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أثر منحى STEM- Oman على اهتمام طلبة الصف العاشر بمهن ومواد العلوم والتكنولوجيا والهندسة والرياضيات STEM

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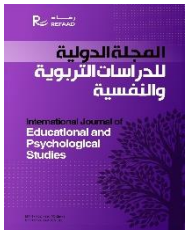

Results of the STEM- Oman Approach on the Interest of 10th Grade Students Towards STEM's Careers and Subjects

أثر منحى STEM- Oman على اهتمام طلبة الصف العاشر بمهن ومواد العلوم والتكنولوجيا والهندسة والرياضيات STEM

Abstract:

Objectives: The purpose of this study is to investigate the effect of STEM- Oman integrated with science class on the interest of 10th grade students towards STEM's careers and subjects.

Methods: Quasi- experimental research was conducted in the second semester of the academic year of 2018-2019. Sixty-four female students of tenth grade from two secondary schools at the same town had participated in this study. The researcher used STEM-Oman approach that was established by the Ministry of Education in Oman with the British Rolls-Royce to be integrated in the common topics in science subject in the experimental group (31) while the control group (33) studied these topics in a normal seating without STEM-Oman. Data were collected by survey of student' interest toward both STEM' subject and career (STEM-CIS).

Results: According to the research results, overall, there is no significant difference in mean scores for interest towards STEM career and subjects between groups. Moreover, there is no significant difference in ISTEMC neither ISTEMS for interactivity between groups or science achievement levels. However, there is a significant difference in interests in STEM careers' Technology between groups favor the control group. In addition, there is significant difference in interests in STEM subject' Math between groups favor the experiment group and interests in STEM subject' Technology between groups favor the control group. In the light of the research results, some suggestions have been made for future studies.

Keywords: *STEM Education Impact; Career awareness in STEM-related fields; Interest Towards STEM Subjects &Careers.*

الملخص:

الأهداف: هدفت الدراسة التحقيق من أثر منحى STEM-Oman على اهتمام طلبة الصف العاشر بمهن ومواد العلوم والتكنولوجيا والهندسة والرياضيات STEM.

المنهجية: تم إجراء بحث شبه تجريبي في الفصل الدراسي الثاني من العام الدراسي (2018-2019). وقد شاركت في هذه الدراسة (64) طالبة من الصف العاشر من مدرستين ثانويتين في نفس المدينة. استخدم الباحث منحى STEM-Oman الذي وضعته وزارة التربية والتعليم في سلطنة عمان مع شركة Rolls-Royce البريطانية ليتم دمجه في الموضوعات المشتركة في مادة العلوم في المجموعة التجريبية (31)، بينما درست المجموعة الضابطة (33) هذه المواضيع بالطريقة الاعتيادية. تم جمع البيانات من خلال مقياس اهتمام الطلبة بدراسة مواد ومهن العلوم والتكنولوجيا والهندسة والرياضيات (STEM-CIS).

النتائج: أظهرت نتائج الدراسة إلى عدم وجود فرق دال إحصائيًا بين المجموعتين التجريبية والضابطة في مقياس الاهتمام بمواد ومهن العلوم والتكنولوجيا والهندسة والرياضيات ككل. كما أظهرت النتائج عدم وجود فرق دال إحصائياً لدى هاتين المجموعتين في هذا المقياس تعزى إلى التفاعل بين طريقة التدريس والمستوى التحصيلي. إلا ان هناك فرق دال احصائيًا في الاهتمام بمهن الرياضيات في STEM بين المجموعتين لصالح المجموعة التجربة، وفرق دال احصائيًا في الاهتمام بالمهن المرتبطة بالتكنولوجيا في STEM بين المجموعتين لصالح المجموعة الضابطة. وفي ضوء نتائج البحث تم تقديم بعض الاقتراحات للدراسات المستقبلية.

الكلمات المفتاحية: *منحى العلوم والتكنولوجيا والهندسة والرياضيات STEM؛ اهتمام الطلبة بمواد ومهن STEM.*

Introduction:

STEM has been used as an acronym for four separate discipline areas of Science, Technology, Engineering and Mathematic; as this indicates that the students have to apply the science and mathematics knowledge, they learn to an engineering problem and utilize technology in finding a solution (Kennedy & Odell, 2014). Educators in science fields mentioned that the awareness of the nature of science (NOS), technology, engineering and mathematics with their fundamental concepts are all the basics of STEM-Literacy that should be an educational priority for all students (Bybee, 2006; National Research Council, National Academy of Engineering, & Committee on Integrated STEM Education, 2014). In STEM activities students can solve problems and extract conclusions based on their previously learned principles applied through science, technology and engineering, and mathematics (Trevallion1 & Trevallion2, 2020).

One of the recommendations of the strategy on quality building in Oman's education is moving towards the use of student-centered teaching methods to develop students' essential skills for life and work (Secretariat General of the Education Council, 2018). The 'STEM- Oman' is enriching materials that complement the curricula that is currently applied in the public Sultanate's schools for tenth grade. It is based on interactive and practical education, which is based on linking science, technology, engineering and mathematics curriculum with the current scientific curricula. This is in order to achieve the quality of the required education, to create a generation of students capable of participating effectively in the development of sustainable society, and to lead to the introduction of a knowledge-based economy in the fields of science, mathematics, engineering and technology.

'STEM- Oman' began its first phase in six public schools at the beginning of the second semester of the academic year 2017-2018 and under the supervision of the Omani Authority for Partnership for Development (OAPD) in partnership with the British Rolls-Royce and in cooperation with the Ministry of Education represented by the Innovation and Scientific Olympiad Department. Therefore, it seeks to link the scientific sciences with the world of students and its external environment and to develop the love of exploration, conclusion and organizing information in an interesting and exciting way; as well as its role in changing negative attitudes of students towards scientific subjects (First phase of 'Stem Oman' launched in six public schools, 2018). Teachers, who teach STEM-Oman topics do one lesson per week in a hall, which is well prepared to fit all the need to implement it.

The term interest can describe the mind-set characterized by a need to give selective attention to something which aims to be significant for a person such as a goal, subject or an activity, and this effected by each persona self-efficacy according to Bandura's (1986) social cognitive theory of learning. He claimed that self-efficacy is the most influential component to goal setting and action, an individual's belief that someone is capable of mastering events within themselves. Self-efficacy is the belief in one's capability to regular and to perform the track of activity requisite to proceed a given task or goal (Bandura, 1997; Zimmerman, 2000). It is involved in setting personal goals, analyzing decisions, and making commitments (Kier, Blanchard, Osborne & Albert, 2014).

Lent, Brown and Hackett (1994, 2000) link Bandura's relationship between goals, outcome expectations and self-efficacy to contextual factors, personal inputs and interests in order to explain how individuals make career-related decisions. In addition, they clarify that contextual supports and barriers are external factors or individuals that either facilitate or impede high self-efficacy or setting academic or career goals. They develop a theoretical model called the social cognitive career theory (SCCT) which can predict interest and intent to pursue academic choices and careers. It allows researchers to use measures of individual's self-efficacy, personal inputs/ backgrounds, outcome expectations, and contextual supports to explain reasoning behind students' academic or career choices.

Kier and other researchers (2014) used this theory to develop STEM Career and subjects Interest Survey (STEM-CIS), which aims to help researchers in professional development and program evaluators to measure the effects of their STEM programs on making changes in student interest in STEM subjects and careers. Therefore, this survey has been used for the purpose of this study. Skamp (2007) claims that when middle school students are engaged in STEM learning environments' discussions about goals and opportunities available to them in STEM fields, they have time to connect their interests to these subjects and demonstrate higher self-efficacy in these fields before college.

Although the international results of TIMSS 2015 in science showed that the eighth-grade students were positive about their learning science and valuing science, they were less positive about their confidence in science (Download center – TIMSS 2015 and TIMSS advanced 2015 international results, n.d). Nevertheless, students' attitudes towards learning science topics and their interest to continue learning them in the future are affected by

their achievement in them; regardless to their self-efficacy in learning environments (Singh, Grandville & Dika, 2002; Newell, Zientek, Tharp, Vogt & Moreno, 2015). Moreover, students' performance in science and mathematics in middle school determines their choice to continue study in these disciplines later in high schools, and their early interests and positive attitudes were related to their educational and career aspirations in them (Singh et al., 2002). Dowey (2013) in his mixed method study had explored the attitudes, interests, and perceived self-efficacy toward science of middle school female students, the quantitative results of it revealed that science's academic achievement accounted for most of the variance of mean scores for students' attitudes and interests in science.

Also, Shahali (2016) and his colleges in Malaysia University tried to identify students' changes of both interest toward STEM subjects and interest to pursuing STEM career after participating in non-formal integrated STEM educational programme, which exposed students with integrated STEM education on five phases engineering design process. Their samples were two cohorts of middle secondary students participated in 2014 (n=129) and 2015 (n=113) and one of groups was quasi-experimental design. The analysis revealed that; overall, there is a significant increase in mean scores for interest towards STEM subjects and career after participating in the programme. The findings also indicated that the program was effective at modifying students' interest level as the result revealed positive changes (from moderate to high level) for both 2014 and 2015 groups for interest toward STEM career and interest towards STEM subjects.

The results of Heacock's study (2016) indicated that the majority of the preadolescent girls thought science was an important topic to study and displayed an attitude of self-confident ability to learn science and be successful in science class ninth. However, Knipprath et al. (2018) mentioned that students' positive attitudes towards science and mathematics appear to decrease with age, so for schools to be encouraged to stop this decline and to avoid that less students end up in STEM fields when they grow older. While a study conducted by Struyf et al. (2019) showed that a learning environment applying an integrated STEM approach seems to support students' engagement and they recommended measuring this according to class high/low achieving levels. Obillo (2021) had mentioned that to integrate underrepresented minorities and women into the STEM fields, it is imperative to build a self-efficacy in the STEM fields that help students feel a sense of belonging within STEM fields and demonstrate the value of pursuing them. So, he conducted a study to investigate the effect of a robotics program on elementary school female students' attitudes STEM fields in US. The result showed that two thirds of females get a positive attitude towards STEM fields.

In Oman, Al Hinai (2019) have investigated the impact of engineering design program on the development of scientific careers interest among the eighth-grade students in Oman, it adopted a semi-experimental research design with two groups. The experimental group (23 students) was enrolled in a special program of engineering design by the Museum of Science in Boston while the control group (25 students) did not participate in any engineering design program. To measure scientific career interest, a scale of (40) items was used. One of its findings is that there were statistically significant differences between the controlled and the experimental group in the scientific career interest in favor of the experimental group. It suggested conducting similar studies in students from different grades.

Japashov (2022) and his colleges in their study analyzed the interest of 398 students in (7-11grades) towards career of STEM subjects by using survey-based quantitative research in the Almaty region of the Kazakhstan Republic; its results indicated that participant students showed positive interest in STEM careers. Also, Higde and Aktamis (2022) conducted quasi-experimental research on seventh grade secondary school, which results showed that STEM activities improved experimental group students' science process skills, STEM career interests and motivation for STEM fields. While McMaster et al. (2023) conducted a case study surveyed (n = 107) 6 year boys' and girls' interests, ability beliefs and expectations in STEM school subjects and careers in an Australian project named MindSET-do which provided students with early positive STEM experiences prior to high school to raise awareness of, interest in, and aspirations for STEM-related subjects and careers. The results showed students' awareness and interest in STEM-related subjects and careers increased significantly following experiences with inquiry-based STEM activities.

The development of proficiencies in STEM education are diverse, and increased focus on needs for further Globally research; therefore, the STEM approach can be considered as one of the Global reform movements in any educational system to achieve that goal, because of that, Oman starts to adapt this approach in some of its public schools, which is called "STEM-Oman". Very recent researches recommended to investigate the effectiveness of STEM approach in students' interest towards STEM's careers and subjects (Struyf, De Pauw & Petegem, 2019; Al Hinai, 2019; Japashov et al.,2022; Higde et al.,2022; McMaster et.al., 2023), and due to that,

this study seeks to examine the influence of STEM-Oman approach on the interest of 10th grade students towards STEM's careers and subjects.

Research Questions:

The current research aimed to answer the following questions in two dimensions as follow:

A: Interests in STEM careers

The first research question in this domain states:

A1-Is there any significant deference in the post interests in STEM careers (Post ISTEMC) between experimental and control groups?

A2- Is there any significant deference in the post interests in STEM careers in the three fields of STEM (Science, Math and Technology) due to science achievement between experimental and control groups?

A3- Is there any significant deference in the post interests in STEM careers in the three fields of STEM (Science, Math and Technology) due to science achievement levels between experimental and control groups?

B: Interests in STEM subjects between groups:

The first research question in this domain states:

B1- Is there any significant deference in the post interests in STEM subjects (STEM S) between experimental and control groups?

B2- Is there any significant deference in the post interests in STEM subjects in the three fields of STEM (Science, Math and Technology) due to science achievement between experimental and control groups?

B3- Is there any significant deference in the post interests in STEM subjects in the three fields of STEM (Science, Math and Technology) due to science achievement levels between experimental and control groups?

Methods:

General Background:

To achieve the purpose of the study, quasi - experimental research was conducted in the second semester of the academic year of 2018-2019. The researcher used STEM-O established by the Ministry of Education in Oman to be integrated in the common topics in science subject in the experimental group as they study them in groups inside the STEM Hall of their school once a lesson per a week. While the control group studied these topics in a normal seating without STEM-O.

Participants:

Sixty-four female students in the tenth grade from two secondary schools at the same town participated in this study. The experimental group consists (31) while the control group is (33) who studied these topics in a normal seating without STEM-O.

Research Instruments:

To achieve this research aims, the researcher used:

STEM- Oman approach for students in the experimental group of this study to learn science topics that are included in STEM Oman approach as extra learning activities that support topics included in the science subject for tenth grade in Oman. STEM -O integrates scientific concepts from the four fields of STEM (Science, Technology, Engineering, and Mathematics, which allow students to apply the associated scientific knowledge in new learning contexts. It contains thirteen lessons about various scientific topics, which are: numerical and vector quantities, types of forces, effects and interactions of forces, movement with graphs, and the relationship between power, mass, acceleration, kinetic energy, position and work, combustion heat and absorbed energy calculation. For example, students study a scientific topic "combustion heat and calculating the absorbed energy" by firstly studying the idea of the jet engine and then by, examining the concepts and scientific facts associated with it. After that, they calculate the efficiency of the engine mathematically and take an example of the design of the engine jet geometrically. Finally, they search on the NASA space site on jet engine applications in the areas of space technology research (Rolls-Royce plc, 2018).

STEM Career and subjects Interest Survey (STEM-CIS) (Kier, et al., 2014)

To measure the interest towards STEM's careers and subjects in this study, as shown in appendix 1, it was developed based on Social Cognitive Career Theory to measure the interest of middle school students' interest in

STEM subjects and careers. The items measure the interest in STEM subjects which are S1, S2, S4, S8, M1, M2, M4, M4, T1, T2, T4 and T7 while the rest of the items measure the interest in STEM careers. The researcher had calculated the reliability of (STEM-CIS) scale by using Cronbach's Alpha that is (0.87), so it was applicable to be used in this study. Data were been collected by applying the survey of STEM-CIS before and after the application of this study.

Results:

The research results presented according to the research questions from two domains as follow:

A: Interests in STEM careers (ISTEMC)

The first research question in this domain states:

A1- Is there any significant difference in the post interests in STEM careers (Post ISTEMC) between experimental and control groups?

In order to answer this question, the researcher had calculated the summation of all scores from the pre/post interests in STEM careers in the three fields of STEM (Science, Math and Technology) to obtain the statistically analysis shown in Table (1).

Table (1): Means and standard deviation of Post ISTEMC by groups

Variable	Groups	N	M	SD	Estimates Mean (M\)	Std. Error
Post ISTEMC	Experimental	31	54.39	5.70	54.44	0.95
	Control	33	56.91	5.89	56.86	0.92
	Total	64	55.69	5.89	-	-

Table 1 shows that there is a difference in means of the post interests in STEM careers (ISTEMC) between the experimental and control groups. As Wright (2006) said:

"The ANCOVA is appropriate more often than a t test on the differences, so should be used more often. The t test approach is preferred when the interest is more in the amount of gain in either of the conditions, rather than explicitly on comparing why there may be differences between the effects" (P: 674-675).

Therefore, ANCOVAs were performed to figure out if these means' differences are significant or not after controlling the Pre ISTEMC scores (Grande, 2014; Cigdemoglu, 2020).

Table (2): ANCOVA test results for Post ISTEMC

Source of variation	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial η^2
Intercept	977.69	1	977.69	35.09	0.000	0.37
Pre ISTEMC	384.40	1	384.40	13.80	0.000	0.18
Groups	93.03	1	93.03	3.34	0.073	0.05
Error	1699.69	61	27.86			

Table (2) shows that there is no significant difference in the post interests in STEM careers (ISTEMC) between the experimental and control groups [F (1, 61) = 3.34, P>0.05]. The value of Partial Eta Squared (η2: 0.01<0.05<0.06) shows small effect of STEM- Oman approach on the experiential group ISTEM career.

The second and third questions in this domain state:

A2- Is there any significant difference in the post interests in STEM careers (ISTEMC) in the three fields of STEM [Science (S), Math (M) and Technology (T)] due to science achievement between experimental and control groups?

Since the formal assessments are the same for all students in this grade, the researcher had used the first semester student's science marks of the academic year 2019-2018 in order to obtain the means in each group of this study and by using a command in SPSS; they were classified in to three levels of achievement (High/ Average/ Low).

Table (3): Means, standard deviation and Estimates Means of Post ISTEMC by groups due to STEM's field

Variables	Groups	N	M	S. D	Estimates Mean (M\)	Std. Error
Post ISTEM CS	Experimental	31	18.45	2.32	18.67	0.53
	Control	33	18.70	2.27	18.20	0.45
	Total	64	18.58	2.28	-	-
Post ISTEM CM	Experimental	31	18.61	2.30	18.49	0.54
	Control	33	18.85	2.29	18.68	0.46
	Total	64	18.73	2.28	-	-
Post ISTEM CT	Experimental	31	17.32	2.94	16.43	0.93
	Control	33	19.36	4.65	19.20	0.80
	Total	64	18.38	4.02	-	-

Table (3) shows that there is a difference in means of the post interests in STEM careers in the three fields of STEM (S/M/T) due to the science achievement between the experimental and control groups. MANCOVA was conducted to figure out if this means' differences are significant or not after controlling the science achievement as it affects the interest towards science (Dowey, 2013) and using groups and science achievement levels as fixed factors (Kim, 2015).

Table (4): MANCOVA test results for Post ISTEMC

Source of variation	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Science Achievement	post ISTEM CS	3.02	1	3.02	0.60	0.44
	post ISTEM CM	4.61	1	4.61	0.87	0.36
	post ISTEM CT	34.69	1	34.69	2.24	0.14
Groups	post ISTEM CS	2.09	1	2.09	0.41	0.52
	post ISTEM CM	0.35	1	0.34	0.07	0.80
	post ISTEM CT	74.04	1	74.04	4.77	0.03
Science Achievement Levels	post ISTEM CS	2.69	2	1.34	0.27	0.77
	post ISTEM CM	11.51	2	5.76	1.09	0.34
	post ISTEM CT	49.34	2	24.67	1.59	0.21
Groups * Science Achievement Levels	post ISTEM CS	9.14	2	4.57	0.90	0.41
	post ISTEM CM	11.20	2	5.60	1.06	0.35
	post ISTEM CT	30.75	2	15.38	0.99	0.38
Error	post ISTEM CS	288.35	57	5.06		
	post ISTEM CM	302.05	57	5.23		
	post ISTEM CT	884.53	57	15.52		

Table (4) shows that there is no significant deference in the post interests in STEM career (ISTEMC) for the three STEM fields (S/M/T) due to science achievement between experimental and control groups or achievement levels considering all the values of F (P>0.05). Moreover, there is no significant difference in the post of ISTEMC for all the three fields of STEM for the interactivity between groups and science achievement levels for all value of F (P>0.05). However, there is a significant difference in the post interests in STEM careers' technology (ISTEMCT) between the experimental and control groups [F (1, 57) = 4.77, P>0.05]. The Pairwise Comparison between groups by ISTEMCT have been conducted in order to figure out for which groups it is significant.

Table (5): Pairwise Comparisons between groups by Post ISTEM career due to Technology

Variable	(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.
Post ISTEMCT	Experimental Group	Control Group	-2.771	1.269	0.033
	Control Group	Experimental Group	2.771	1.269	0.033

Table (5) shows that the Pairwise Comparison in the post ISTEMCT is significant (P<0.05) for the two comparisons between experimental and control groups in favor of the control group (M\=19.20) as it is illustrated by Figure (1) bellow.

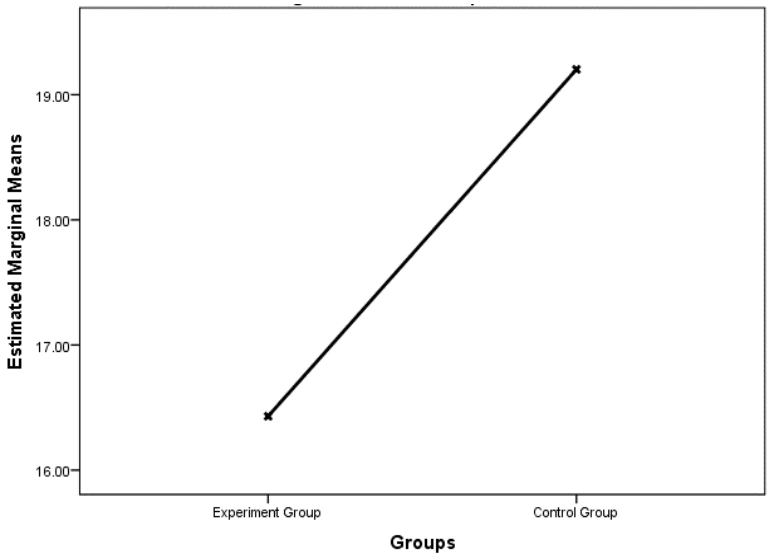

Figure (1): Estimated Marginal Means for the post ISTEMCT between groups

B: Interests in STEM subjects between groups:

The first research question in this domain states:

B1- Is there any significant deference in the post interests in STEM subjects between experimental and control groups?

In order to answer this question, the researcher had calculated the summation of all scores from the pre/post interests in STEM subjects in the three fields of STEM (S/ M/ T) to obtains the statistically analysis shown in table (6) below:

Table (6): Means and standard deviation of Post ISTEMS by groups

Variable	Groups	N	M	S. D	Estimates Mean (M\)	Std. Error
Post ISTEMS	Experimental	31	34.23	2.36	34.31	0.30
	Control	33	34.88	1.45	34.80	0.30
	Total	64	34.56	1.96	-	-

Table (6) shows that there is a difference in means of the post interests in STEM subjects (ISTEMS) between the experimental and control groups. ANCOVAs has been performed to figure out if these means' differences are significant or not after controlling, the Pre ISTEMS score (Grande, 2014).

Table (7): ANCOVA for Post ISTEMS

Source of variation	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	66.70	2	33.35	11.62	0.000	0.28
Intercept	43.36	1	43.36	15.11	0.000	0.20
Pre ISTEMS	59.89	1	59.89	20.87	0.000	0.26
Groups	3.73	1	3.73	1.30	0.259	0.02
Error	175.05	61	2.87			

Table (7) shows that there is no significant difference in the post interests in STEM subjects (ISTEMS) between the experimental and control groups [F (1, 61) = 1.30, P>0.05]. The value of Partial Eta Squared (2: 0.01<0.02<0.06) shows small effect of STEM- Oman approach on the experimental group ISTEM subjects.

The second and third questions in this domain state:

B2- Is there any significant deference in the post interests in STEM subjects in the three fields of STEM (S/ M/ T) due to science achievement between experimental and control groups?

B3- Is there any significant deference in the post interests in STEM subjects in the three fields of STEM (S/ M/ T) due to science achievement levels between experimental and control groups?

In order to answer those questions, the researcher used the same procedures used in domain A to obtains the statistically analysis required to achieve that, but by considering the data related to ISTEM subjects (ISTEMS).

Table (8): Means and standard deviation of Post ISTEMS by groups due to STEM's field

Variable	Groups	N	M	S. D	Estimates Mean (M\)	Std. Error
Post ISTEMSS	Experimental	31	11.58	0.81	11.62	0.13
	Control	33	11.70	0.59	11.66	0.12
	Total	64	11.64	0.70	-	-
Post ISTEMSM	Experimental	31	11.81	0.48	11.84	0.11
	Control	33	11.61	0.70	11.57	0.11
	Total	64	11.70	0.61	-	-
Post ISTEMST	Experimental	31	10.84	1.46	10.89	0.21
	Control	33	11.58	0.79	11.53	0.21
	Total	64	11.22	1.21	-	-

Table (8) shows that there is a difference in means of the post interests in STEM subjects (ISTEMS) between the experimental and control groups. MANCOVA was conducted to figure out if this means' differences are significant or not (Kim, 2015).

Table (9): MANCOVA test results for Post ISTEMS

Source of variation	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Science Achievement	post ISTEMSS	1.42	1	1.415	3.03	0.09
	post ISTEMSM	0.12	1	0.124	0.36	0.55
	post ISTEMST	0.17	1	0.170	0.13	0.72
Groups	post ISTEMSS	0.20	1	0.197	0.42	0.52
	post ISTEMSM	1.76	1	1.756	5.06	0.03
	post ISTEMST	5.75	1	5.751	4.29	0.04
Science Achievement Levels	post ISTEMSS	2.25	2	1.126	2.41	0.10
	post ISTEMSM	0.03	2	0.014	0.04	0.96
	post ISTEMST	4.94	2	2.469	1.84	0.17
Groups * Science Achievement Levels	post ISTEMSS	0.68	2	0.341	0.73	0.49
	post ISTEMSM	1.95	2	0.974	2.81	0.07
	post ISTEMST	1.86	2	0.929	0.69	0.50
Error	post ISTEMSS	26.61	57	0.47		
	post ISTEMSM	19.78	57	0.35		
	post ISTEMST	76.46	57	1.34		

Table (9) shows that there is no significant deference in the post interests in STEM subjects (ISTEMS) for all STEM fields [Science (S), Math (M) and Technology (T)] due to science achievement between experimental and control groups or Achievement Levels considering all the values of F ($P>0.05$). Moreover, there is no significant difference in the post of ISTEMS for all the three fields of STEM for the interactivity between groups and science achievement levels for all value of F ($P>0.05$). However, it shows that there is a significant difference in the post interests in STEM subjects due to STEM fields (S/M/T) between the experimental and control groups in the post ISTEMSM [$F(1, 57)= 5.06, P>0.05$] and the post ISTEMST [$F(1, 57)= 4.29, P>0.05$].

Table (10): Pairwise Comparisons between groups by Post STEM subjects due to Math and Technology

Dependent Variables	(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.
Post ISTEMSM	Experimental Group	Control Group	0.427	0.190	0.028
	Control Group	Experimental Group	-0.427	0.190	0.028
Post ISTEMST	Experimental Group	Control Group	-0.772	0.373	0.043
	Control Group	Experimental Group	0.772	0.373	0.043

Table (10) above shows that the Pairwise Comparison in the post ISTEMSM is significant ($P<0.05$) for the two comparisons between the experimental and control groups in favor of the experimental group ($M\=11.84$); while that for the post ISTEMST is significant ($P<0.05$) for the two comparisons between the experimental and control groups in favor of the control group ($M\=11.53$). As they are illustrated by Figures. (2-3) below.

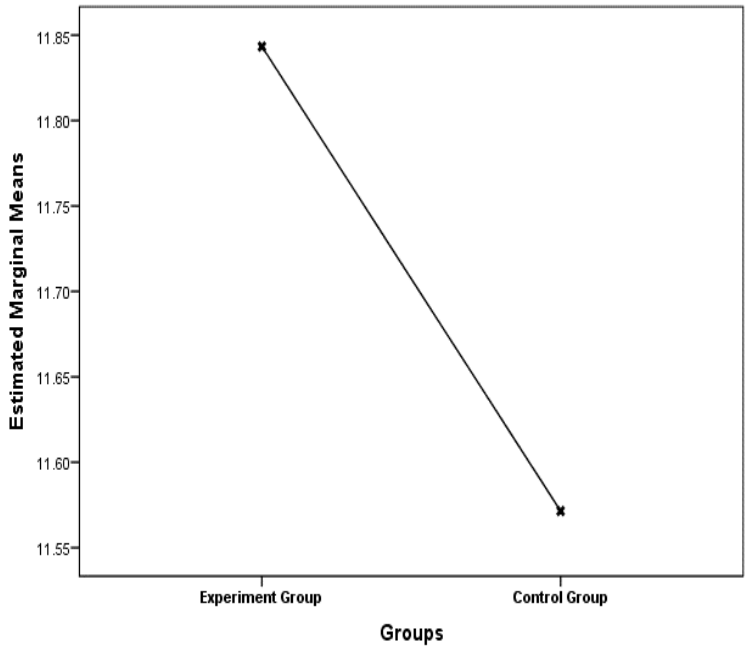

Figure (2): Estimated Marginal Means for the post ISTEMSM between groups

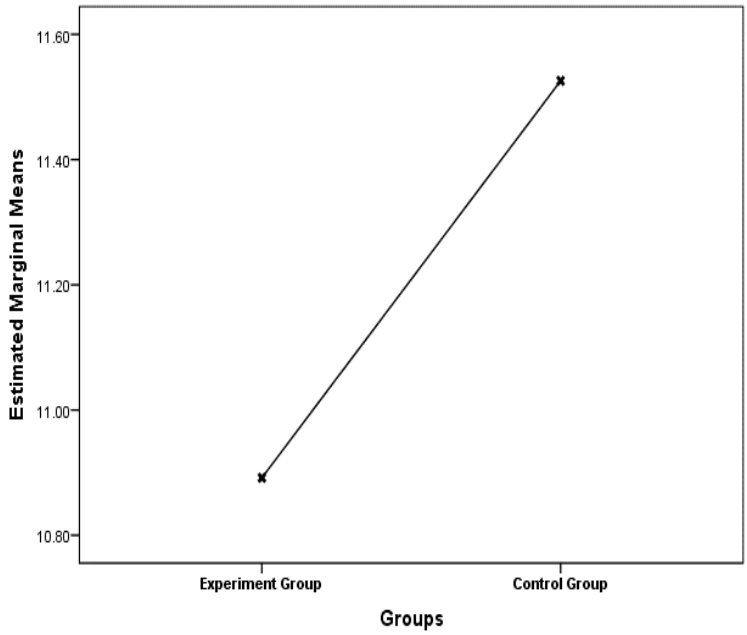

Figure (3): Estimated Marginal Means for the post ISTEMST between groups

Discussion and Conclusions:

The current study investigated the effects of the STEM - Oman approach on the interest of 10th grade students towards STEM's careers and subjects. Overall, the findings indicate, that there is no significant difference in mean scores for interest towards STEM career and subjects between groups. However, the findings indicate that due to science achievement, there is a significant difference in interests in STEM careers' Technology and STEM subjects' Technology between groups in favor of the control group. Moreover, the results show that there is no significant difference in ISTEMC neither ISTEMS for the interactivity between groups or science achievement levels. This finding is not supporting the result of the study done by Halim et al. (2016) as this approach is effective on increasing the students' interest in all the fields of STEM, neither the study of Obillo (2021) is (Higde, et al., 2022; Japashov, et al., 2022).

These results could be referred to the design of science curriculum in Omanis' public schools in 10th grade; when analyzing the contents of each lesson, they integrate STEM subjects by somehow inside its topics as well as mentioning the careers related to STEM (Al mahrouqi, 2009). Furthermore, science teachers in Oman commonly

use websites that are related to the topics they thought to show their technical application for their theoretical information in their classrooms; this exactly what STEM-Oman does to show how it is related to Technology field on it (General Directorate for Curriculum Development, n.d).

However, the findings show that there is a significant difference in interests in STEM Math subject between groups in favor of the experimental group. This supports the finding from the study of Al Hinai (2019) in which that STEM's approach improves students' interest towards STEM' subject. In addition, it also supports the result that integrated STEM approach in science class which can support students' engagement in their learning for more interest in some of careers and subjects related to it (Knipprath, et al., 2018; Struyf, et al., 2019; McMaster et al., 2023). These results could be referring to the extra tasks in mathematics' related to each lesson included in the STEM - Oman approach, which are supposed to be done by all students in the experimental group as a homework (Rolls-Royce plc, 2018).

Recommendations:

As STEM-Oman approach is oriented to let students learn in environments away from any anxiety or stress during the learning process, so one limitation of the current study is the missing of assessment tools to evaluate their achievements, which caused low levels of seriousness due to their low of self-efficacy (Al Mahrouqi, 2018). This might cause them to have less engagement in some of STEM's careers and subjects in their future. As a suggestion, STEM- Oman approach can be a part of the informal curriculum, where students study it outside the classroom, and their scientific achievements are evaluated through scientific competitions by giving them an award to motivate and enhance their interests in both STEM's careers and subjects.

The other limitation is the number of participants inside STEM-Oman's hall is much higher than it should be. As the increase in students numbers leads to less chance to engage effectively in the learning activities versus smaller class sizes which have a positive impact on student engagement (Schanzenbach, 2014). Therefore, it is important to overcome these things when adapting this approach in other public schools in Oman for more effectiveness of it in the future. Education researchers in Oman can do deeper investigation if STEM-Oman approach can achieve Oman Vision 2040 related to improving the quality level of School Education to fit the workforce sector.

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Appendix A.

STEM's Careers and subjects Interest Survey (STEM-CIS)

Directions: please responds to all items that given in this survey. Each question is a Likert scale with the following choices: Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly, Agree (5)

Science:

S1 I am able to get a good grade in my science class.
S2 I am able to complete my science homework.
S3 I plan to use science in my future career.
S4 I will work hard in my science classes.
S5 If I do well in science classes, it will help me in my future career.
S6 My parents would like it if I choose a science career.
S7 I am interested in careers that use science.
S8 I like my science class.
S9 I have a role model in a science career.
S10 I would feel comfortable talking to people who work in science careers.
S11 I know of someone in my family who uses science in their career.

Mathematics:

M1 I am able to get a good grade in my math class.
M2 I am able to complete my math homework.
M3 I plan to use mathematics in my future career.
M4 I will work hard in my mathematics classes.
M5 If I do well in mathematics classes, it will help me in my future career.
M6 My parents would like it if I choose a mathematics career.
M7 I am interested in careers that use mathematics.
M8 I like my mathematics class.
M9 I have a role model in a mathematics career.
M10 I would feel comfortable talking to people who work in mathematics careers.
M11 I know someone in my family who uses mathematics in their career.

Technology:

T1 I am able to do well in activities that involve technology.
T2 I am able to learn new technologies.
T3 I plan to use technology in my future career.
T4 I will learn about new technologies that will help me with school.
T5 If I learn a lot about technology, I will be able to do lots of different types of careers.
T6 My parents would like it if I choose a technology career.
T7 I like to use technology for class work.
T8 I am interested in careers that use technology.
T9 I have a role model who uses technology in their career.
T10 I would feel comfortable talking to people who work in technology careers.
T11 I know of someone in my family who uses technology in their career.