



International Journal of Technology in Education

www.ijte.net

Attitudes of University Students towards STEM Approach

Bahjat H. Altakhneh, Mofeed Abumusa
Arab Open University, Jordan

To cite this article:

Altakhneh, B.H. & Abumusa, M. (2020). Attitudes of university students towards STEM approach. *International Journal of Technology in Education (IJTE)*, 3(1), 39-48.

International Journal of Technology in Education (IJTE) is a peer-reviewed scholarly online journal. This article may be used for research, teaching, and private study purposes. Authors alone are responsible for the contents of their articles. The journal owns the copyright of the articles. The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of the research material. All authors are requested to disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations regarding the submitted work.

Attitudes of University Students towards STEM Approach

Bahjat H. Altakhneh, Mofeed Abumusa

Article Info

Article History

Received:
15 September 2019

Accepted:
5 November 2019

Keywords

Mathematics
STEM approach
Technology

Abstract

The study aimed at investigating the attitudes of university students towards science, technology, engineering, mathematics (STEM) approach. The participants of the study consist of (60) students who were studying in bachelor and master degree, they trained in the center of training at the university, the participants acquiring the skills of STEM approach by using the WeDo2.0 application, they received knowledge and skills of STEM approach. The tool of the study was questionnaire which was validity and reliability verified. Results of the study showed that positive student attitudes toward using STEM approach Reached 86.4%. Each of the following scores is ranked as descending order: desire to apply strategy (87.4 %%), collaboration and communication (86.4%), thinking and problem solving (86%), motivation and problem solving (86%). There was no statistical significance difference between the variable type degree of study (master/bachelor) as well as the nature of employment in terms of whether the learner was either an employee or non-employee. In light of results of the study, researchers recommend using STEM approach in teaching courses in open learning systems.

Introduction

New educational systems seek to relate theory with practice, applying the experience in world, help learners to develop practical skills, meet challenging of 21 century skills; which are: creative thinking skills, problem solving, critical thinking, and communication (Becker & Park, 2011). Trends of international mathematics and science study (TIMSS) showed that the decreasing of Jordanian students achievement in mathematics in 8th grade (386 points) while the maximum achievement of Singapore students (621 points) , this indicates that problems in strategy of teaching mathematics, and educational systems still use traditional methods of teaching mathematics and science, and focus on teaching mathematics and science as literature view without appearing the uses of mathematics in our life, and the systems focus on the quantity of information provided to learners without interested to quality of information (IEA, 2016).

In view of the developments in the field of modern technology, the importance of integrating them in education, and the use of different programming languages in solving scientific and educational problems, the interest in incorporating modern technological means, programming, scientific expertise and mathematics have increased in a consensual integration approach that helps the curriculum field to provide real educational opportunities. (STEM) are interacting elements, each of which influences and is influenced by the other, resulting in educational strategies that directly develop the learner and meaningfully experiences (Mustafa, 2018; Seage & Türegün, 2020; Vu, Harshbarger, Crow, & Henderson, 2019; Zandler, Klautdt, & Seitz, 2017). STEM education is an approach to teaching and learning that integrates the content and skills of science, technology, engineering, and mathematics. STEM Standards of Practice guide STEM instruction by defining the combination of behavior, integrated with STEM content, which is expected of a proficient STEM student (Almalki, 2018).

The aim of this educational approach is every individual who constitutes the society in the face of global developments solves all kinds of problems and increases interest in STEM disciplines (Carnevale, Smith & Melton, 2011; Reding et al., 2017). In line with this aim, efforts are being made to overcome the inadequacies of solving daily life problems in society with the integration of STEM education into school curricula (DeChenne, Koziol, Needham & Enochs, 2015). Although there are different approaches and studies on the integration of STEM education into school curricula, it is not right to adhere to a certain approach in the integration of the common opinion (Altun & Yildirim, 2015). From the literature review about STEM approach we can develop steps in teaching with STEM approach as merging between problem based learning (PBL) and technology in integrating approach as follows: firstly defines a problem and recognizes the major goal of the project, secondly: determines the tools and planning for method of solving the problem, thirdly: collecting data, and connection of relations and developing a model, fourthly: verifying the results.

The crucial aim of using STEM approach in teaching to engage students through activities; to motivate the students as John Dewey confirms the importance of learning with doing (Almalki, 2018). The educational project is an integrated system that provides educational opportunities and methodological and extracurricular activities, whether in classrooms, laboratories or students' homes. This is a fertile environment for students' talents, their ability to think and solve problems creatively, and to integrate engineering and scientific concepts and technology. The STEM project is an educational approach in which concepts, skills and problem-solving are integrated into various subjects (technology-engineering-science-mathematics) and achieve different outcomes at the cognitive, emotional and skill level (Celestin & Steve, 2018).

One of the most important skills developed by STEM is to provide learners with a meaningful practice to discover their experiences, increase their motivation to learn, connect theory to practice, provide solutions to educational problems, increase awareness of the functionality of knowledge received in education, The talent and creativity of early school teachers increase learners' self-confidence, self-fulfillment, and provide practical activities that help them succeed, innovate, and develop teamwork and communication skills (Koyunlu, Dokme & Unlu, 2016). In this decade many researchers interest in this approach, Michaluk et.al (2018) conducted a study about Beliefs and Attitudes about Science and Mathematics in Pre-Service Elementary Teachers, the study showed that Attitudes toward science and mathematics were significantly positively correlated with accurate beliefs about the teaching of mathematics and science for all student groups, also Pre-service teachers initially evidenced more positive beliefs about the teaching of mathematics and science, and their beliefs even increased slightly over the course of the semester, while these beliefs in other groups remained the same.

There are many projects in the world focused on improving the scientific and mathematical thinking of pre-service teachers (PSTs) by aligning their pedagogy with the scientific and mathematical thinking that occurs in authentic, real-world contexts, the report of annual meeting in Australia year 2018 discusses emotional literacy and emotional regulation as aspects of self-reflective professional development and how these measures are conceptually relate to improving competence and confidence for pre-service STEM teachers. This report details how emotional feedback was used in trials of a pilot program to enable PSTs to analyze, understand, and make use of emotional information to improve their teaching confidence, particularly in mathematics (Woolcott, & Yeigh, 2018). Akran and Asiroglu (2018) conducted a study to identify the perceptions of the teachers towards the STEM education and the constructivist education approach in Turkey, the study showed that the primary school teachers have positive and negative perceptions towards the STEM education, whereas teachers of information technology have negative perceptions. It was also concluded that teachers of mathematics and science have a positive perception of STEM education. Gulen (2018) studied the effect of STEM approach on the resolution of daily life problems and the change of high-level thinking skills. Mixed method was used in the research; it was observed as positive change in the participants thinking on the identification and solution of daily life problems. Also, the unresolved problem factor determined for the land factor in hazelnut transportation is removed after the application.

Morgan and others (2013) state Project-Based Learning (PBL) that presents an original approach to STEM centric PBL. They define PBL as an "ill-defined task with a well-defined outcome," which is consistent with our engineering design philosophy and the accountability highlighted in a standard-based environment. This model emphasizes a backward design that is initiated by well-defined outcomes, tied to local, state, or national standard that provides teachers with a framework guiding students ,design, solving, or completion of ill-defined tasks. This book was designed for middle and secondary teachers who want to improve engagement and provide contextualized learning for their students. However, the nature and scope of the content covered in the 14 chapters are appropriate for preserve teachers as well as for advanced graduate method courses. New to this edition is revised and expanded coverage of STEM PBL, including implementing STEM PBL with English Language Learners and the use of technology in PBL.

The reform movement in the United States had focused on STEM education and 21st century soft skills such as critical thinking, communication, collaboration, and creativity (Elwood, 2018). This spotlight on STEM instruction provided an opportunity to explore how K-14 STEM teacher participants perceived a Design Thinking Instructional Problems (DTIP) approach to developing instructional lessons. The study used a convergent parallel mixed-methods design with a survey instrument and a multiple case study focused on K-14 in-service STEM teachers. The teacher participants viewed themselves as designers solving complex instructional problems, teachers found the DTIP professional development sessions to have "somewhat" to "very much" provided additional value during their RET summer programs. Six of the ten case-teachers perceived the DTIP model graphic as "mostly" to "completely" corresponding to the way in which they developed their RET instructional lesson. Lastly, eight of the 10 case-teachers chose to embed a Design Thinking student learning strategy into the RET instructional lesson they developed.

Nickels and Gartner (2018) indicate that blending learning in mathematics classrooms can support personalized learning, rich mathematical understanding, and deeper engagement with STEM. Al-sayed and Abbas (2017) conducted a study aimed at investigating the effectiveness of STEM approach in developing visual reasoning and learning independence for preparatory stage students. The results of the study were the effectiveness of STEM approach in the achievement and visual reasoning, and indicate the development of the students' ability to take responsibility of their learning, their ability to choose, their confidence, and consequently their competency in the aspects of learning independence.

Wachira and others (2017) conducted a study about the beliefs, view, perceptions of Thailand teachers regards STEM approach, the results of the study showed that 85.5% of teaches had never heard about STEM education, and 19% of in-service teachers could not provide a definition of STEM, with 20.53% of the teachers view STEM as a trans-disciplinary course or program. While teachers think that a STEM teaching approach is very interesting. Cinar and others (2016) conducted a study to investigate the Views of Science and Mathematics Pre-Service Teachers Regarding STEM the participants of the study were the senior class students. The results showed that the pre-service teachers have more positive views about the STEM approach, and there is not a significant difference between the views of science and mathematics teachers. Also, they reported positive views about making such applications in their future classes.

Carreira and Baioa (2018) did a study to find out how students estimate the credibility a modeling task setting when it integrates a hands-on experimental approach. The results indicate that students viewed the event as credible, as well as the goal of the task. They also considered the experimental work to be necessary and found the mathematical model obtained to be feasible. Moreover the students showed awareness of a distinction between their experiments and models and those developed by professionals. In short, the students ascribed credibility to the task setting and were able to acknowledge an approximation to reality in both the prototype created and the model built.

Integrated Science, Technology, Engineering and Mathematics (STEM) education is an emerging approach to improve students' achievement and interest in STEM disciplines (Thibaut et al., 2018). However, the implementation of integrated STEM education depends strongly on teachers' competence, which entails, among other, teachers' attitudes. Nonetheless, not much is known about the factors that influence teachers' attitudes toward teaching integrated STEM. Therefore this paper uses a survey method to get insight into the relationship between three groups of variables and teachers' attitudes toward teaching integrated STEM: teacher background characteristics, personal attitudes and school context variables. The results of the multiple regression analyses reveal three variables that are positively linked with teachers' attitudes: professional development, personal relevance of science and social context. Moreover two variables show a negative correlation: having more than 20 years of teaching experience and experience in mathematics. The results of this study provide valuable information about factors related to teachers' attitudes toward teaching integrated STEM. Moreover, these results can be deployed by school administrators to guide them when implementing integrated STEM education at their school.

A STEM book is published with 25 Project-Based Learning (PBL) chapters written by a combination of undergraduate preserve teachers, in-service teachers, and graduate students (Capraro et al., 2016). Everyone who wrote a chapter strives to improve STEM education to help others implement standards-based STEM instruction that takes learning in isolation to greater accountability through integrated and meaningful tasks that answer the question every teacher dreads: When am I going to use this? The PBLs were written to implement in middle and high-school classrooms. All of them are interdisciplinary in nature. We have divided them into six themes: construction and design, water, environment, mixtures, technology, nutrition and genetics. Each lesson contains a "schedule at a glance" and the "well-defined outcome" so you can quickly see how a particular PBL fits into your curriculum. Objectives are listed along with STEM connections written as objectives. We have included all materials needed and then each day of activities including an imbedded engagement, exploration, explanation, evaluation (including rubrics), and extension. We have tried to include everything necessary for successful implementation. This practical book is the perfect companion to the handbook for learning about implementing PBLs: *Project-Based Learning: An Integrated Science, Technology, Engineering, and Mathematics (STEM) Approach – second edition*. The study of Ogle et al. (2017) explored whether participation in Fashion Fundamentals (FF), FF enhanced girls' self-efficacy, knowledge, and interest in math and science. At the conclusion of the program, participants in FF demonstrated higher scores on measures of self-efficacy in math and science and knowledge in math. Girls' self-efficacy in math and science positively predicted their interest in STEM. Focus group data revealed that some girls demonstrated enthusiasm for science and acquired science knowledge specific to FF.

The study of Education Council of Australia ECA (2015) there are many factors that affect student engagement in science, technology, engineering and mathematics (STEM). Underlying this are the views of the broader community--and parents in particular--about the relevance of STEM, and the approach to the teaching and learning of STEM from the early years and continuing throughout schooling. Connected to this is the way industry articulates the importance of STEM related-skills that extend beyond traditional STEM occupations. University admissions policies also have a strong influence on student choices in the senior secondary years. The purpose of the strategy is to build on a range of reforms and activities already underway. It aims at better coordinating and targeting this effort and sharpening the focus on the key areas where collaborative action will deliver improvements to STEM education. The national strategy is focused on action that lifts foundational skills in STEM learning areas, develops mathematical, scientific and technological literacy, and promotes the development of the 21st century skills of problem solving, critical analysis and creative thinking. It recognizes the importance of a focus on STEM in the early years and maintaining this focus throughout schooling.

This document outlines two goals (ensure all students finish school with strong foundational knowledge in STEM and related skills; and ensure that students are inspired to take on more challenging STEM subjects), five areas for national action, and guiding principles for schools to support STEM education. Within the literature there has been a call for the integration of science, technology, engineering, and mathematics (STEM) disciplines (Becker & Park, 2011). However, little research has been conducted to investigate the effects of integrative approaches among STEM subjects.

The purpose of this study was to synthesize the findings from existing research on the effects of integrative approaches among STEM subjects on students' learning. Meta-analysis was employed to address the research questions of this study. Twenty-eight studies were selected and thirty-three effect sizes were calculated to examine the effects of integrative approaches among STEM subjects. With respect to the grade levels, the effects of integrative approaches showed the largest effect size at the elementary school level and the smallest effect size at the college level. Regarding the types of integration, STEM, the integration of four subjects, presented the largest effect size, and E-M and M-S-T showed the smallest effect size. In addition, concerning the achievement through integrative approaches, STEM achievement showed the highest effect size and mathematics achievement showed the smallest effect size. The results of this preliminary meta-analysis reveal that integrative approaches among STEM subjects have positive effects on the students' learning. Further empirical research on the effects of STEM education needs to be conducted to confirm the findings of this preliminary meta-analysis.

Joho and others (2016) conducted study aimed at investigating STEM teacher education and examining the successful conditions for its implementation. The study tools videotaped actual lessons, interviewed teachers. The results of study showed that the two communities shared similar dimensions: open-mindedness and self-innovation as joint enterprise, reciprocal relationship and continuous role exchange as mutual engagement, and educational materials and abundant time as shared repertoire. Beker and Cumhuri (2017) investigated the opinions of middle school science and mathematics teachers towards STEM education were examined. The sample of study consisted of mathematics teacher in Istanbul. The study was conducted by the case study method among qualitative research Methods. To determine the opinions of the secondary school science and mathematics teachers, „STEM interview form for Teachers” consisting of eight questions was created. As result of the analysis, the teachers emphasized that they did not feel Sufficient about STEM education and that good STEM teacher should have STEM knowledge, pedagogy knowledge andthe21st century skill knowledge. However, it was found that after the STEM training, teachers had positive changes in their opinions towards engineering and technology.

Cevik and Ozgunay (2018) conducted a study aimed at exploring the views of STEM teachers working to secondary schools and administrators of the schools, in which these teachers are working, regarding STEM. This research is based on a survey model in which quantitative data tools were used to directly obtain the opinions of teachers about STEM education; in parallel with qualitative data tools were used to deeply understand the views of administrators about STEM education. The sample of the study consisted of 136 STEM field educators working at 21state and private public secondary schools and 45 administrators working at these schools. While views of teachers indicated that the impact of STEM on students was higher than its effect on courses and teachers with each subscale of the quantitative data collection tool conducted with teachers, no significant relation was observed between these findings, gender and branch variables. Similarly, administrators stated that STEM is more effective on the students, teachers are not well equipped to teach STEM, they need to train themselves to implement STEM in courses and curriculums should be prepared on a STEM basis.

Bakrici and Karisan (2017) point out the today's life requires individuals to be prepared for complex world environment, to make complex decisions, and to have critical thinking skills related to everyday life issues at hand. STEM education is thought to be the glorious Present study aims to investigate the preserve primary school, mathematics and science teachers STEM awareness. Quantitative research methodology guided the present study. Cross-sectional survey type which collects information from a sample that has been selected from a predetermined population was used. The STEM Awareness Scale, a five point Likert type instrument developed by Buyruk and Korkmaz (2016), was used to measure preserve teachers STEM awareness. Data was collected from 558 (371 females, 187 males) preserve teachers enrolled in three different teacher preparation programs. The results of this research demonstrates that there is no significant interaction effect for gender and department variables however there is significant difference among different department students STEM awareness preserve science teachers" and preserve primary school teachers STEM awareness scores have similar mean values and also outnumbers the preserve mathematics teachers" STEM awareness solution to thrive in a global knowledge driven world. Teachers are key elements for successful STEM education.

Cameron and Jay (2017) highlighted as a means of promoting college and career Readiness for high school students. Applied STEM coursework is a promising area of high school study that has particular relevance in the technologically progressive world of today. Previous Research has illustrated that applied STEM coursework at high school is associated with a Number of positive educational outcomes. Importantly, no previous empirical investigation has examined the relationship between applied STEM coursework and students" reported levels of math and science self-efficacy, two important harbingers of academic ability and success. Consequently, the current study used nationally representative data to explore applied STEM coursework participation and self-efficacy. Results indicated that applied STEM coursework was Predictive of increases in both math and science self-efficacy, except among females and students with disabilities (SWDs).

Research Questions

1. What are the attitudes of university students towards using STEM education strategy in teaching?
2. Are the attitudes of the students of the Faculty of Education different from the use of STEM approach by type of degree (master / bachelor)?
3. Are the attitudes of the students of the Faculty of Education different from the use of STEM approach by type of training (trained / non-trained)?

Terminology of the Study

STEM: Science, Technology, Engineering, Mathematics (STEM) approach requires the processing of effective learning environments in which students actively learn in the workshops and educational research projects that the learner feels the pleasure of learning, which leads to access to a comprehensive and integrated knowledge on the topics related to them away from the deafness of the concepts traditionally received at the classroom. The properties of STEM: Understanding scientific concepts with their applications, acquiring the scientific thinking and creativity, acquiring the research skills and problem solving, decision making, and relate mathematical thinking through the science and technology, apply the design engineering science on integrated model (Almalki, 2018).

Attitudes towards STEM Approach: It is predisposition or a tendency to respond positively or negatively towards STEM approach. And the major component of the attitudes towards the STEM approach, emotions beliefs, inclination, and positive or negative to stimuli. In this research the attitudes are divided into four cores according to the 21 century skills: desire of applying the strategy developing thinking and problem solving, motivation and self-learning skills, communication and collaboration.

Methodology

The research tool was measurement of attitudes towards the STEM strategy which is used in the training program for both bachelor and master students enrolled at the academic year 2018-2019, and we train the students to use the STEM strategy by using WeD02.0 application as one of the programs. The participants of the study were 60 university students in Jordan, 30 trained were training at the WeDo2.0 application (15 master degree, 15 bachelor), and 30 non-trained (15 master degree, 15 bachelor). Table 1 shows the subjects of the study.

Table 1. Distribution of the Subjects of the Study

Training Variable	Degree of Students	Number	Total
Trained	Master	15	30
	Bachelor	15	
Non-trained	Master	15	30
	Bachelor	15	

The tool of study was a questionnaire of the attitudes towards the STEM approach, the participants taught about the STEM approach, and acquiring the skills of STEM through training to design lessons in science, mathematics, engineering, and merging the skills of technology, the questionnaire consists of (19) paragraphs distributed into four cores: the core of desire of applying the strategy, core of developing thinking and problem solving, core of motivation and self-learning skills, and communication and collaboration (see Appendix). The validity and reliability reached (0.83). The arithmetic means and standard deviation, and multi analysis of variance of two ways (MANOVA) used to answer the questions of the study.

Results and Discussion

Attitudes of University Students towards Using STEM Education Strategy in Teaching

The arithmetical averages, standard deviations, and trend domains were extracted as shown in Table 2.

Table 2. The Arithmetic Means and Standard Deviations of the Attitudes Domains STEM Approach

Domain	Type of training	Mean	Std. Deviation	Percentage	Order
Desire to apply strategy	Trained	4.56	0.57	91.2%	4
	Non-trained	4.16	0.79	83.2%	
	Total	4.37	0.72	87.4%	
Thinking and problem solving	Trained	4.53	0.63	90.6%	2
	Non-trained	4.07	0.78	81.4%	
	Total	4.30	0.74	86.0%	
Motivation and self-learning	Trained	4.53	0.57	90.6%	1
	Non-trained	4.06	0.74	81.2%	
	Total	4.30	0.70	86.0%	
Collaboration and communication	Trained	4.56	0.57	91.2%	3
	Non-trained	4.07	0.78	81.4%	
	Total	4.32	0.72	86.4%	
Total	Trained	18.20	1.95	91.0%	
	Non-trained	16.37	1.82	81.9%	
	Total	17.28	2.09	86.4%	

It is noted from the previous round that the attitudes of students towards the use of STEM approach applications in teaching courses was high (86.4%), and was the highest focus for students in the use of desire to apply strategy in teaching the course. All the domains where the trend towards the application of high application ranked as descending order: desire to apply strategy (87.4 %%), collaboration and communication (86.4%), thinking and problem solving (86%), and motivation and problem solving (86%). The STEM approach considers interesting teaching methods, as the use of the STEM approach which motivates the students to explore knowledge with hands –on, as John Dewey confirmed the importance of learning with doing, and the university students, while they are trained at the STEM approach with integrated application (WeD02.0) that supports the individuals with software application on the site of the LEGO education, and all of students engaged with the application starting with sorting the studs, and construct the shape, through the concrete and pictorial and then abstract, at all stages of using the (WeD02.0) Kite the learners integrate technology, and may be used mathematics skills or principles, and the learners used the science skills and rules. It also provided answers and solutions to the problems faced by students, and provided sources and videos that illustrated solutions to some exercises. It is important to note that the students interacted greatly with each other and cooperated with each other positively. Also, the STEM approach encourages students to collaborate; because the team works to communicate, and they always solve the problems which faced them. This finding is consistent with each of Akran and Asiroglu (2018) and Gulen (2018).

Attitudes of University Students towards the Use of STEM Approach by Type of Degree (Master/Bachelor) and Type of Training (Trained /Non-trained)

The arithmetic means and standard deviations were used as shown in Table 3.

Table 3. Arithmetic Means and Standard Deviation of the Attitudes of the Subjects towards STEM Approach

Training	Degree	Mean	Std. Deviation	N
Trained	Master	19.1333	1.24595	15
	Bachelor	17.2667	2.12020	15
	Total	18.2000	1.95466	30
Non-trained	Master	16.8000	1.61245	15
	Bachelor	15.9333	1.98086	15
	Total	16.3667	1.82857	30
Total	Master	17.9667	1.84733	30
	Bachelor	16.6000	2.12700	30
	Total	17.2833	2.09189	60

It is noted from the previous table that the student's average of the master (17.97) is higher than the student's arithmetic mean of the bachelor (16.6) and the difference is (1.37). And for the training variable, the arithmetic mean for the trained students (18.2) was higher than the non-trained (16.37) and the difference is (1.83). To study the significance of the differences between the attitudes of students in the faculty of education towards the use of STEM approach according to the type of degree of the study (master / bachelor) as well as (trained / non-trained), two-way analysis of variance (MANOVA) was used as shown in Table 4.

Table 4. A Two-Way Analysis of Variance (MANOVA) Results for Differences between the Type of Degree (Master/Bachelor) and the Variable Training (Trained/Non-Trained)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	82.183 ^a	3	27.394	8.72	<.001
Intercept	17922.817	1	17922.817	5702.71	<.001
Training	50.417	1	50.417	16.04	<.001
Degree	28.017	1	28.017	8.91	.004
Training * Degree	3.750	1	3.750	1.19	.279
Error	176.000	56	3.143		
Total	18181.000	60			
Corrected Total	258.183	59			

It is evident from the previous table that there are statistically significant differences ($\alpha \leq 0.01$) between the variable type of study level among the students with master or bachelor in their attitudes towards the use of STEM approach in teaching in the open learning in Jordan, with f-value (8.91), and there were significant differences ($\alpha \leq 0.01$) between the variable nature of the student's trained and non-trained with f-value (16.04). The previous table showed differences between trained and non-trained students in their attitudes towards using STEM approach in teaching subjects at students in Jordan in favor of trained students. Also, there were differences in attitudes due to the fact that the students were master degree or bachelor degree, in favor of master degree, indicates that the use of STEM approach created positive attitudes for master degree; because most of master students are working at schools and they are more interested in teaching with strategy that motivates students and decreases the anxiety. Both master and bachelor degree students that trained on STEM approach have the procedures and steps to apply the approach at their schools, and they acquire skills of STEM approach, and the most important point through training the high motivation, hands-on, collaboration, they solve their problems only. Researchers noticed that the STEM reduced anxiety of students during communication with the trainer; increase the opportunity for communicating and collaboration, and supporting the problem solving ability through engaging activities, most of all increases the motivation to the learning and acquiring different skills like programming and constructing, sorting, research skills, and problem solving, which we need for our students in the 21 century skills (NCTM, 2000).

Conclusion

The results of the study showed that positive student attitudes toward using STEM approach in Jordan, reached 86.4%. Each of the following scores is ranked as descending order: desire to apply strategy (87.4 %),

collaboration and communication (86.4%), thinking and problem solving (86%), motivation and problem solving (86%). It means that the importance of using new approaches in training mathematics teachers in serves and in preserves, the STEM approach considered as an integrated approach which connect the concepts and principle of many subjects like mathematics and science in technological environment.

There was no statistical significance difference between the variable type degree of study (master/bachelor) as well as the nature of employment in terms of whether the learner was either an employee or non-employee. Based on the results of the study, researchers recommend using STEM approach in teaching courses in open learning systems. In the light of the study results, the researchers recommend using STEM approach in teaching students in the open learning systems in Jordan, using modern strategies for teaching mathematics and science courses, and conducting studies on students of schools and universities.

References

- Akran, S., Asiroglu, S. (2018). Perceptions of teachers towards the STEM education and the constructivist education approach: Is the Constructivist Education Approach Preparatory to the STEM Education?, *Universal Journal of Educational Research*, 6(10), 2175-2186.
- Almalki, M. (2018). The effect of STEM approaches in teaching sciences in research ISEF standards at elementary students. *International Journal of Educational and Psychological Studies*, 4(1), 113-135.
- Al-sayed, R., Abbas, S. (2017). Using STEM approach to develop visual reasoning and learning independence for preparatory stage students, *Education*, 137(3), 320-332
- Altun, Y. & Yildirim, B. (2015). *Theoretically to practice STEM and sample applications*. Istanbul: Pozitif publish.
- Bakrici, H., Karisan, D. (20-17). Investigating the pre-service primary school, mathematics and science teachers' STEM awareness, *Journal of Education and Training Studies*, 6(1), 32-42.
- Becker, K., Park, K. (2011). Effects of integrative approaches among science, technology, engineering, and mathematics (STEM) subjects on students' learning: A preliminary meta-analysis. *Journal of STEM Education*, 12(5), 23-37.
- Bekir, Y., Cumhuri, T. (2017). Conducted a study to investigate the opinions of secondary school science and mathematics teachers on STEM education, *World Journal on Educational Technology: Current*, 10(1), 052-060.
- Cameron, S., Jay, S. (2017). How does applied STEM coursework relate to mathematics and science self-efficacy among high school students? Evidence from a national sample, *Journal of Career and Technical Education*, 32(1), 1-29.
- Capraro, M., Whitfield, J., Etchells, M., Capraro R. (2016). *A Companion to interdisciplinary STEM project-based learning: For educators by educator's ed.:* Second edition. Rotterdam: Sense Publishers, e-book.
- Carnevale, A. P., Smith, N. & Melton, M. (2011). *STEM: science technology engineering mathematics*. Washington, DC: Georgetown University Center for Education and the Workforce.
- Carreira, S., Baioa, A. (2018). Mathematical modeling with hands-on experimental tasks: on the student's sense of credibility. *ZDM*, 50(1):201-215.
- Celestin, N., Steve, O. (2018). The implementation of integrated science technology, engineering and mathematics (STEM) Instruction using Robotics in the Middle School Science Classroom, *International Journal of Education in Mathematics, Science and Technology*, 6(1), 12-40.
- Çevik, Mustafa; Ozgunay, Esmâ (2018). STEM Education through the Perspectives of Secondary Schools Teachers and School Administrators in Turkey
- Cinar, S., Pirasa, N., Sadoglu, G. (2016). Views of science and mathematics pre-Service teachers regarding STEM, *Universal Journal of Educational Research*, 4(6), 1479-1487.
- DeChenne, S. E., Koziol, N., Needham, M. & Enochs, L. (2015). Modeling sources of teaching self-efficacy for science, technology, engineering, and mathematics graduate teaching assistants. *CBE—Life Sciences Education*, 14, 1–14.
- Education Council of Australia (2015). *National STEM school education strategy: A Comprehensive Plan for Science, Technology, Engineering and Mathematics Education in Australia*.
- Elwood, Kristin. (2018). "Design thinking instructional problems (DTIP): exploring the perspectives of K-14 STEM teachers on the DTIP approach to developing instructional lessons", Ph.D. Dissertation, Arizona State University.
- Gulen, S. (2018). Determination of the effect of STEM-integrated argumentation based science learning approach in solving daily life problems, *World Journal on Educational Technology*, 10(4), 95-114.
- IEA. (2016). *International association for the evaluation of educational achievement*. Boston College, (timms.bc.edu).

- Jho, H.; Hong, O.; Song, J.(2016).An Analysis of STEM/STEAM teacher education in Korea with a case study of two schools from a community of practice perspective, *Eurasia Journal of Mathematics, Science & Technology Education*, 12(7), 1843-1862.
- Koyunlu u., Z., Dokme, I., & Unlu, V. (2016). Adaptation of the science, technology, engineering, and Mathematics career interest survey (STEM-CIS) into Turkish. *Eurasian Journal of Educational Research*, 63(1), 21-36.
- Michaluk, L., Stoiko, R., Stewart, G., Stewart, J.(2018).Beliefs and attitudes about science and mathematics in pre-service elementary teachers, STEM, and Non-STEM Majors in Undergraduate Physics Courses, *Journal of Science Education and Technology*, 27(2), 99-113.
- Morgan, R., Capraro, M., Capraro, R. (2013). *STEM Project-based learning: An integrated Science, Technology, Engineering, and Mathematics (STEM) Approach-book (2nd edition)*, sense publishers.
- Mustafa, C. (2018). Impacts of the Project Based (PBL) Science, Technology, Engineering and Mathematics (STEM) Education on Academic Achievement and Career Interests of Vocational High School Students, *Pegem academy for training and teaching*, 8(2), 281-306.
- Nickels, S., Gartner, A. (2018).Rethinking the mathematics mlock: A blended STEM approach. *Kappa Delta Pi Record*.54(4), p186-189.
- Ogle J., Hyllegard, K., Rambo-Hernandez, K., Juyeon, P. (2017). Building middle school girls' self-efficacy, knowledge, and interest in math and science through the integration of fashion and STEM. *Journal of Family & Consumer Sciences*, 109(4):33-40.
- Reding, T.E., Squires, A., Grandgenett, N., Keller, S., Grandgenett, H., Hodge, A., Argo, C., Jacobberger, K. (2017). Determining quantity and strength of relationships between STEM camp participants and the math student camp leaders. *International Journal of Research in Education and Science (IJRES)*, 3(1), 171-179.
- Seage, S.J., & Türegün, M. (2020). The effects of blended learning on STEM achievement of elementary school students. *International Journal of Research in Education and Science (IJRES)*, 6(1), 133-140.
- Thibaut, L.; Knipprath, H.; Dehaene, W.; Depaepe, F. (2018). How school context and personal factors relate to teachers' attitudes toward teaching integrated STEM, *international Journal of Technology and Design Education*, 28(3), 631-651.
- Vu, P., Harshbarger, D., Crow, S., & Henderson, S. (2019). Why STEM? Factors that influence gifted students' choice of college majors. *International Journal of Technology in Education and Science (IJTES)*, 3(2), 63-71.
- Wachira, S., Hanuscin, D., Faikhamta, C. (2017).Perceptions of in-service teachers toward teaching STEM in Thailand. *Asia-Pacific Forum on Science Learning & Teaching*, 18(2), 1-23.
- Zendler, A., Klaudt, D., & Seitz, C. (2017). Instructional methods in STEM and English subjects: A validation study. *International Journal of Technology in Education and Science (IJTES)*, 1(1), 1-17.

Author Information

Bahjat H. Altakhneh

Arab Open University

Jordan

Contact e-mail: b_takhneh@aou.edu.jo**Mofeed Abumusa**

Arab Open University

Jordan

Appendix. Scale of Trends towards the Use of STEM Approach in Education

Dear teacher, the aim of this scale is to measure the level of trends towards the use of STEM approach in education. Please answer the sentences of the measure in all honesty and integrity, and the results of this measure only for scientific research purposes.

Name:..... Specialization:.....

Academic level: High School / Bachelor / Master

Type of work: Worker education / Non-worker education

Survey Item	Strongly Agree 5	Agree 4	Neutron 3	Disagree 2	Strongly Disagree 1
Core (1): Desire to Apply Strategy					
I think STEM strategy is useful to me in teaching.					
I feel that the tools that have been used in the course on the STEM system are useful to me.					
I gained important new experience for me in teaching through the course.					
I believe that STEM's strategy has provided elements of complementarity in the three areas of purpose :cognitive ,skillful, and compassionate.					
I feel a desire to apply the STEM strategy in teaching math and science courses.					
I think this strategy develops the learner's motivation to study.					
Core (2): Thinking and Problem Solving					
I think this strategy is important for the development of creative thinking.					
I think this strategy is important for the development of critical thinking.					
I think this strategy is important for the development of computational thinking.					
STEM's educational strategy develops autonomy in thinking					
Core (3): Motivation and Self-learning					
I think this strategy is interesting and fun for learners.					
I think this strategy relieves students' anxiety in mathematics and science.					
STEM's strategy has an educational benefit in increasing the self-confidence of learners.					
The STEM education strategy develops the ability to self-manage and organize.					
The STEM educational strategy takes into account individual differences among students.					
Core (4): Collaboration and Communication					
I feel that STEM's educational strategy fosters collaborative work among students.					
STEM Stereotyping Strategy develops the ability to communicate with others.					
STEM strategy can be applied in math and science classes at all stages.					
STEM tools are multiple and varied.					