaching status.

1.7. Understanding of STEM

As schools and teachers focus more on STEM education, there is a need to define what it entails. The term STEM is often defined as including science, technology, engineering, and mathematics, but there are questions about which sciences are included, the level of mathematics required, and the definition of technology (B. R. Brown et al., 2021; Merrill et al., 2010). Defining the specific areas of science, technology, engineering, and mathematics within STEM education is not the only concern; there are also questions about how STEM education should be implemented (Chen, 2009). These questions are crucial for understanding how STEM education should function in schools and what it will look like in classrooms.

1.8. Scope of the Study

The scope of the present study is limited to the following

- Only higher secondary level students which engaged in imparting higher secondary school education in the class of twelfth was included.
- The study focused on the higher secondary level education with Tamil Nadu state board education.

2. METHODOLOGY

A survey method was approved by the researcher to conduct this study.

2.1. Objectives of the Study

- To find out the level of STEM knowledge awareness among higher secondary school students.
- To find out whether there is any significant difference in STEM knowledge awareness of higher secondary school students owing to differences in Parents' Educational status.
- To find out whether there is any significant difference in STEM knowledge awareness of higher secondary school students owing to differences in Type of school.

2.2. Hypothesis of the Study

- The level of STEM knowledge awareness among higher secondary school students is moderate.
- There is no significant difference in STEM knowledge awareness of higher secondary school students owing to differences in Parents' Educational status.
- There is no significant difference in STEM knowledge awareness of higher secondary school students owing to differences in Type of school.

2.3. Participants

The researcher applied a random sampling technique for selecting the sample. The sample for the present study comprises 204 students from higher secondary schools around Karaikudi in Sivaganga.

2.4. Procedures and Research Instruments

Watson et al. (2022) prepared a questionnaire that was used for the collection of data. The tool comprises 2 sections such as the demographic profile, and STEM knowledge awareness (16 statements). Raw data from the questionnaires was digitised, manually coding them using SPSS statistical analysis software. The statements under the usage of the Internet were measured using a 5-point Likert scale consisting of 5 Strongly Agree, 4 Agree, 3 Neutral, 2 Disagree, and 1 Strongly Disagree. The critical ratio was computed to test the difference in STEM knowledge awareness among higher secondary school students concerning Parents' Educational status and type of School.

2.5. Research Method

Descriptive survey method has been employed in this study.

2.6. Tools Used for the Study

The present study made use of printed tools for data collection. The printed paper tool was STEM knowledge awareness questionnaires that were designed based on the research work of (Kulturel-Konak, 2020) by the first and second authors. These questionnaires were used to gather STEM knowledge awareness of higher secondary school students. Additionally, the Researcher developed the STEM knowledge awareness scale with the guidance of the Research Supervisor.

2.7. Selection of Sample

The study's sample consisted of 204 higher secondary school students from Karaikudi and surrounding areas in Sivaganga, Tamil Nadu, who were selected through simple random sampling.

2.8. Statistical Techniques

The critical ratio was computed to test the difference in students' awareness of STEM knowledge with respect to Parents' Educational status, and Type of school.

The following statistical techniques were used to analyze the data and draw meaningful generalizations.

- To find out the level of STEM knowledge awareness among higher secondary school students was also determined.
- Differential Analysis i.e. 't' test to find out the mean difference between two variables.
- Differential Analysis i.e. ANOVA to find out the mean difference among more than two variables.

3. RESULTS

3.1. Hypothesis 1: The Level of STEM Knowledge Awareness Among Higher Secondary School Students Is Moderate

Table 1. Level of STEM Knowledge Awareness

Low Q_1= Below 53		Moderate Q_2=54-65		High Q_3=66+	
No.	**%**	**No.**	**%**	**No.**	**%**
40	19.6	131	64.2	33	16.2

It is inferred from the above Table 1 that, 19.6% of the students have low, 64.2 % of them have moderate and 16.2% of them have high levels of STEM knowledge awareness. Since the moderate level is high the hypothesis is accepted.

4.2. Hypothesis 2: There is No Significant Difference in STEM Knowledge Awareness of Higher Secondary School Students Owing to Differences in Parents' Educational Status

From Table 2, 'the t-test analysis result of the demographic variable parents' educational status shows that 58.47 the school education mean score is less than 59.49 the higher education mean score of parent education. Accordingly, ±6.458 the standard deviation of parent-school education students' STEM knowledge awareness is significantly greater than ±5.173 the standard deviation of parent-higher education students' STEM knowledge awareness. Since the calculated value (1.24) is less than the table value (1.96) the hypothesis, 'There is no significant difference in STEM knowledge awareness of higher secondary school students owing to parent' educational status is accepted and the school education and higher education do not differ significantly in STEM knowledge awareness.

Table 2. Mean Difference in the STEM Knowledge Awareness of Higher Secondary School Students Owing to Differences in Parents' Educational Status

		STEM Knowledge Awareness				
Demographic variable	**Sources of Variation**	**No**	**Mean**	**Standard Deviation**	**Calculated Value**	**Significance**
Parents' educational status	School education	81	58.47	6.458	1.24	1.24<1.96 NS
	Higher education	123	59.49	5.173		

(At a 5% level of significance table value of 't' is 1.96)

4.3. Hypothesis 3: There is No Significant Difference in STEM Knowledge Awareness of Higher Secondary School Students Owing to Differences in Type of School

ANOVA test analysis of Table 3 shows that the calculated 'f' value of 0.695 is less than the 'f' table value of 2.99. The hypothesis is assumed that there is no significant difference in the STEM knowledge awareness of higher secondary school students owing to the type of school. Hence, the investigator infers that there is no significant difference in STEM knowledge awareness owing to the type of school among higher secondary school students.

Table 3. Mean Difference in the STEM Knowledge Awareness of Higher Secondary School Students Owing to Differences in Type of School

Demographic Variable		**SS**	**Df**	**MS**	**f**	**Level of Significance**
Type of school	Between groups	45.687	2	22.843	0.695	0.695<2.99 **NS**
	Within groups	6605.897	201	32.865		

(At a 5% level of significance table value of 'f' is 2.99)

5. DISCUSSION AND CONCLUSION

Educators in the 21st century need to find innovative ways to engage and prepare students for current and future challenges, while also fostering an interest in STEM disciplines among students. According to the B. R. Brown et al. (2021), the findings of this study highlighted the need for STEM education and STEM career opportunities. Furthermore, understandable information about STEM has got to parents. More information about STEM academies and their benefits has been given to be made available to parents. Nowadays, awareness and benefits of STEM classes and STEM careers are made available to parents (Tekerek & Karakaya, 2018). Along with this, Potential STEM employers are invited to speak to parents. All types of schools provide STEM education awareness and opportunities for students. Adequately, new STEM curricula are implemented the all types of schools. Due to this reason, there is no significant difference in STEM knowledge awareness.

STEM education is not well understood. Less than one-half of the higher secondary level students understood the concept of STEM education. Even students in the STEM fields had varying levels of understanding of STEM education at every educational institution who intend to start a STEM-focused course or program. There is a great need for awareness-raising at higher secondary level students. Many in the field of technology education have embraced STEM education (as evidenced by the ITEEA website, conference, and publications) but there is a lack of understanding of STEM education in schools. Science learning with the STEM approach has the potential for the development of learning-oriented to the provision of students' higher-order thinking skills, thus the classroom climate must be able to actively involve students in the learning process. Scientific and technological developments occurring in the world have affected people's lives remarkably. Today being called as information age, science, technology, mathematics and engineering knowledge and skills must be integrated to understand and interpret the developments in the world, to communicate using the technologies introduced to make scientific evaluations and to develop innovations. One of the main goals of STEM education is to develop 21st-

century skills such as problem-solving, critical thinking, creativity, and collaboration. Skills are acquired at a young age and improved at later ages. Because it is incumbent on students who implement STEM education to develop these skills, it is of key importance for students to know the four disciplines.

Data Availability Statement. In the analysis, the authors generated primary data using a structured questionnaire. The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interest. The authors declare no conflicts of interest.

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