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Awareness of Stem Approach among School Teachers in Tirunelveli District

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The study determines how well-informed Tirunelveli district school teachers are about the concept of the STEM (Science, Technology, Engineering and Mathematics) approach. To foster students' critical thinking, problem-solving and innovative abilities, the STEM approach combines these disciplines in an interdisciplinary and practical learning framework and emerges as a crucial element of contemporary education. Nevertheless, a pivotal entity in the success of STEM education is the comprehension and application of this strategy by teachers. Teachers who wanted to completely integrate STEM concepts in their classes faced obstacles like insufficiency of resources, curriculum limits and a lack of training. This work signifies the need for targeted professional development programmes, better access to resources, and curriculum revision to ensure that teachers can effectively incorporate STEM instruction.

Keywords: Critical thinking, problem-solving, real-world application.

1. Introduction

The cornerstone of human progress is education. It develops people's intrinsic abilities, improves their knowledge and skills, modifies their behaviour, and turns them into civilized and cultured citizens. Learning is a continuous process throughout life. It is the process of development from early childhood to adulthood. It's a process of developing one's character that makes one more logical, competent, receptive and intellectually independent. It serves as the cornerstone upon which a nation is built. Every person experiences it as a dynamic force that shapes their physical, mental, emotional, social, and ethical development. Education is the process of gaining knowledge, skills, habits, attitudes and beliefs. It inevitably aids individuals in developing into valuable contributors to society. Education is the medium through which information about current events is disseminated and modern understanding is increased.

Education tries to meet the needs of the nation while addressing the challenges of the modern day.

In today's educational scenario, science cannot be understood without technology, which

bases the majority of its research and development on engineering, which is impossible to produce without a grasp of mathematics. utilizing an integrated, multidisciplinary STEM approach. This method provides pupils with holistic outcomes and pertinent learning experiences. The STEM approach places a strong emphasis on 21st-century abilities including self-reliance, creativity, problem-solving, critical thinking and invention as well as teamwork.

STEM approach

The notion of STEM was initially introduced by the National Science Foundation (NSF) in 2001. Studying the four topics, namely Science, Technology, Engineering and Mathematics from both theoretical and practical perspectives is known as the STEM method. The STEM approach to learning and skill development has been evolving from a collection of distinct disciplines to a more integrated and multidisciplinary approach. A broader integration strategy in STEM education is made possible and encouraged by this innovative method, which combines formal and informal learning environments with real-world context-based instruction. The STEM approach is crucial for technology since it integrates concepts and relates to several disciplines.

Define STEM

STEM is the foundation of academic pursuits for students with Science and Mathematics in particular. They are defined as:

Science: Science is the systematic study of the physical and natural world's structure and behaviour by observing, investigating, and testing hypotheses derived from gathered data.

Technology: The educational or instructional technology that is used to foster teaching and learning. The practical goals of human life are linked with the application of scientific knowledge.

Engineering: Divergent approaches to designing, constructing, and maintaining machines, structures, materials, tools, systems, processes and organizational frameworks using science, mathematics, and empirical data.

Mathematics: The science and study of quality, structure, space and change.

2. Review of related literature

Shweta Mishra and Satyendra Gupta (2023) studied the analysis of school teachers' awareness level in STEM education. The study analyzed the variables that affect teachers' awareness, investigated the difficulties they encounter when adopting STEM education and suggested methods to raise teacher awareness for successful STEM integration in the classroom.

Kratika and Khan Adnan Lodi (2022) explored the attitude and teacher's awareness of STEM education. The sample consisted of 302 elementary school teachers in Delhi. The result showed that STEM improved the quality of teaching and learning as teachers have positive attitudes towards it.

Bakirci and Karisan, et al. (2018) discovered the level of STEM approach knowledge among pre-service elementary school Math and Science teachers. Awareness of Science and

Technology preparation training for teachers in both Science and primary education Mathematicians' STEM awareness is greater than pre-service teachers.

Significance

The world is becoming progressively more competitive these days. Throughout our lives, the primary objective of all our endeavours has been to execute with quality. The aspiration for exceptional performance places a great deal of strain and stress on educators, students, and the educational system as a whole. Alongside core subjects, the STEM approach to education promotes creativity and divergent thinking. Students are encouraged and inspired to create new technology, ideas, and a wide range of experiences and abilities. For an all-round education, the contribution of STEM education is pivotal and note-worthy.

A wide and in-depth awareness of the world can be imbibed by the students who learn Science. This will eventually broaden their critical thinking skills and research. Technology prepares young people who work in an atmosphere rich in high-tech innovations. This study also seeks to determine the best course of action for raising teacher knowledge and incorporating STEM education into the classroom. The study will aid the teachers in improving their understanding of STEM methodologies in education.

Operational definition

Awareness

Awareness or comprehension of something happening or already existing: awareness and understanding of the situation.

STEM approach

STEM education is a curriculum created to teach children four different subjects namely, Science, Technology, Engineering and Mathematics, which uses a multi-disciplinary and applied approach. STEM curriculum combines a unified learning archetype centred on their practical applications and does not teach the four disciplines as distinct and discrete subjects.

School teachers

Teachers are professionals who work in academic institutions like elementary, middle, or high schools, where they are in charge of teaching and guiding pupils in a variety of disciplines. Lesson planning, providing educational materials, monitoring student achievement, controlling classroom behaviour, and cultivating a secure, encouraging learning environment are among their responsibilities. To fulfil each student's unique requirements and improve the educational experience, they also work in conjunction with parents, administrators, and other educators. Teachers have a significant impact on how pupils develop intellectually, socially, and emotionally.

Objectives

1. To develop and validate the awareness of STEM approach inventory.

2. To explore the level of awareness of STEM approach in school teachers with regard to gender.

3. To ascertain whether there is any significant difference between rural and urban school

teachers regarding awareness of STEM approach.

4. To ascertain whether there is any significant difference between Tamil and English medium primary school teachers regarding awareness of STEM approach.

Null hypotheses

1. There is no significant difference between male and female school teachers regarding awareness of STEM approach.

2. There is no significant difference between rural and urban school teachers regarding awareness of STEM approach.

3. There is no difference between Tamil and English medium school teachers regarding awareness of STEM approach.

3. Methodology

The Survey method has been used in the work "Awareness of STEM approach among school teachers in Tirunelveli District".

Population

The population is school teachers, employed at government, aided and self-financing schools in the district of Tirunelveli.

Sample

Simple random sampling technique is used. The sample includes 250 school teachers from 20 schools in the district of Tirunelveli.

Tools used

Awareness of the STEM approach Inventory was used in the study, which was prepared and validated by Viji and Deepa (2023).

Descriptive analysis

Objective 1

To explore the level of awareness of STEM approach in school teachers with regard to gender.

Table 1. Level of awareness of STEM approach in school teachers with regard to gender

Dimensions	Gender	Low		Moderate		High	
		N	%	N	%	N	%
Knowledge about STEM approach	Male	4	22.2	6	33.3	8	44.4
	Female	39	16.8	170	73.3	23	9.9
Government Initiatives	Male	5	27.8	4	22.2	9	50.0
	Female	47	20.3	142	61.2	43	18.5
STEM pedagogy	Male	2	11.1	7	38.9	9	50.0

	Female	28	12.1	168	72.4	36	15.5
Applicability of STEM approach	Male	2	11.1	8	44.4	8	44.4
	Female	26	11.2	169	72.8	37	15.9
Improvement of Skills	Male	2	11.1	8	44.4	8	44.4
	Female	41	17.7	157	67.7	34	14.7
Awareness of STEM approach in Total	Male	4	22.2	5	27.8	9	50.0
	Female	33	14.2	160	69.0	39	16.8

From Table 1, it is found that 22.2% of male school teachers have low, 33.3% have moderate and 44.4% have high levels of knowledge about the STEM approach. Regarding female school teachers, 16.8% have low, 73.3% have moderate and 9.9% have high level of knowledge about STEM approach.

27.8% of male school teachers have low, 22.2% have moderate and 50.0% have high level of government initiatives. Regarding the female school teachers, 20.3% have low, 61.2% have moderate and 18.5% have high level of government initiatives.

11.1% of male school teachers have low, 38.9% have moderate and 50.0% have high level of STEM pedagogy. Regarding the female school teachers, 12.1% have low, 72.4% have moderate and 15.5% have high level of STEM pedagogy.

11.1% of male school teachers have low, 44.4% have moderate and 44.4% have high level of applicability of STEM approach. Regarding the female school teachers, 11.2% have low, 72.8% have moderate and 15.9 % have high level of applicability to STEM approach.

11.1% of male school teachers have low, 44.4% have moderate and 44.4% have high level of improvement of skills. Regarding the female school teachers, 17.7% have low, 67.7% have moderate and 14.7 % have high level of improvement of skills.

22.2% of male school teachers have low, 27.8% have moderate and 50.0% have high level of awareness of STEM approach in total. Regarding the female school teachers, 14.2% have low, 69.0% have moderate and 50.0% have high level of awareness of STEM approach in total.

B. Differential analysis

Ho 1: There is no significant difference between male and female school teachers regarding awareness of the STEM approach.

Table 2. Awareness of STEM approach with regard to gender

Dimensions	Gender	N	Mean	S.D	Calculated 't' value	Remarks at 5% level
Knowledge about STEM approach	Male	18	19.06	6.557	1.731	NS
	Female	232	16.34	4.310		
Government initiatives	Male	18	18.33	6.817	1.521	NS
	Female	232	15.86	4.604		

STEM pedagogy	Male	18	20.89	6.489	2.200	S
	Female	232	16.84	4.329		
Applicability of STEM approach	Male	18	21.17	6.922	2.217	S
	Female	232	17.49	4.666		
Improvement of skills	Male	18	22.72	6.524	2.637	S
	Female	232	18.59	4.435		
Awareness of STEM approach in total	Male	18	102.17	32.715	2.177	S
	Female	232	85.12	20.624		

(At 5% level of significance for df 248, the table value of 't' is 1.96, S – Significant, NS-Not Significant)

In the aspects of knowledge of STEM approaches and government initiatives, Table 2 shows that the calculated "t" value (1.731, 1.521) is less than the table value (1.96) for df 298 at the 5% level of significance. Nonetheless, there is a notable distinction between male and female educators in the dimensions of STEM pedagogy, applicability of STEM approach, improvement of skills and awareness of STEM approach than the female school teachers. Thus, the respective null hypothesis is rejected.

When comparing the mean scores of male (Mean=20.89, 21.17, 22.72, 102.17) and female teachers (Mean=16.84, 17.49, 18.59, 85.12) it is inferred that male school teachers have better in the dimensions of STEM pedagogy, applicability of STEM approach, improvement of skills and awareness of STEM approach than the female school teachers.

Ho 2: There is no significant difference between rural and urban school teachers regarding awareness of STEM approach.

Table 3. Awareness of STEM approach with regard to locality

Dimensions	Gender	N	Mean	S.D	Calculated 't' value	Remarks at 5% level
Knowledge about STEM approach	Rural	92	16.25	4.434	0.756	NS
	Urban	158	16.70	4.616		
Government initiatives	Rural	92	15.92	5.179	0.281	NS
	Urban	158	16.11	4.616		
STEM pedagogy	Rural	92	17.22	4.600	0.213	NS
	Urban	158	17.09	4.647		
Applicability of STEM approach	Rural	92	17.89	4.606	0.350	NS
	Urban	158	17.67	5.133		
Improvement of skills	Rural	92	18.80	4.693	0.224	NS
	Urban	158	18.94	4.753		
Awareness of STEM approach in total	Rural	92	86.09	22.449	0.144	NS
	Urban	158	86.51	21.919		

(At 5% level of significance for df 248, the table value of 't' is 1.96, S – Significant, NS-Not Significant)

The calculated "t" value (0.756, 0.281, 0.213, 0.350, 0.224, 0.144) for df 298 at the 5% level of significance is less than the table value (1.96), according to Table 3. Therefore, the corresponding null hypothesis is accepted. It demonstrates that there is no significant difference between teachers in rural and urban areas in the dimensions of knowledge about the STEM approach, government initiatives, STEM pedagogy, applicability of the STEM approach, improvement of skills and awareness of the STEM approach.

Ho 3: There is no difference between Tamil and English medium school teachers regarding awareness of the STEM approach.

Table 4. Awareness of STEM approach with regard to medium

Dimensions	Gender	N	Mean	S.D	Calculated 't' value	Remarks at 5% level
Knowledge about STEM approach	Tamil	42	11.55	2.760	11.647	S
	English	208	17.54	4.159		
Government initiatives	Tamil	42	11.10	2.775	11.198	S
	English	208	17.04	4.525		
STEM pedagogy	Tamil	42	12.98	2.967	9.061	S
	English	208	17.98	4.441		
Applicability of STEM approach	Tamil	42	12.76	2.730	11.291	S
	English	208	18.76	4.667		
Improvement of skills	Tamil	42	14.64	2.712	9.722	S
	English	208	19.75	4.578		
Awareness of STEM approach in total	Tamil	42	63.02	10.240	13.108	S
	English	208	91.06	20.797		

(At 5% level of significance for df 248, the table value of 't' is 1.96, S – Significant, NS-Not Significant)

Table 4 shows that, at the 5% level of significance, the calculated "t" value (11.647, 11.198, 9.061, 11.291, 9.722, 13.108) is higher than the table value (1.96) for df 298. Therefore, the corresponding null hypothesis is rejected. It demonstrates that teachers in Tamil and English-medium schools differ greatly from one another in the dimensions of knowledge about the STEM approach, government initiatives, STEM pedagogy and applicability of the STEM approach, improvement of skills and awareness of the STEM approach.

When comparing the mean scores of Tamil medium (Mean=11.55, 11.10, 12.98, 12.76, 14.64, 63.02) and English medium school teachers (Mean=17.54, 17.04, 17.98, 18.76, 19.75, 91.06) it is found that English medium school teachers have better in the dimensions of knowledge about STEM approach, government initiatives, STEM pedagogy, and applicability of STEM approach, improvement of skills and awareness of STEM approach than the Tamil medium school teachers.

5. Findings

a. Findings based on objectives

(i) 44.4% of male and 9.9% female school teachers have high level of knowledge about STEM.

(ii) 50.0% of male and 18.5 % female school teachers have high level of Government initiatives.

(iii) 50.0% of male and 15.5 % female school teachers have high level of STEM pedagogy.

(iv) 44.4% of male and 15.9 % female school teachers have high level of applicability in STEM.

(v) 44.4% of male and 14.7 % female school teachers have high level of improvement in skills.

(vi) 50.0% of male and 50.0% female school teachers have high level of STEM approach in total.

b. Findings based on null hypotheses

(i) There exists a significant difference between male and female school teachers in the dimensions of STEM pedagogy, applicability of the STEM approach, improvement of skills and awareness of the STEM approach. Male school teachers have better in the dimensions of STEM pedagogy, applicability of STEM approach, improvement of skills and awareness of STEM approach than female school teachers.

(ii) No significant difference between rural and urban school teachers in the dimensions of knowledge about the STEM approach, government initiatives, STEM pedagogy and applicability of the STEM approach, improvement of skills and awareness of the STEM approach.

(iii) Significant difference between Tamil and English medium school teachers in the dimensions of knowledge about the STEM approach, government initiatives, STEM pedagogy, applicability of the STEM approach, improvement of skills and awareness of the STEM approach. English medium school teachers have better in the dimensions of knowledge about STEM approach, government initiatives, STEM pedagogy, applicability of STEM approach, improvement of skills and awareness of STEM approach than Tamil medium school teachers.

Interpretations

The t test result revealed that male school teachers are better than female school teachers regarding STEM pedagogy, applicability of the STEM approach, improvement of skills and awareness of the STEM approach. This may be because male teachers are having time for their professional only. They have updated knowledge about their profession. The results of the t test showed that instructors in English medium schools have a greater understanding of the STEM approach, government initiatives, STEM pedagogy, the applicability of the STEM approach, improvement of skills and awareness of STEM approach than the teachers in Tamil medium schools, as English medium school have better resources and good environment.

Suggestions

There are some suggestions for further research:

(i) In-depth studies can be undertaken to explore the relative effectiveness of STEM Education.

(ii) A case study can be conducted to study the extent of implementation of STEM Education in classrooms and to identify the factors contributing to or impeding the use of these practices.

Educational implications

Teachers may find this study useful in their efforts to become more knowledgeable about the STEM approach. This study supports teachers with adequate pre-service and in-service training to assist them acquire the knowledge and abilities needed to successfully apply the STEM approach in the classroom. Education specialists and researchers will find it useful to create STEM-integrated pedagogical approaches that are appropriate for classrooms and to effectively disseminate among practitioners. Educators need to be knowledgeable about the several ways to help students develop their critical thinking abilities and apply those skills following the situation and goal of the lesson. This study may be useful to school administrators in providing adequate support systems, such as infrastructure availability, resource materials, and flexible class scheduling, to enable teachers to use STEM-related tactics with ease and efficacy.

6. Conclusion

The study determines school teachers' awareness of grades and the subjects they teach. This study shows that although school instructors have a favourable STEM approach, their awareness of the subject is just mediocre. It is critical to give educators the right training so they can better integrate the STEM approach in the classrooms. Teachers with a positive attitude can enhance the quality of teaching and learning. It can be utilized in the classroom to help students understand topics more clearly and to add interest to learning through experience-based learning.

References

1. Abdioglu, C., Cevik, M., & Kosar, H. (2021). Investigating STEM awareness of university teacher educators. European Journal of STEM Education, v6 n1. https://eric.ed.gov/?id=EJ1289908
2. Buechel, C. (2021). An investigation of the effects of self-efficacy on STEM implementation. Curriculum and Instruction [Undergraduate Honors Theses]. Retrieved from https://scholarworks.uark.edu/cieduht/24
3. Bakirci and Karisan, et al. (2018). Investigating the Preservice Primary School, Mathematics and Science Teachers' STEM Awareness. Journal of Education and Training Studies, v6 n1 p32-42 Jan 2018
4. Deepa, H. (2020). Test Engineering and Management, 82(January-February 2020), 7882–7886. https://doi.org/The Mattingley Publishing Co., Inc.
5. Jiang, H., Wang, K., & Wang, X. (2021). Understanding a STEM teacher's emotions and

professional identities: a three-year longitudinal case study. IJ STEM Ed 8, 51. https://doi.org/10.1186/s40594-021-00309-9

6. Kratika Khan,Adnan Lodi. (2022). Teachers Awareness and Attitude towards integrating STEM Education in Teaching and Learning A Study. Shodhanga. http://hdl.handle.net/10603/412985
7. Kamizi, W. & Iksan, Z. (2021). Teachers' Perceptions and Attitudes towards the Science, Technology and Society Approach in Science Teaching. Creative Education, 12, 2216-2227. doi: 10.4236/ce.2021.129169.
8. Nguyen, T., & Tran, T. (2020). STEM Education in Secondary Schools: Teachers' Perspective towards Sustainable Development. Sustainability, MDPI, vol. 12(21), 1-16.
9. Shweta Mishra & Satyendra Gupta. (2023). Analysis of the Levels of Awareness of School Teachers toward STEM Education. JOURNAL OF TEACHER EDUCATION AND RESEARCH, 18. https://doi.org/https://doi.org/10.36268/JTER/18104