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RESEARCH ARTICLE

Teachers' attitudes towards S.T.E.M. in secondary education

Maria Kalliontzi

Department of Preschool Education, University of Crete, Crete, Greece

Correspondence to: Maria Kalliontzi, Department of Preschool Education, University of Crete, Crete, Greece; Email: ptpep604@edc.uoc.gr

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Abstract: The primary purpose of this study was to examine the level of secondary education teachers' attitudes towards implementing S.T.E.M. in the classroom. Moreover, previous relative research studies' findings were reviewed to assist in the analysis of the current study. The main instrument of the study was a questionnaire containing 18 items using a 5-point Likert scale administered to 121 K-12 school teachers. Descriptive, independent t-tests and ANOVA analyses were applied to analyze the research findings. The results showed a highly positive attitude towards S.T.E.M. education. Nevertheless, teachers seem concerned about implementing the framework in the classroom and appear willing to participate in relative seminars. Overall, this study's findings comply with the findings of the international literature and are expected to raise awareness among the relevant departments of the Hellenic Ministry of Education and Religious Affairs.

Keywords: S.T.E.M., teachers' attitudes, secondary education, software application

1 Introduction

The educational framework Science - Technology - Engineering - Mathematics (S.T.E.M.) is increasingly attracting the interest of the educational community due to the offered added value in the educational process and the numerous benefits, not only in cognition but also as a life attitude. More researchers agree that S.T.E.M. is a collaborative learning environment where students broaden their knowledge and learn through exploration, invention and discovery using real problems and situations (Chatzopoulos et al., 2019; Chatzopoulos et al., 2022; Kanaki & Kalogiannakis, 2022). At the same time, students can develop the necessary 21st-century skills like adaptability, problem-solving, complex communication and syS.T.E.M. thinking to facilitate solving grand challenges that have not yet been solved in the local, national or global community (Courtney, 2016).

The role of the teachers in implementing S.T.E.M. education is the main parameter that significantly influences the learning outcomes, which can be achieved so that students acquire many skills. Research has shown that teaching S.T.E.M. can be improved, provided that the teacher has the necessary knowledge both in the pedagogical part and in the content related to the context of teaching (Nadelson et al., 2012). S.T.E.M. requires teachers to be adequately trained and informed on the benefits of this framework, as it differs from conventional teaching (Kalogiannakis & Papadakis, 2017).

The successful integration and implementation of S.T.E.M. contain challenges, mainly since teachers need to develop a comprehensive understanding of the concepts and tools of integration (Psycharis, 2018; Kalogiannakis et al., 2018). In this challenge, teachers must approach teaching interdisciplinarity to go beyond the limits of their speciality (Mayes & Gallant, 2018). Teachers' attitudes are related to their teaching in the classroom since it determines the level of commitment of the teacher to the transmission of new knowledge and principles in their daily teaching (Rockland et al., 2010).

This paper deals with the current issue of teachers' attitudes toward implementing S.T.E.M. in Greek secondary education (Papadakis et al., 2020). Aside from the limited S.T.E.M. training and initiatives in Greece, the S.T.E.M. research area is significantly poor (Ampartzaki et al., 2022; Kalogiannakis et al., 2018; Kastriti et al., 2022; Kalogiannakis & Papadakis, 2019a; 2019b; 2022), and the importance of teachers' attitudes to quality implementation of the S.T.E.M. framework is strongly related (Tallou, 2022). Therefore, this quantitative research is needed to offer meaningful feedback and contribute to developing and implementing S.T.E.M. education in Greek classrooms. The purpose of the research is to investigate how important Secondary education teachers consider the application of S.T.E.M. education related to their student's future development.

1.1 Research area

De Vries et al. (2012) indicated why science and technology are essential in young students' education. According to their literature review, in countries like the United States and the United Kingdom, there are studies which indicate that science and technology can help young students to:

(1) Keep up with the rapid and continuous changes that technology and science bring;

(2) Understand and recognize science as an important human achievement;

(3) Know how to approach problems by looking for relevant information and making evidence-based decisions.

Participation in S.T.E.M. reportedly improves students' technological skills and increases their interest in their respective fields (Duran et al., 2013). Interdisciplinarity, as a concept, is a critical element of S.T.E.M. that, through an interdisciplinary approach, focuses on understanding real-world problems. However, teachers' attitudes and perceptions significantly influence the educational process and practices (Thibaut et al., 2018; Wang et al., 2011). Therefore, investigating the teachers' attitudes towards S.T.E.M. is particularly interesting, as they comprise the most critical factor in implementing innovative programs and policies (Green, 2017).

1.2 S.T.E.M. education

S.T.E.M. education is a mature educational framework adopted by most countries worldwide. Researchers and educators consider S.T.E.M. a critical factor in further equipping children with the necessary skills for their future careers (Psycharis, 2018; Saxton et al., 2014). S.T.E.M. education refers to teaching and learning science, Technology, Engineering and Mathematics. Nevertheless, S.T.E.M. is a general title for any educational program, practice, policy or action involving one or more of its disciplines. It typically includes educational activities across all grades and education levels in formal and informal settings (Gonzalez & Kuenzi, 2012). The teaching model S.T.E.M. is achieved through structured activities that resemble scientific laboratory research, using a project-based problem-solving methodology (Kastriti et al., 2022). The purposeful, collaborative, practical, and meaningful hands-on experiments and S.T.E.M. activities are applied according to the socio-constructivist learning approach, which encourages "learning by doing" (Pellas et al., 2017). Recent research suggests that young students, even at preschool age, can perceive scientific concepts to a greater extent than previously believed (Kalogiannakis & Papadakis, 2019). Another research conducted by Huber et al. (2016) confirmed that interactive technologies provide preschool-age children with remarkable gains in S.T.E.M. learning. Through appropriate software applications, they become great problem solvers. Recent research also suggests that young students, even in preschool, can understand scientific concepts more than previously thought (Kalogiannakis et al., 2018). Through S.T.E.M., students (Ioannou & Bratitsis, 2016; Morrison & Bartlett, 2009):

(1) Are encouraged to express creative ideas motivated by curiosity;

(2) Encouraged to think in different ways;

(3) Embrace teamwork and a sense of belonging;

(4) Develop new skills, become technologically literate;

(5) Become competent problem solvers, innovators and logical thinkers.

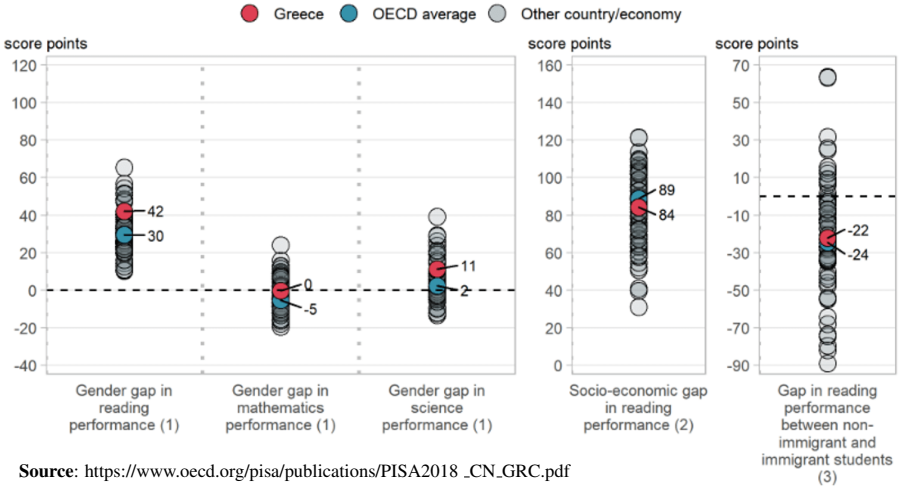
S.T.E.M. education contributes to bridging national and racial differences, which are often encountered in the educational community, especially in the fields of Mathematics and Science. A typical example is the small percentage of girls involved in science (Mostafa, 2019; Tsoukala, 2021). Children exposed to S.T.E.M. and coding activities at a young age encounter fewer gender-based stereotypes in their future career choices (Bers, 2018). One of the significant benefits of S.T.E.M. training is the interdisciplinary methodology used for activities and problem-solving projects. Students develop collaboration and autonomy skills in search of innovative solutions while improving their technological literacy (Vlasopoulou et al., 2020). S.T.E.M. requires a pedagogical design for flexible constructivist teaching approaches that enhance student engagement Dahal et al., 2022; Margot & Kettler, 2019). Moreover, placing students at the centre of the learning process encourages them to engage with meaningful yet challenging problematic situations, promoting higher levels of cognitive reasoning (English, 2017).

1.3 S.T.E.M. education in Greece

Implementing S.T.E.M. education in the most developed countries is considered a high priority to stand out in the competitive environment of the international market. It is noteworthy that the most famous technological institutes in the U.S.A., one of the leading countries in the world economy, such as the Massachusetts Institute of Technology (M.I.T.), the U.S. California Institute of Technology (Caltech) and Stanford University offer specific studies in this the field

of S.T.E.M. education. Although the implementation of S.T.E.M. education in Greek primary schools has been a matter of discussion during the last years, the steps in this direction are still slow (Ioannou & Bratitsis, 2017). S.T.E.M. education is rarely applied in primary schools, mainly by individual initiatives of teachers who wish to offer an innovative experience to their students (Chaldi & Mantzanidou, 2021; Foti, 2021; Papadakis & Kalogiannakis, 2020). Until the school year of 2021, the curricula of Primary and Secondary education did not yet include specific modules or activities of S.T.E.M. According to the International Student Assessment Program (P.I.S.A.) 2018, Greece is below average in science, reading and mathematics. The exact figure also shows the average performance on a three years basis, in the three researched areas, where Greece shows a declining tension by 6 points in science, 2 points in comprehension while in mathematics it remains stable (in all cases though below the average).

As shown in Figure 1, concerning gender, there is a significant gap based on the general O.E.C.D. Average in comprehension (12 points), science (9 points), as well as in mathematics (5 points).



Source: https://www.oecd.org/pisa/publications/PISA2018 _CN_GRC.pdf

Figure 1 Gender gap, P.I.S.A. results in 2018

Overall, as shown in Figure 2, the averages in comprehension, mathematics and science are far below the general average (+30 points) and even higher than the averages of the top countries.

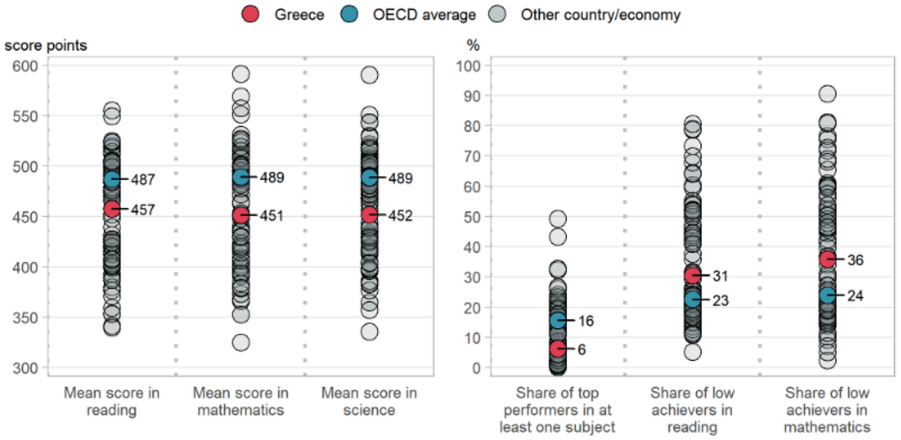


Figure 2 Snapshot of performance in reading, mathematics and science

An important recent initiative to provide robotic equipment, for all students, in mandatory education aims to create the conditions for effective integration of S.T.E.M. activities into the curriculum (Qureshi & Qureshi, 2021). The successful implementation of the project will imply a substantial acceptance of the S.T.E.M. framework and the transformation of the educational process into a new, student-centred type of education.

1.4 Teachers' attitudes

Many researchers contend that beliefs shape attitudes, arguing that a person's beliefs about an object also determine their attitudes toward it (Ajzen & Fishbein, 1980; Oppenheim, 1992;

Sabini, 1995). Unexpressed beliefs can be accounted as positive or negative. The creation of positive attitudes towards an object is caused by positive, unexpressed beliefs and vice versa (Ajzen, 1988; 1993; Ajzen & Fishbein, 1980; Sabini, 1995). In this sense, positive or negative, pleasant or unpleasant emotions are represented in attitudes towards the object. The development of positive attitudes is caused by environments that create positive experiences and vice versa (Zimbardo & Leippe, 1991; Tinker, 1991; Oppenheim, 1992). A long positive experience can evoke a person's positive attitude towards an object that the individual creates for that object (Fishbein & Ajzen, 1975; Ajzen, 1988; 1993; Anderson, 1981; 1994; Zimbardo & Leippe, 1991). Silver and Rushton (2008) stated that an important reason for the early introduction of science and technology in education is that attitudes towards science develop earlier in life than in other fields. Studies have revealed that prior exposure to related technologies affects teachers' perceived difficulty with the amount of effort required to integrate technology into their classrooms effectively (Pamuk, 2011). However, none of these would be substantial if these changes were not focused on the curriculum (Eguchi, 2014; Katsaris & Vidakis, 2021). Traditional teaching and learning practices must be transformed to respond to the evolving modern educational learning environment (Leoste & Heidmets, 2019; Trybulska et al., 2016).

1.5 S.T.E.M. education – A literature review

Although a researcher's subjectivity may raise doubts, the syS.T.E.M.atic collection and review of scientific data are always helpful (Moher et al., 2009; Pai et al., 2004; Tawfik et al., 2019). The questions of this research were shaped by its purpose and focus on S.T.E.M. implementation, a key search term for scientific articles in the international literature. Baltsavias & Kyridis (2020) research seems to be the only published study conducted on primary school teachers in Greece. The results of the 21 selected surveys show significant similarities. In particular, primary school teachers seem to have positive attitudes toward the benefits of implementing the framework (Nuangchalerm, 2018; Tao, 2019; Wei & Maat, 2020; Baltsavias & Kyridis, 2020). They also seem to understand the importance of cultivating a culture of positive attitudes by students towards knowledge (Baltsavias & Kyridis, 2020) and show a positive attitude towards S.T.E.M. education while accepting its usefulness levels. Problematic attitudes negatively affect teachers' performance in the educational process (Abdullah et al., 2017). Positive attitudes also lead to positive behaviour (Ring et al., 2017; Galih & Chatree, 2020).

Teachers perceive S.T.E.M. education as a Project-based learning process that promotes creative collaboration and innovation by improving analytical thinking and problem solving (Nuangchalerm, 2018; Tao, 2019; Wei & Maat, 2020). The results also show the correlation between the knowledge of educational science for S.T.E.M. education and their attitudes towards its implementation. The science teachers, who have more knowledge of S.T.E.M. education modules, are also more confident in its implementation than the rest teachers whose knowledge of S.T.E.M. is minor (Galih & Chatree, 2020; Abdulwali et al., 2019; Papadakis et al., 2021). Also, while teachers show high percentages in their attitudes toward technology and mathematics, a large percentage express concerns about the field of Engineering, a field in which there is no pre-existing knowledge for most specialities of both secondary and primary education (Chia & Maat, 2018). Scott & Martin (2013) argued that teachers are convinced that S.T.E.M. is not easy because difficulty arises from the combined teaching of the modules that make up S.T.E.M. in contrast to the autonomous teaching of each unit. They are also concerned if students will achieve higher scores if the modules are taught separately. According to Madden et al. (2014; 280), *"the lack of specialization in S.T.E.M. and content development experiences, combined with high stress and low efficiency",* can lead to excessive stress and ineffectiveness, as well as lack of interest and lack of motivation in S.T.E.M. This uncertainty translates into their desire to participate in training programs to learn S.T.E.M. and incorporate it into their teaching (Yildiz et al., 2020). Madden et al. (2016) conclude that teachers are not sufficiently trained to teach S.T.E.M. They have not received proper education during university studies to adopt a detailed view of the S.T.E.M. framework before teaching in the classroom. This trend is evident in the pedagogical university undergraduate programs (Kartal & Tasdemir, 2021).

In conclusion, the majority of teachers understand the importance of S.T.E.M. to develop the skills of their students but are concerned regarding the challenges of its implementation (Chia & Maat, 2018; Hackman et al., 2021; Alsmadi, 2020; Kartal, 2021; Yildiz et al., 2019; Thibaut et al., 2018).

1.6 Research problem

Teachers' attitudes towards S.T.E.M. in secondary education affect its implementation in the classroom.

1.7 Research purpose and questions

This research aimed to examine secondary education teachers' attitudes in Heraklion prefecture regarding implementing S.T.E.M. education in the classroom. The main goals of the research were to record the teachers' attitudes and try to answer the following key research questions:

(1) Do teachers consider that they are ready to implement S.T.E.M. in the classroom?
(2) Do teachers consider that S.T.E.M. improves the quality of education?
(3) Do teachers consider that S.T.E.M. attracts students?
(4) Are teachers willing to participate in educational seminars around S.T.E.M.?

The research hypothesis is that secondary school teachers consider S.T.E.M. education crucial for developing skills, critical thinking etc.

2 Methods

2.1 Sample

The target population consisted of 121 secondary education teachers in schools in the prefecture of Heraklion selected by random sampling. To determine the teachers' attitudes towards S.T.E.M., an anonymous questionnaire was sent through the Google forms platform during January and April 2022. In our research context, national and international research ethics guidelines were followed (Petousi & Sifaki, 2020). Online data collection offers significant benefits such as speed in response and processing, zero cost and automatic tabulation of results that allow data to be exported to IBM SPSS compatible formats.

2.2 Measurement procedure

Descriptive analysis was used to describe the levels of attitudes of secondary school teachers in S.T.E.M., per the needs of the proposed quantitative research. This analysis is commonly appropriate for recording a current situation or phenomenon. Teachers' attitudes (independent variable) were measured based on (2020)Wei's & Maat's (2020) tool, reliability (Cronbach's alpha $0.86 > 0.6$). Its creators requested and approved the relevant license for its use on January the 25^{th}, 2022. The questionnaire was modified and split into two main sections: the first part included the demographic data of the study like gender, age group, years of service and level of studies. The second part, which consisted of four sub-sections, included the measurement data. Overall, the questionnaire included 18 questions. For this publication, only the related four are mentioned. Respondents were asked to indicate their level of agreement with these items on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Thus, the higher the score, the more positive the teachers' attitudes towards implementing S.T.E.M. Statistical Package for Social Sciences (S.P.S.S.) software version 21.0 was used for statistical analysis.

Furthermore, to test the reliability of the modified questionnaire, a new Cronbach's alpha coefficient was computed for each subscale. All Cronbach's alpha values exceeded 0.7, which is generally considered a minimum acceptance level. All questionnaire items had an acceptable confidence level above 0.93 (Table 1).

Table 1 Reliability statistics

Cronbach's Alpha	N of Items
0.937	17

3 Results

3.1 Sample demographics

The sample N = 121 the teachers consisted of 74 women (61.2%) and 47 men (38.8%). All answers were accepted as valid. In terms of age, 15 people (12.4%) belonged to the age group of 24 to 35 years, 42 people (34.7%) belonged to the age group of 36 to 45 years, and 64 people (52.9%) belonged to the age group of 46 and over. An overview of demographics is given in Table 2 and 3.

3.2 Data analysis

Descriptive statistics were used to highlight the degree of teachers' attitudes (Table 4 and 5). A significance level of 0.05 was considered for all tests, and $P < 0.05$ was accepted as

Table 2 Teachers' sample demographic statistics

Variable	Category	*N*	%
Gender	Men	47	38.8
	Women	74	61.2
	Total	121	100.0
Age (years)	24-35	15	12.4
	36-45	42	34.7
	≥ 46	64	52.9
	Total	121	100.0
Service Years	0-5	20	16.5
	6-10	15	12.4
	≥ 11	86	71.1
	Total	121	100.0
Studies	University graduate	47	38.8
	Master's Degree	63	52.1
	PhD	11	9.1
	Total	121	100.0

Table 3 Gender frequency of sample

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Men	47	38.8	38.8	38.8
	Women	74	61.2	61.2	100.0
	Total	121	100.0	100.0	

statistically significant. Indicators such as mean values, standard deviation, and minimum and maximum values were used to study the research scales.

Table 4 Descriptive statistics of the four research questions

	Strongly Disagree		Disagree		Neither agree nor disagree		Agree		Strongly Agree	
	Count	Row (N %)	Count	Row (N %)	Count	Row (N %)	Count	Row (N %)	Count	Row (N %)
I am willing to participate in S.T.E.M. educational seminars	1	0.8%	10	8.3%	19	15.7%	36	29.8%	55	45.5%
I am ready to implement S.T.E.M. education in my classroom	7	5.8%	14	11.6%	44	36.4%	37	30.6%	19	15.7%
I believe S.T.E.M. education attracts students	1	0.8%	2	1.7%	19	15.7%	57	47.1%	42	34.7%
I am confident that S.T.E.M. education improves the overall education process	2	1.7%	1	0.8%	25	20.7%	57	47.1%	36	29.8%

Table 5 Mean values of the four research questions

	N	Min	Max	Mean	SD
I am willing to participate in S.T.E.M. educational seminars	121	1	5	4.11	1.007
I am ready to implement S.T.E.M. education in my classroom	121	1	5	3.39	1.067
I believe S.T.E.M. education attracts students	121	1	5	4.13	0.795
I am confident that S.T.E.M. education improves education overall	121	1	5	4.02	0.831

To examine the effect of the demographic factors such as gender, age, years of service and level of education, an independent sample t-test was conducted. The descriptive methods used included the presentation of the means and standard deviations of the frequencies and percentages for the categorical variables.

(1) Do teachers consider that they are ready to implement S.T.E.M. education in the classroom?

In the first research question, analysis shows that 46.3% (19 + 37 teachers) were willing to implement S.T.E.M. education, 36.4% (44) were not sure if they would like to implement it, and 17.4% (17 + 4) were not interested in the implementation. In conclusion, teachers have a positive attitude toward the readiness to implement the S.T.E.M. framework, but most teachers are concerned about its implementation (44 + 14 + 7). (see in Table 6)

The Independent Samples T-Test Analysis for gender variable, ANOVA analysis for age, years of service and level of the study showed that all variables do not affect their belief of readiness to implement S.T.E.M. in the classroom.

Table 6 I am ready to implement S.T.E.M. education in my classroom

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	5.8	5.8	5.8
	Disagree	14	11.6	11.6	17.4
	Neither agree / nor disagree	44	36.4	36.4	53.7
	Agree	37	30.6	30.6	84.3
	Strongly Agree	19	15.7	15.7	100.0
	Total	121	100.0	100.0	

(2) Do teachers believe that S.T.E.M. improves the quality of education?

In the second research question, according to table 3, the most significant percentage of 47.1% (57) answered "I agree", while 29.8% (36) said, "I totally agree". A percentage of 20.7% (25 teachers) answered "Neither agree nor disagree", while 0.8% (1) "Disagree" and finally 1.7% (2) "Strongly disagree". (see in Table 7)

Table 7 I am confident that S.T.E.M. education improves education overall

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	1.7	1.7	1.7
	Disagree	1	0.8	0.8	2.5
	Neither agree / nor disagree	25	20.7	20.7	23.1
	Agree	57	47.1	47.1	70.2
	Strongly Agree	36	29.8	29.8	100.0
	Total	121	100.0	100.0	

The Independent Samples T-Test Analysis for gender variable, ANOVA analysis for years of service and level of the study showed that all of the above variables do not affect teachers' belief that the quality of education improves with S.T.E.M. implementation. On the contrary, age, specifically the age groups 36-45 and 46 and above, influences teachers' belief that the quality of education improves with S.T.E.M. implementation (ANOVA, Post Hoc test with Bonferonni).

(3) Do teachers believe that S.T.E.M. attracts students?

In the third research question, according to Table 8, the largest percentage of 47.1% (57 teachers) answered "I agree", followed by 34.7% (42) "I totally agree". A percentage of 15.7% (19) "Neither agree nor disagree", while 1.7% (2) "Disagree" and finally 0.8% (1) "Absolutely Disagree". (see in Table 8)

Table 8 I believe S.T.E.M. education attracts students

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	0.8	0.8	0.8
	Disagree	2	1.7	1.7	2.5
	Neither agree / nor disagree	19	15.7	15.7	18.2
	Agree	57	47.1	47.1	65.3
	Strongly Agree	42	34.7	34.7	100.0
	Total	121	100.0	100.0	

The Independent Samples T-Test Analysis for gender variables, and ANOVA analysis for years of service, showed that the above two variables do not affect teachers' belief that S.T.E.M. can attract students. On the contrary, age, specifically age groups 36-45 and 46 and above, influences teachers' belief that S.T.E.M. attracts students (ANOVA, Post Hoc test with Bonferonni). Also, the level of studies, specifically the acquisition of a master's degree, affects teachers' belief that S.T.E.M. attracts students (ANOVA, Post Hoc test with Bonferonni).

(4) Are teachers willing to participate in educational seminars around S.T.E.M.?

In the fourth research question, according to Table 9, the largest percentage, 45.5% (55 teachers), answered "I totally agree", followed by 29.8% (36) "I agree". A percentage of 15.7% (19) "Neither agree nor disagree", while 8.3% (10) "Disagree" and finally 0.8% (1) "Absolutely disagree". (see in Table 9)

Table 9 I am willing to participate in S.T.E.M. educational seminars

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	0.8	0.8	0.8
	Disagree	10	8.3	8.3	9.1
	Neither agree / nor disagree	19	15.7	15.7	24.8
	Agree	36	29.8	29.8	54.5
	Strongly Agree	55	45.5	45.5	100.0
	Total	121	100.0	100.0	

The Independent Samples T-Test Analysis for Gender, ANOVA for the years of service and level of study (ANOVA) showed that these variables do not affect teachers' willingness to participate in S.T.E.M. workshops/seminars/courses. On the contrary, age, specifically the age groups 36-45 and 46 and above, affect the willingness of teachers to participate in workshops/seminars/courses S.T.E.M. (ANOVA, Post Hoc test with Bonferonni).

4 Limitations and further research

The main limitation of the research was that only an anonymous questionnaire in a quantitative frame was used. Although this was a deliberate choice to examine a larger dataset's attitudes, this approach also has disadvantages. Respondents may provide socially desirable answers and are not allowed to explain their answers further. Therefore, future research could benefit from additional teacher interviews, classroom observations, or other qualitative data. Given the above limitations, it would be interesting to design a new sample survey by applying S.T.E.M. in the classroom and recording the attitudes before and after the implementation of S.T.E.M.

5 Discussion and conclusions

The present study was conducted to analyze the attitudes of secondary education teachers towards S.T.E.M. education to contribute to implementing the S.T.E.M. framework in the classroom. The findings showed that teachers' attitudes towards S.T.E.M. are at positive levels (more "I agree" and "I totally agree" answers). They appear willing to work with teachers of other specialities and are ready to use new learning methods. Teachers with a positive attitude and high awareness of the importance of S.T.E.M. education tend to implement S.T.E.M. more frequently and promote S.T.E.M. education to their colleagues. Positive attitudes can lead to positive behaviours, better motivation and confidence in implementing S.T.E.M. education (Wei & Maat, 2020). Most of the teachers have not participated in S.T.E.M. workshops/seminars. (76/121, 62.8%), nevertheless, the corresponding participation rate can be considered satisfactory (45/121, 37.2%). An important finding is that they appear concerned about implementing S.T.E.M. education (53.8%). Regarding the demographic factors, the gender, age group, years of service and level of studies, the present study, with the applied statistical tests, verified that the gender and the years of service a) do not affect the readiness in the implementation of S.T.E.M. education, b) teachers' belief that the quality of education improves with the implementation of S.T.E.M. education c) teachers' belief that S.T.E.M. can attract students and d) the willingness of teachers to participate in S.T.E.M. workshops/seminars/courses. Age, specifically the age groups 36-45 and 46 and above, influence a) teachers' belief that the quality of education improves with the implementation of S.T.E.M. (ANOVA, Post Hoc test with Bonferonni), b) the belief that S.T.E.M. education attracts students (as the acquisition of a Masters degree) and c) the will of teachers to participate in S.T.E.M. training.

The specific findings align with those of the literature review where teachers express uncertainty in the implementation of S.T.E.M. education, possibly due to lack of training, lack of guidance - resources, difficulty in interdisciplinary, expressed in their increased will to participate in educational activities (Papadakis, 2021; Scott & Martin 2013; Kartal & Tasdemir, 2021; Yildiz et al., 2020; Mayes & Gallant, 2018). The Hellenic Ministry of education has not yet implemented a nationwide S.T.E.M. awareness training program as the "In-service Training of Teachers in the utilization and application of Digital Technologies in the teaching practice" (B-Level I.C.T. Teacher Training Project). The latter has had great success amongst teachers by introducing new tools to facilitate and elevate the learning process. Based on the findings of a study, it would be highly advised to organize a relevant project related to S.T.E.M. education.

Conflicts of interest

The author declares that they have no conflict of interest.

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