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Teachers' Perceptions of Integrating STEM in Omani Schools

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Abstract
The current study falls in line with global and local mobility that aims to investigate the science teachers' perceptions of integrating STEM approach in cycle 2 schools in AL Batinah North Governorate in the Sultanate of Oman. To implement the study, a descriptive methodology was used with a questionnaire of 19 items divided into two parts: Achieving requirements of 21st-century skills and linking science education with economic issues. After verifying the psychometric characteristics of the questionnaire, it was applied to the sample of 147 science teachers (71 male and 76 female). The findings showed a high perception of the science teachers towards integrating STEM in teaching science to acquire students the significant skills and competencies to help them to keep pace with modern scientific developments and have an opportunity to compete in the labor market. According to the findings, the study recommends adding engineering design steps to the science curricula and activating workshops to train the teachers to formulate classroom questions in real problems context.
Keywords: STEM, Integrating Approach, Perceptions.

Introduction

Education is a process that aims to prepare generations to have abilities to understand life-challenges and try to foster suitable solutions, and STEM is an educational approach that matches with this statement. STEM means integrating Science, Technology, Engineering and Mathematics to enable students to work as scientists and engineers to study different phenomena. Based on STEM, students will observe phenomena, develop models to simulate reality, use technological instruments to record data, and apply mathematical manipulation to introduce quantitative aspects to the phenomenon.

STEM approach was created as a result of an economical conflict in industrial countries, especially in the USA. Therefore a lot of projects appeared to refer to the importance of integrating all applied sciences with real life. The project 2061 emphasizes the principles of including social and technological issues to the science curriculum. Also, National Science Education Standards NSES have stressed the importance of understanding the relationship between science and technology, which helps the students to develop their skills toward engineering design, working in groups, and publish their ideas (Green, 2016). Finally, Next Generation Science Standards NGSS focuses on science curriculum reform to prepare qualified students for the labor market by training them to understand ideas globally to solve real problems according to applied inquiry processes, 2017).

A lot of studies reflect teachers' perceptions about applying STEM approaches such as the study, which aimed to inquire teachers' perceptions toward STEM by analyzing published articles in the reviewed journals from 2000 through 2016 (Margot & Kettler, 2019). Findings showed that teachers have positive attitudes toward STEM and students accept the integration ideas, but they refer to some challenges about curriculum and assessment procedures. Also, the study applied to a sample of 144 science teachers in UAE showed the importance of applying STEM in science education (Al Basha, 2018). Another study (Park et al., 2016) applied to a sample of 729 science teachers who are working in 252 STEM schools in South Korea. Findings showed that to integrate STEM in science education, it is necessary to face a lot of challenges such as time management, teachers' overload, and leakage of financial support. In addition many studies focus on economic challenges, teacher's competencies, laboratory activities and scientific skills to integrate and apply STEM in schools properly (Hacioglu et al., 2016; Keamy, 2015; Lynch et al., 2014; Rhond, et al., 2014; Stevens, 2012; Bayer, 2009).

The Problem Statement

The Sultanate of Oman is a country that tries to work hard to develop the educational system. In science education, there are real efforts towards applying STEM approaches at schools in all stages. STEM Oman is one of these trials; it is a global education system designed by Rolls-Royce UK and adopted by the Oman Authority for Partnership for Development (OAPD) for implementation in the Sultanate. STEM Oman aims to enable science teachers to use modern teaching methodologies and to create a generation capable of effectively participating in sustainable development in society and entering the knowledge-based economy in the fields of science, mathematics, engineering and technology. This project was launched at the beginning of the first semester of 2018-2019 academic years in 18 public schools from various governorates in the Sultanate and hoped to be 30 schools in 2019/2020. The current study falls in line with Omani efforts, which aim to redirect science teaching and to learn towards STEM. Specifically, the study tries to answer the following two questions:

1. What are science teachers' perceptions about the requirements for integrating STEM in Omani schools according to 21st-century skills?
2. What are science teachers' perceptions about the requirements for integrating STEM in Omani schools according to the relationship between education and economic issues?

Methods

Population and Sample

The population consisted of 791 science teachers (421male and 370 female) in the AL Batinah North governorate. The sample was chosen by the simple random method and included 147 science teachers (71 male and 76 female) with percentage 19 of the population.

Study Tool

The current study applied the descriptive quantitative method (Gay et al., 2013) with a questionnaire as the main tool to collect data. The tool was constructed according to the following procedures:

1. Revising the related literature (Al Basha, 2018; Ring, 2017; Haruna, 2015; Avery& Reeve, 2013; Locke, 2009).
2. Constructing a draft copy of the questionnaire with 20 items that were distributed into two parts: part1 about 21st-century skills (12 items) and part two about economic issues competencies (8 items).
3. To check validity, the questionnaire was submitted to 14 experts in science curricula, Instructional technology, and also submitted to science supervisors to put their notes about the suitability of items to be applied. After collecting the experts' point views and implemented their modifications, the final version of the questionnaire consisted of 19 items (11 for part 1 and 8 for part 2) with 5 points Likert scale (strongly agree = 5, agree = 4, neutral = 3, disagree = 2, strongly disagree = 1).
4. To check reliability, the final version of the questionnaire was applied on a pilot sample of 25 teachers out of the study sample, then calculated the self-constancy by Cronbach's Alfa formula;

the value was 0.9, which means that the study tool was applicable.

Study Findings and Discussions

Study findings were obtained after applying the study tool on the science teachers that were used as a sample. The averages and standard deviations were calculated for each item in the questionnaire. Also, an intervals of a typical 5 point Likert scale were calculated to determine the science teachers' perception degree about requirements for integrating STEM approach in Omani Schools as in the following: calculating the Range (max. score – min. score = 5-1= 4), then calculating the category interval (=Range/max. score = 4/5 = 0.8), so we have 5 intervals as shown in table (1).

Table 1 Teachers' Perceptions of Degrees Vs. Average Intervals of the Questionnaire Items

Average Interval	Perception's degree
1.0-1.8	Very low
>1.8-2.6	low
>2.6-3.4	intermediate
>3.4-4.2	high
>4.2-5.0	Very high

Also, averages were transformed into the Percentage of perception from the equation: Percentage = [(Average – 1)/Range] × 100%. Data were collected and then arranged in the table (2 & 3) to discuss the study questions.

Table 2 Averages and Standard Deviations of Science Teachers' Perceptions According to 21st-Century Skills

Item No	Items	Averages	Standard Deviations	Percentage of Perceptions	Perception's degree	Rank
21st century skills that required to integrate STEM in Omani schools						
1	Critical thinking skills	4.18	0.93	79.5	high	1
2	Creative thinking skills	4.09	0.99	77.3	high	3
3	Working in groups	4.14	0.94	78.5	high	2
4	Responsibility and accountability	4.01	0.91	75.3	high	4
5	Self-evaluation	3.96	0.99	74.0	high	5
6	Comprising between scientific knowledge and information that published in social media	3.80	1.06	70.0	high	10
7	Applying digital technology	3.94	0.99	73.5	high	7
8	Understanding phenomena in local and global context	3.90	0.95	72.5	high	8
9	Problem solving	3.95	1.04	73.8	high	6
10	Social and culture acceptance	3.87	1.00	71.8	high	9
11	Communication and publishing	3.95	0.87	73.8	high	6
	Total Average	3.98	0.76		high	

Table 2 shows that science teachers have a high degree of perceptions about the requirements of 21st-century skills. The total average was M=3.98, with a standard deviation δ=0.76 and averages' range (3.80-4.18). This result reflects the awareness-raising of 21st-century skills in teaching and its positive effect on developing students' abilities to apply STEM procedures and standards in their learning. Item 1, which is related to critical thinking skills, has rank 1 with the highest average M=4.18 and δ=0.93. This means that teachers have high awareness about the importance of critical thinking skills as a base to integrate STEM in teaching and learning science. Critical thinking skills include interpretation, analysis, conclusion, and self-evaluation, which is matching with scientific methods applied by science teachers. On the other side, item 6, which is stated as"Comprising between scientific knowledge and

information published in social media," has the last rank with the lowest average M=3.95 and δ=1.06. This refers that teachers focus on content in the science book and consider it as the one and the only text for teaching without enriching the content by experience that obtained from electronic databases and social media which means relatively low perceptions about the importance of other knowledge resources in integrating STEM in teaching science.

Table 3 shows that science teachers have a high degree of perceptions about requirements for integrating STEM approach in Omani schools according to the economic issues competencies.

Table 3 Averages and Standard Deviations of Science Teachers' Perceptions According to the Economic Issues Competencies

Item No	Items	Averages	Standard Deviations	Percentage of Perceptions	Perception's degree	Rank
Competencies that related with Economicissues that the teachers should be achieved to integrate STEM in Omani schools						
12	Linking knowledge with real life	4.15	0.88	78.8	high	1
13	Explaining mutual relationships between science and its economical applications	3.86	0.96	71.5	high	6
14	Developing students' interests toward technology, engineering	3.87	1.05	71.8	high	5
15	Encourage students to introduce alternative solutions for economical problems	3.81	0.90	70.3	high	7
16	Developing entrepreneurship skills	3.75	0.89	68.8	high	8
17	Developing leadership skills	3.98	1.04	74.5	high	2
18	Encourage students to show their products in exhibitions	3.90	0.96	72.5	high	4
19	Linking between scientific issues and future careers.	3.95	1.10	73.8	high	3
	Total Average	3.90	0.80		high	

Results in table 3 refer to high perceptions degree for teachers about the importance of immersion economic issues in teaching science, especially if the aim is teaching by applying the STEM approach. The total average was m=3.90, with a standard deviation δ=0.80 and averages' range (3.75-4.18). Science teachers have awareness-raising toward linking economics concepts such as entrepreneurship and leadership with science education. According to Future Fore sight Foundation report about careers in 2040, careers will transform from traditional style to another world that includes artificial intelligence, big data and robot revolution. Therefore, there will be no place for those individuals that have not a high level of competencies in Science, Mathematics, Technology and engineering. One of the reasons that lead to formulate high perceptions about the relationship between STEM and Economic issues is the growing interest of Sultanate of Oman in STEM outside the classroom such as organizing the 4th Industrial Revolution Conference in WilayatSohar in January 2019 where a lot of papers and projects were introduced about the future challenges that will affect directly the individuals and communities especially in fields of education, technology and economic. Also, the National Week of STEM was held in all cities in Oman with participations of Educational institutes and Industrial sectors to change the community point view about future developments and to disseminate STEM culture among students and teachers.

Conclusions

According to current study findings, there are high perceptions of the science teachers about the

significant of STEM approach in teaching science. The teachers also showed understanding towards applying 21st-century skills inside and outside the classrooms that help the students to keep pace with modern scientific developments. Also, they drew attention toward training the students for future careers' competencies by linking education and economics. These high perceptions should be appropriately reflected in learning outcomes and teaching procedures. To achieve that, science curricula should be included STEM requirements and standards such as engineering design steps and educational technology. And encouraging science teachers to introduce the instructional situations in terms of true problems matching with a local and global context. Also, it is important to direct students' projects in science towards creativity and try to introduce (in groups) alternative solutions for economic problems. In addition to held workshops to train the teachers about how to apply digital skills, virtual laboratories, stimulation, and interactive learning that matching with 21st-century skills.

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