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Evaluating Students' Attitudes Toward STEM Education: The Case of Greek Pre-Service Teachers

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Abstract

The objective of this research paper is to assess Greek pre-service teachers' attitudes towards STEM Education through multidimensional statistical analysis. The sample consist of 130 Greek pre-services participated in the study. The study used a Scale related to respondents' feedback on teachers to implement STEM constructed by Abdullah et al. (2017) by applying a five-point Likert scale. The scale consisted of three conceptual constructs named Readiness to implement STEM from the cognitive aspect, Readiness to implement stem from the affective aspect, Readiness to implement stem from the behavioural aspect. Greek Students' General attitudes toward STEM education were evaluated by another item that rate from 1 to 100 scaling the total score. The results demonstrated that the strongest correlation was between the conceptual construct named Readiness to implement STEM from the cognitive aspect and Readiness to implement stem from the affective aspect.

In addition, the study made it evidence that the correlation between the conceptual constructs Total score related to General attitudes toward Readiness to implement STEM the conceptual construct Readiness to implement STEM from the cognitive aspect was strong.

Keywords: Attitudes, Students, Science Technology, Engineering, Mathematics, STEM

1.Introduction

Science, Technology, Engineering and Mathematics configure STEM education. Teachers claimed that STEM education has the potentiality to deliver skilled and qualified students in the epoch of globalization towards STEM Education (Wei & Maat, 2020). A comprehensible and fundamental approach to science, technology, engineering, and mathematics education or STEM education demands consideration to interdisciplinary or multidisciplinary commitment between learners (Deák et al., 2021). Mathematics, science and technology combination or cooperation is an inescapable improvement regarding teaching and learning, although this methodology involves sufficient expertise of the field aiming to integration of many courses (Deák et al., 2021). The knowledge of mathematics is evidence in every scientific domain. Moreover, the knowledge of mathematics is necessary to analyze algorithm complexity. Apparently, individuals with no mathematical background are unable to produce efficient in terms of time and space complexity (Souravlas, Katsavounis, Anastasiadou. 2020). Mathematics play an important role in science. Together science, technology, engineering, and mathematics constitute STEM, that has been widely studied in primary and secondary education level (Fernández-Cézar et al. 2020). In adding, teaching of mathematics usually operates in many areas such as Big Data applications, Cloud structures (Souravlas & Katsavounis, 2019; Souravlas, 2019), algorithms for stream processing (Souravlas, Anastasiadou & Katsavounis 2021; Souravlas & Anastasiadou, 2020; Tantaraki et al., 2020a, Tantalaki, et al., 2020b, Tantalaki, et al., 2019) and many more different applications (Tantalaki, Souravlas, & Roumeliotis, 2019; Souravlas & Roumeliotis, 2015a; Souravlas & Roumeliotis, 2015b; Souravlas & Roumeliotis, 2014a; Souravlas & Roumeliotis, 2014b; Margaris et al., 2007).

In the other way around several big data applications relate to awareness of various mathematical algorithmic functions that influence all facets of our ordinary life, education (Florou et al., 2021; Valsamidis et al., 2021). As Souravlas & Anastasiadou (2020a) and Souravlas, et al. (2020a) claimed mathematics areas relate to AI algorithms complexity, scheduling of Big Data Stream, Modeling and Simulation correlated with Cloud Computing, efficiency of AI algorithms, advance knowledge in analytics, in mathematics together with in AI, improvement programming skills and strongminded students' achievement. Students' achievement regarding learning AI algorithms, scheduling of Big Data Stream and Cloud Computing simulation is strongly associated with learners Self-Confidence in mathematics (Anastasiadou, 2009a, 2009b; Souravlas, et al., 2020a). Three major components such as achievement in computer programming courses, computers programming self-efficacy and perceived learning are considerable predictors of teachers' attitudes toward computer programming (Gurer et al., 2019). As science persists to growth, attitudes toward science appear to turn out to be even further differentiated. While several put their faith in science, others regularly discard and reject scientific evidence (Rutjens et al., 2018).

Students often have major difficulties regarding mathematical problem solving (Jeong, & González-Gómez, 2021). Negative attitudes toward mathematics are one of the major obstacle toward understanding and learning mathematics and create mostly difficulties to students' cognitive competence (Atan, & Kasmin, 2018; Petridis et al., 2017; Nicolaou, et al., 2017; Anastasiadou, 2004a, 2004b, 2004c, 2004d; Anastasiadou, Anastasiadou (2002), Chadjipadelis & Kofou 2013; Chadjipantelis & Anastasiadou, 2010), their perceptions regarding the value and the necessity of a subject, its importance both in professional life and everyday life (Anastasiadou & Papadimitriou, 2001, 2003; Anastasiadou, 2007a, Anastasiadou, 2007b; Anastasiadou, 2008a, 2008b, 2008c; Anastasiadou, 2012aq Hagan et al., 2020). Enjoyment and satisfaction has also an effect on attitudes toward mathematics (Anastasiadou, 2005a, 2005b, 2005c; Anastasiadou & Gagatsis, 2005a, 2005b; Anastasiadou & Chadjipantelis, 2008; Anastasiadou, Elia, Gagatsis, 2007; Anastasiadou & Gagatsis, 2007; Anastasiadou, Gagatsis, Elia, 2005, Draganis et al., 2013). Self-confidence and Value and Importance of Mathematics, Math anxiety as well as well gender have a serious direct effect regarding achievement in mathematics (Awaludin et al., 2015; Manalaysay, 2019; Wahid et al., 2014; Hagan et al., (2020). Brezavšˇcek, et al. (2020) showed a strong negative effect of mathematics confidence on seeming degree of math anxiety. Furthermore, they claimed that the perceived level of math anxiety has a robust negative effect on mathematics accomplishment. Fernández-Cézar et al. (2020) examine whether a STEM outreach experimentation program could possibly affect on the attitude toward mathematics and science in 5th and 6th grades as well as whether this potential effect of a STEM experimentation program be affected by parameters like gender, schools' type and environment as well as the teacher. They founded that the STEM program based on experimentation exerts and improvement in the attitude towards mathematics, given that it is less negative. Above and beyond this, the attitude towards school science turns out to be more positive. Though, both effects are tiny. They also found that the program neither had an impact on attitude towards mathematics nor the attitude towards school science differently for females and males. Fernández-Cézar et al. (2020) research results implied that STEM program can not have any serious effect on the students' attitude towards mathematics differently related to different schools. Moreover, the STEM program did have a different effect regarding the teacher for mathematics, but it had regarding the attitudes toward the science (Fernández-Cézar et al., 2020).

In Abdullah et al. (2017) research including 190 teachers searching their attitudes toward Readiness to implement STEM from cognitive, affective and behavioural point of view. 190 teachers' readiness related from cognitive, affective and behavioural aspects were at moderate level, although that cognitive aspect has the biggest mean value comparing to affective and behavioural aspects (Abdullah et al., 2017).

This the present study tries to capture Greek students' attitudes towards Science, Technology, Engineering and Mathematics configure STEM education. The conceptual constructs of Scale related to respondents' feedback on teachers to implement STEM constructed by Abdullah et al. (2017) are named Readiness to implement STEM from the cognitive aspect, Readiness to implement stem from the affective aspect, Readiness to implement stem from the behavioural standpoint.

2. Purpose of the study-Research Hypotheses

The objective of current study is to evaluate Greek pre-service teachers' attitudes towards STEM education through multidimensional statistical analysis. In addition, the present paper examines the following research hypotheses.

Ho1: Readiness to implement STEM from the cognitive aspect has a strong effect on General attitudes toward Readiness to implement STEM

Ho2: Readiness to implement STEM from the affective aspect has a strong effect on General attitudes toward Readiness to implement STEM

Ho3: Readiness to implement STEM from the behavioural aspect has a strong effect on General attitudes toward Readiness to implement STEM

Ho4: Readiness to implement stem from the cognitive aspect is significantly correlated with Readiness to implement STEM from the affective aspect

Ho5: Readiness to implement STEM from the cognitive aspect is significantly correlated with Readiness to implement STEM from the behavioural aspect

Ho6: Readiness to implement STEM from the affective aspect correlated with Readiness to implement STEM from the behavioural aspect

Ho7: Gender influences General attitudes toward Readiness to implement STEM

3. The instrument

The study used a 5-point response scale, higher scores then correspond to more positive attitudes, whereas 1 corresponding to strongly disagree to 5 strongly agree. The scale named was adapted from Abdullah et al. (2017) instrument exploring attitudes toward Readiness to implement STEM from cognitive, affective and behavioural point of view.

Table 1: Scale

Scale	
Conceptual Construct	Item
Readiness to implement stem from the cognitive aspect	
	Read_Gog Asp1: I understand the objectives of implementing STEM education drawn up in the curriculum
	Read_Gog Asp2: I understand the teacher role in implementing STEM education at school
	Read_Gog Asp3: I understand the planned STEM education curriculum
	Read_Gog Asp4: I understand the STEM education curriculum that will be developed
	Read_Gog Asp5: I understand the scope of the planned STEM education curriculum
	Read_Gog Asp6: I implement the STEM teaching approach in my teaching and learning which involves applying STEM practices to solve problems in the context of daily life
	Read_Gog Asp7: I am responsible in ensuring that my students are able to explore their surroundings by solving problems that are related to the real world in the effort to install STEM practices
	I am responsible in ensuring that my students are able to explore their surrounding by solving
	Read_Gog Asp8: I need to discuss with other mathematics teachers to further improve my teaching quality of STEM education using multimodal learning
	Read_Gog Asp9: I am responsible for ensuring that the process of Teaching & Learning STEM education that is student centered is able to produce meaningful learning experience

	Read_Gog Asp10: I am responsible for ensuring that the process of Teaching & Learning STEM education that is student centered is able to produce a fun learning experience Read_Gog Asp11: I need to spend a lot of time searching for effective ideas before implementing Teaching & Learning of STEM education integration in the classroom Read_Gog Asp12: I refer to the STEM education module to ensure that I have a clear understanding in the implementation of this approach according to the procedures and requirements on Greek educational system
Readiness to implement stem from the affective aspect	
	Read_Aff Asp1: I enjoy implementing STEM education approach in Teaching & Learning in the classroom Read_Aff Asp2: I am happy with the implementation of STEM education approach as it is able to help me identify students; strengths Read_Aff Asp3: I am happy with the implementation of STEM education approach as it is able to help me identify students; weakness Read_Aff Asp4: I am satisfied with the implementation of STEM education approach as it is able to increase my two-way communication with students Read_Aff Asp5: I feel at ease for being able to implement the STEM Education approach in a way that is systematic and organised Read_Aff Asp6: I am excited with the implementation of STEM education approach in classrooms as it enables me to understand students; grasp of knowledge Read_Aff Asp7: I do not feel burdened by the many elements contained in STEM education that need to be related to the realword context Read_Aff Asp8: I do not feel disappointed with the implementation of STEM education approach although it makes it harder for me to finnish teaching the syllabus Read_Aff Asp9: approach in the classroom The differences in the students' level of mastery do not make it difficult for me to implement STEM education Read_Aff Asp10: I do not find difficulties in implementing STEM education Read_Aff Asp11: I do not feel pressured with the increased work burden
Readiness to implement stem from the behavioural aspect	
	Read_Beh Asp1: I follow the schedule set by Greek Educational System in applying STEM education approach. Read_Beh Asp2: STEM education allows me to conduct activities by preparing materials that are able to attract the attention of students in the classroom based on their capabilities Read_Beh Asp3: I am prepared to attend STEM education enhancement courses to enhance my skills Read_Beh Asp4: I am prepared to attend STEM education enhancement courses to enhance my knowledge Read_Beh Asp5: I always analyse students' achievement in STEM education for further actions Read_Beh Asp6: I have to work overtime to monitor students' progress in the classroom Read_Beh Asp7: I do not find difficulties in controlling students during the Teaching & Learning of STEM education in the classroom Read_Beh Asp8: I have enough time to implement STEM education although I need to cover many syllabuses Read_Beh Asp9: I do rigorous preparations before implementing STEM education approach in the classroom Read_Beh Asp10: I am confident in implementing STEM education approach in the classroom

4.Profiles of the respondents

The demographic profiles include the following characteristics of the despondences' gender, age and year of education. The demographic profiles shown in Table 3 is based on frequency and relative frequency distributions. The sample comprised of 130 interviewees of whom 91 (70%) were men and 39 (30%) were women (Table 2).

Table 2: Demographic data of the sample (N = 168)

Variables	Classes	N=130	%
Gender	Male	91	70
	Female	39	30

5. Results

Below (Table 3) the results related the internal consistency or reliability of the instrument, and its conceptual constructs are described. The reliability of the Scale related to Readiness to implement STEM from cognitive, affective and behavioural point of view was related to items 1 to 33 was estimated by Cronbach alpha coefficient (a) (Cronbach, 1984).

The Cronbach' alpha coefficient is calculated to measure the reliability of the three conceptual constructs, i.e. Readiness to implement STEM from cognitive aspect, Readiness to implement STEM from affective aspect and Readiness to implement STEM from behavioural aspect (Table 2). Cronbach' alpha coefficient equals to 0.912 verified the reliability of the Readiness to implement STEM scale of pre-service teachers towards Readiness to implement STEM from affective aspect and Readiness to implement STEM from behavioural aspect. In additions Cronbach' alpha coefficient was above the cutoff point of 0.70 for all the dimensions of Readiness to implement STEM scale (Anastasiadou, et al., 2014b; Anastasiadou et al., 2016a; Anastasiadou et al., 2016b; Anastasiadou & Giossi, 2014; 2018a, 2018b; Anastasiadou & Karakos, 2011; Anastasiadou, 2014; Anastasiadou, 2016; Anastasiadou, 2018a, 2018b, 2018c, 2018d) (Table 3).

The value of Cronbach's α coefficient for this instrument related to General attitudes toward Readiness to implement STEM was equal to 0.912 and it is a very high value in terms of internal consistency (Anastasiadis, 2020; Anastasiadis & Christoforidis, 2019; Anastasiadou, 2006; Anastasiadou, 2007c; Anastasiadou, 2008d; Anastasiadou, 2009c; Anastasiadou et al., 2010b; Anastasiadou, 2011; Anastasiadou, 2012a, 2012b, 2012c, 2012d, 2012e, 2012f) (Table 3).

The value of Cronbach's α coefficient for General attitudes toward Readiness to implement stem from the cognitive aspect, conceptual construct was equal to 0.851 and it is a very high value in terms of internal consistency (Anastasiadou & Anastasiadis, 2011; Anastasiadou & Anastasiadis, 2019; Anastasiadou, et al., 2010a; Anastasiadou, et al., 2010b; Anastasiadou, et al., 2013; Anastasiadou & Pappa, 2009; Anastasiadou & Pappa, 2019; Anastasiadou & Taraza, 2020a; Anastasiadou & Taraza, 2020b; Anastasiadou & Tiliakou, 2014, 2015, 2016a, 2016b) (Table 3).

The value of Cronbach's α coefficient for Readiness to implement stem from the affective aspect conceptual construct was equal to 0.907 and it is a very high value in terms of internal consistency (Panistides & Anastasiadou, 2015; Patrali et al., 2012; Souravlas & Anastasiadou, 2020; Souravlas, et al., 2020; Thapa et al., 2016; Theodoridou, et al., 2014; Anastasiadou et al., 2013; Cohen, et al., 1988; Florou, et al., 2015; Fotiadis & Anastasiadou, 2018a,2018b; Florou & Anastasiadou 2013; Kapetanopoulou et al., 2021; Kofou, & Anastasiadou, 2013; Ntotsi, & Anastasiadou, 2019a, 2019b) (Table 3).

The value of Cronbach's α coefficient for Readiness to implement stem from the behavioural aspect conceptual construct was equal to 0.823 and it is a very high value in terms of internal consistency (Anastasiadou et al., 2007, Anastasiadou et al., 2014; Anastasiadou & Draganis, 2014; Anastasiadou, et al., 2014a; Anastasiadou & Kofou, 2013a, 2013b; Anastasiadou & Loukas, 2009; Anastasiadou & Panitsides, 2014; Anastasiadou et al., 2015; Gkolia et al., 2007; Papademetriou et al., 2022; Anastasiadou, 2013a,2013b,2013c, 2013d; Anastasiadou, Florou, 2013; Batiou & Anastasiadou, 2015) (Table 3).

Table 3: **Cronbach's Alpha**

Dimensions	Cronbach's Alpha
General attitudes toward Readiness to implement STEM	0.912
Readiness to implement STEM from the cognitive aspect	0.851
Readiness to implement stem from the affective aspect	0.907
Readiness to implement stem from the behavioural aspect	0.823

The following table presents the mean value (M) and the Standard Deviation (SD) of each item and each conceptual construct of General attitudes toward Readiness to implement STEM scale (Table 4). Among the dimensions, the highest mean level of perceptions was 3.8109 (SD=0.59704) for Readiness to implement STEM from the cognitive aspect conceptual construct following by Readiness to implement stem from the affective aspect conceptual construct 3.5545 (SD=0.74870) following by the Readiness to implement stem from the behavioural 3.1615 (SD=0.43764) that was the lowest mean level (Table 4).

Table 4: ATMI Scale

	General attitudes toward Readiness to implement STEM	**Cronbach's Alpha**	**M**	**SD**
Conceptual Construct	**Item**	**.912**		
Readiness to implement STEM from the cognitive aspect		**.851**	**3.8109**	**.59704**
	Read_Gog Asp1: I understand the objectives of implementing STEM education drawn up in the curriculum		4.39	.802
	Read_Gog Asp2: I understand the teacher role in implementing STEM education at school		4.39	.792
	Read_Gog Asp3: I understand the planned STEM education curriculum		4.44	.797
	Read_Gog Asp4: I understand the STEM education curriculum that will be developed		4.20	.772
	Read_Gog Asp5: I understand the scope of the planned STEM education curriculum		3.97	.948
	Read_Gog Asp6: I implement the STEM teaching approach in my teaching and learning which involves applying STEM practices to solve problems in the context of daily life		4.42	.776
	Read_Gog Asp7: I am responsible in ensuring that my students are able to explore their surroundings by solving problems that are related to the real world in the effort to install STEM practices		4.35	.870
	I am responsible in ensuring that my students are able to explore their surrounding by solving			
	Read_Gog Asp8: I need to discuss with other mathematics teachers to further improve my teaching quality of STEM education using multimodal learning		3.12	1.118

Read_Gog Asp9: I am responsible for ensuring that the process of Teaching & Learning STEM education that is student centered is able to produce meaningful learning experience		2.78	1.365
Read_Gog Asp10: I am responsible for ensuring that the process of Teaching & Learning STEM education that is student centered is able to produce a fun learning experience		2.93	1.149
Read_Gog Asp11: I need to spend a lot of time searching for effective ideas before implementing Teaching & Learning of STEM education integration in the classroom		3.57	.998
Read_Gog Asp12: I refer to the STEM education module to ensure that I have a clear understanding in the implementation of this approach according to the procedures and requirements on Greek educational system		3.17	1.065
Readiness to implement stem from the affective aspect	**.907**	**3.5545**	**.74870**
Read_Aff Asp1: I enjoy implementing STEM education approach in Teaching & Learning in the classroom		3.12	1.111
Read_Aff Asp2: I am happy with the implementation of STEM education approach as it is able to help me identify students; strengths		3.55	1.114
Read_Aff Asp3: I am happy with the implementation of STEM education approach as it is able to help me identify students; weakness		3.320	1.022
Read_Aff Asp4: I am satisfied with the implementation of STEM education approach as it is able to increase my two-way communication with students		4.04	1.060
Read_Aff Asp5: I feel at ease for being able to implement the STEM Education approach in a way that is systematic and organised		3.97	0.923
Read_Aff Asp6: I am excited with the implementation of STEM education approach in classrooms as it enables me to understand students; grasp of knowledge		3.43	1.063
Read_Aff Asp7: I do not feel burdened by the many elements contained in STEM education that need to be related to the realword context		3.67	0.918
Read_Aff Asp8: I do not feel disappointed with the implementation of STEM education approach although it makes it harder for me to finnish teaching the syllabus		3.49	1.006
Read_Aff Asp9: approach in the classroom The differences in the students' level of mastery do not make it difficult for me to implement STEM education			
Read_Aff Asp10: I do not find difficulties in implementing STEM education		3.81	1.086
Read_Aff Asp11: I do not feel pressured with the increased work burden		3.30	1.032

Readiness to implement stem from the behavioural aspect		**.823**	**3.1615**	**.43764**
	Read_Beh Asp1: I follow the schedule set by Greek Educational System in applying STEM education approach.		3.63	.997
	Read_Beh Asp2: STEM education allows me to conduct activities by preparing materials that are able to attract the attention of students in the classroom based on their capabilities		1.52	.934
	Read_Beh Asp3: I am prepared to attend STEM education enhancement courses to enhance my skills		1.73	.994
	Read_Beh Asp4: I am prepared to attend STEM education enhancement courses to enhance my knowledge		1.47	.917
	Read_Beh Asp5: I always analyse students' achievement in STEM education for further actions		3.53	.837
	Read_Beh Asp6: I have to work overtime to monitor students' progress in the classroom		3.83	.799
	Read_Beh Asp7: I do not find difficulties in controlling students during the Teaching & Learning of STEM education in the classroom		4.15	.873
	Read_Beh Asp8: I have enough time to implement STEM education although I need to cover many syllabuses		3.91	.876
	Read_Beh Asp9: I do rigorous preparations before implementing STEM education approach in the classroom		3.94	.994
	Read_Beh Asp10: I am confident in implementing STEM education approach in the classroom		3.91	.927
Model Fit	x2/df=1.86 CFI=0.95, GFI=0.94, RMSEA=0.03, AGFI=0.90, IFI=0.95			

The following table, Table 5, presents the intercorrelations across the three conceptual constructs used in this study plus an item measures the General attitudes toward Readiness to implement STEM.An assessment of the bivariate correlations indicates that all the correlations are significant and are in the expected direction. The strongest correlation was between the conceptual constructs Readiness to implement STEM from the cognitive aspect and Readiness to implement stem from the affective aspect ($r=0.581$, $p<0.001$). The second strongest correlation was between the conceptual constructs Readiness to implement stem from the behavioural aspect and Readiness to implement STEM from the cognitive aspect ($r=0.497$, $p<0.01$) and Readiness to implement stem from the behavioural aspect and Readiness to implement STEM from the affective aspect ($r=0.497$, $p<0.01$)

As far as the correlations between Readiness to implement STEM from the cognitive aspect, Readiness to implement stem from the affective aspect and Readiness to implement stem from the behavioural aspect and General attitudes toward Readiness to implement STEM concerns that correlation analysis revealed significant correlations at a significant level of 99%.

Morespecifically, the strongest correlation was between the conceptual construct Readiness to implement STEM from the cognitive aspect and Total score related to General attitudes toward Readiness to implement STEM ($r=0.585$, $p<0.01$), the second strongest correlation was between the conceptual construct Readiness to implement stem from the affective aspect and Total score related to General attitudes toward Readiness to implement STEM ($r=0.305$, $p<0.01$), whereas the third strongest correlation was between the conceptual construct Readiness to implement stem from the behavioural aspect and Total score related to General attitudes toward Readiness to implement STEM ($r=0.295$, $p<0.01$) (Table 5).

Finally, gender has statistically insignificant correlations with Readiness to implement STEM from the cognitive aspect, Readiness to implement stem from the affective aspect but Readiness to implement stem from the behavioural aspect conceptual construct ($r=0.177$, $p<0.05$) (Table 5).

Table 5: Correlation Estimates

Correlations

		COGNITIVE	AFFECTIVE	BEHAVIOUR	GENERAL ATTITUDE	GENDER
COGNITIVE	Pearson Correlation	1				
AFFECTIVE	Pearson Correlation	,581**	1			
BEHAVIOUR	Pearson Correlation	,497**	,497**	1		
GENERAL ATTITUDE	Pearson Correlation	,585**	,305**	,295**	1	
GENDER	Pearson Correlation	,161	,115	,177*	,160	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Furthermore, the seven hypothesized effects were supported (Table 6). Thus, it is evident that the conceptual constructs Self-Confidence, Value, Enjoyment and Motivation, have a positive effect on Total score related to Greek Students' attitudes towards Mathematics.

Table 6: Hypotheses Testing

Hypotheses	Standardized estimates	p-value	Results
Ho1: Readiness to implement STEM from the cognitive aspect has a strong effect on General attitudes toward Readiness to implement STEM	.59	<0.001	Supported
Ho2: Readiness to implement STEM from the affective aspect has a strong effect on General attitudes toward Readiness to implement STEM	.56	<0.001	Supported
Ho3: Readiness to implement STEM from the behavioural aspect has a strong effect on General attitudes toward Readiness to implement STEM	.47	<0.001	Supported
Ho4: Readiness to implement stem from the cognitive aspect is significantly correlated with Readiness to implement STEM from the affective aspect	.51	<0.001	Supported
Ho5: Readiness to implement STEM from the cognitive aspect is significantly correlated with Readiness to implement STEM from the behavioural aspect	.44	<0.001	Supported
Ho6: Readiness to implement STEM from the affective aspect correlated with Readiness to implement STEM from the behavioural aspect	.52	<0.001	Supported
Ho7: Gender influences General attitudes toward Readiness to implement STEM	.32	>0.05	Not Supported

6. Conclusions

The objective of current study is to evaluate Greek pre-service teachers' attitudes towards STEM Education through multidimensional statistical analysis. The study used a Scale related to respondents' feedback on teachers/ pre-service teachers to implement STEM constructed by Abdullah et al. (2017). The scale consisted of three conceptual constructs named Readiness to implement STEM from the cognitive aspect, Readiness to implement stem from the affective aspect, Readiness to implement stem from the behavioural aspect. The structuralequation model verified the measurement model fit regarding the observed data (Model Fit x2/df=1.86 CFI=0.95, GFI=0.94, RMSEA=0.03, AGFI=0.90, IFI=0.95) ((Churchill, 1979; Cohen, et al., 1988; Fornell & Larcker, 1981; Chin, 1998; Kim, et al., 2008). Spector, 1992; Wixon, & Watson, 2001, Hair et al., 1995; Hair, et al., 2005).

Therefore, the conceptualized model that describes of teachers/ pre-service teachers to implement STEM in education. The model revealed teachers/ pre-service teachers' attitudes toward consist of conceptual constructs named Readiness to implement STEM from the cognitive aspect, Readiness to implement stem from the affective aspect, Readiness to implement stem from the behavioural aspect. The strongest correlation was between the conceptualconstruct named Readiness to implement STEM from the cognitive aspect and Readiness to implement stem from the affective aspect.

In addition, the study made it evidence that the strongest correlation between the conceptual constructs Total score related to General attitudes toward Readiness to implement STEM was the correlation was between the conceptual construct Readiness to implement STEM from the cognitive aspect and Total score related to General attitudes toward Readiness to implement STEM. However, there is great need for empirical research related to pre-service torchers' attitudes toward Readiness to implement STEM in education. The aim of STEM education could possibly be achieved by teachers and pre-service teachers' positive attitudes (Wei & Maat, 2020).

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