

Effect of a Science Unit " Light & Life" designed according to the Integrative STEM approach on the Improvement of Scientific Practices among 9th grade students

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Abstract: The study aimed to investigate the effect of Unit Designed according to the Integrated Approach STEM on Scientific Practices Improvement among female Ninth-grade students, used the experimental approach (the Quasi-experimental Design), the study used the Content analysis tool, Scientific practices List and Scientific practices observation card as tools, The study was conducted on 40 female ninth-grade students from Taiba Secondary School for girls, Results showed statistically significant differences at significance level ($\alpha = 0.01$) between the average scores of the scientific practices of the experimental group students in the pre- and post- application of Scientific Practices Observation card, And that the teaching of science in the direction of STEM has a significant impact ($\eta^2 = 0.79$).

Keywords: (Integrated Approach, STEM, Scientific Practices, ninth-grade)

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I. Introduction

Today, the world is witnessing unprecedented acceleration, a tremendous knowledge explosion and an extraordinary accumulation of knowledge, which poses great challenges to different areas of life and to education in particular. The challenge lies in adapting the curricula to the needs of students on the one hand and the rapid changes in the field of education on the other. This cognitive explosion and digitization of the present era to the development of new knowledge systems in line with the novelty of this age and its requirements, such as: - Bioinformatics - Green technology - Robotics - Object Programming - Artificial intelligence techniques - nanotechnology and others, highlighting the integration of science and technology in the integration of knowledge of interpretations of different phenomena, and the production of new knowledge. (Zaiton, 2010)

The most important challenge today is to teach science content, strategies, approaches and mechanisms. The teaching of science is the mainstay in providing students with knowledge of different scientific concepts, in conjunction with the performance skills and scientific methodologies in thinking, The next generation Science Standards (NGSS) is designed to add engineering design as a cornerstone of science education, where students are taught to learn the skills of design thinking, design steps and modeling, Science Education for the Next Generation (NGSS) will integrate the various sciences in terms of: focusing on concepts that are comprehensive rather than, so that the student will study these criteria from preschool to the end of the secondary school of the same concepts, with expansion at each stage in line with The students' abilities, aptitudes and developmental characteristics.

The next generation's science education standards widely studied In order to harmonize the curricula according to these standards or determining the average of what currently included from these standards as Shoman(2018) study, Abu Hasel,Asmari (2018), and the study of Ahmad and al-Bakmi (2017), all of which concluded that the inclusion of science standards for the next generation between the few and medium in the content of books. The Duschl and Bybee study (2014) aimed to explore the implications of applying next-generation standards and discover the nuances in adopting a practical approach to science teaching through the lens of one of the Next Generation Science Standards Practices, "Planning and carrying out investigations".

The objectives of science education cannot be successful unless the curricula are designed according to the data of cognitive acceleration and technical explosion. There have been many efforts in studying the different aspects of science teaching and the proposed approaches to these aspects. One of the most important aspects of science teaching is STEM(Science, Technology, Engineering and Mathematics) which raised up in the light of a factthat real world problems were not fragmented in isolated disciplines As they are taught in schools; they are real situations that require the use of knowledge in an integrated manner; they are real

situations that require the use of knowledge in an integrated manner. Therefore, the IntegrativeSTEM approach calls for teaching subjects in complementary contexts between knowledge and application branches, Harrison (2011) finds that the STEM curriculum is one of the most important programs aimed at achieving the quality of the outputs of the educational system. If the quality of education outputs is achieved, it ensures the development of the economy and the upgrading of the fields of industry by preparing the students themselves for effective interaction with their reality. (In Ghanem, 2012)

The integrative STEM approach is defined as an integrated knowledge building between the disciplines of science, mathematics and engineering design with its technological applications. This structure is based on learning through the application of applied scientific activity, digital and computer technology activities, expertise-based activities, discovery and investigation activities, Scientific and logical thinking activities, and decision-making (Ghanem, 2012).

Many studies are conducted on STEM such as Al-Shammari (2018) aimed to instigate the effectiveness of an enrichment program based on the Integrative STEM approach in developing the mathematical strength skills of gifted students in the intermediate stage in Hail. The DAOID study (2017) aimed at detecting the effectiveness of a science training program based on the STEM In developing the habits of the mind and decision-making skills of third-grade middle school students, some studies aim to provide a framework that defines educational practices in the STEM integrated secondary education system such as Thibaut and others (2018), which summarized educational practices in five basic principles: STEM integration, problem-based learning, inquiry-based learning, design-based learning, collaborative learning, cognitive and emotional learning, and studies that have paid attention to the study of Chen and Chang (2018) Which aimed to develop the robotics approach in the light of the integrative STEM orientation, test its effects on learning outcomes for high school students, career orientation, and STEM perceptions, the Sarikan and Akgunduz study (2018) to assess the impact of STEM on academic attainment and skills Reflective thinking towards solving problems and maintaining the impact of learning in science education, In line with previous studies, and because of STEM's philosophy of focusing on the performance side of science through integrated skills and philosophy on which the science-learning criteria of the next generation were based, depending on the observation of the researchers in the field of education where the Science educators suffers from the weakness of practical skills, the study problem was shaped to examine the effectiveness of teaching in an integrated approach to the Improvement of scientific practices, Science Education.

II. Study Problem

The study aims at revealing the effect of STEM's integrated approach on the Improvement of scientific practices among science learners. Therefore, the problem was formulated in the following main question: What is the effect of a science unit designed according to Integrative STEM approach on the Improvement of scientific practices among 9th grade students?

It has the following sub-questions:

1. What are the scientific practices to be Improved by the ninth graders in science?
2. Are there statistically significant differences at the level of ($\alpha \leq 0.05$) between the average scores of the scientific practices of the students of the Pre-post group in the tribal and remote applications of the observation card?

III. Research Objectives

The study aims to achieve a number of objectives including:

1. Introducing STEM in teaching science
2. Identify the scientific practices to be improved within the next generation science education standards (NGSS).
3. Detect the effects of the STEM-oriented unit on Improving the scientific practices of students in the target group.

Study Hypotheses:

1. There were no statistically significant differences at the level of ($\alpha \leq 0.05$) between the mean scores of the scientific practices of the students of the Pre-post group in the tribal and remote applications of the observation card.

Study Importance:

The importance of the study is that:

- Provides a general framework for the teaching of science in the basic stage according to the STEM integrated approach, which benefits the teachers of science (science, technology, engineering and mathematics), curriculum designers and developers.

- The study defines science education standards for the next generation in general, and scientific practices in particular, which benefit science teachers and researchers in the field.
- The study provides a list of scientific practices and indicators to be improved in the ninth-grade applications, which may benefit other researchers.

The limits of the study:

The study was conducted in the second semester of the academic year 2018/2019 in East Khan Yunis Moderate on the ninth-grade female students.

Study Terms:

The researchers define the study terms operationally as:

- STEM Education:

It is an educational system based on research, thinking, problem solving, and project learning through which students apply what they learn in science, mathematics, and engineering using technology. The learning of these materials is built on one another and linked to the students' real applications. Procedural the Integrative STEM approach is defined as the use of problem solving strategies, project inquiry and learning in the teaching of the light and life module of the ninth grade science, and the learning outcomes are measured using the note of scientific practices.

- Scientific Practices:

Scientific practice is the integration of knowledge in the application of knowledge, in a meaningful context, the sum of the skills and behaviors followed by scientists in their access to facts, and answers to questions about different phenomena, supported by a framework of knowledge related to these skills. In this study, we define the following six scientific practices: asking science questions, planning, conducting the survey, analyzing and interpreting the data, using evidence in the argument, obtaining information, evaluating and communicating it to others.

- Grade 9:

Is one of the grades of the upper elementary stage, which begins with the sixth grade and ends with the tenth, and the age of female students between (14-15) years.

IV. Methodology

The study used both of the descriptive approach and the Quasi-experimental Design (Pre-Post group design), The study was conducted on 40 female ninth-grade students from Taiba Secondary School for girls.

4.1 Data Collection Instruments:

Scientific Practices Observation Card used to collect data and measure the differences in student's Scientific Practices level before and after the study.

4.2 Scientific Practices Observation Card:

After the random choose of the Pre-post group, the Scientific Practices Observation card was applied as a pre-observation, then the "Light and Life" unit designed according to Integrative STEM approach was taught using Project Based Learning (PBL), Investigation and Problem-Solving strategies, then the Observation card was applied as a post-observation to compare between students results in pre and post application of Observation card.

4.3 Data Analysis:

Data collected in the study were analyzed by using SPSS Statistics version 22 program: Paired Samples t-test was conducted to determine if the different between the pre-test and post-test was significant, the value of η^2 was computed to determine the effect volume of Teaching science according to Integrative STEM approach.

V. Findings

Answer of first question : 1. What are the scientific practices to be improved by the ninth graders in science? The answer of this question , researchers studied the Next Generation Science Study NGSS with its four categories, prepared scientific practices list and Scientific Practices Observation Card which attache with the research was derived from it .

Results of question 2 : Are there statistically significant differences at the level of ($\alpha \leq 0.05$) between the average scores of the scientific practices of the students of the Pre-Post group in the tribal and remote applications of the observation card? The researchers formulate the hypothesis: There were no statistically significant differences at the level of ($\alpha \leq 0.05$) between the mean scores of the scientific practices of the students of the Pre-Post group in the tribal and remote applications of the observation card.

Table 1: (Paired-Samples T Test)

Scientific Practices	df	Test	Means	Standard Deviation	t-test	sig
Asking Science Questions	39	Pre	6.30	1.381	**10.924	0.002
		Post	9.48	2.038		
Planning	39	Pre	6.18	1.810	**11.207	0.007
		Post	9.65	1.833		
Holding Investigations	39	Pre	6.80	1.588	**9.993	0.001
		Post	9.40	1.736		
Analyzing data and constructing interpretations	39	Pre	8.90	2.296	**10.046	0.001
		Post	12.58	2.341		
Use the evidence in the controversy	39	Pre	7.30	1.652	** 7.187	0.003
		Post	9.43	1.933		
Get information, and contact with others	39	Pre	10.38	1.821	** 9.401	0.001
		Post	13.13	1.964		
Total degree	39	Pre	45.85	6.945	**12.113	0.000
		Post	60.30	9.376		

Table 2: Effect Size η^2

Scientific Practices	t-test value	t ²	df	η^2
Asking Science Questions	10.924	119.33	39	0.75
Planning	11.207	125.60	39	0.76
Holding Investigations	9.993	99.86	39	0.72
Analyzing data and constructing interpretations	10.046	100.91	39	0.72
Use the evidence in the controversy	7.187	51.65	39	0.57
Get information, and contact with others	9.401	88.37	39	0.69
Total degree	12.113	146.73	39	0.79

As indicated in table 1 there was a significant difference at level ($\alpha = 0.01$) between students' pre-test results and post-test result. The mean value of students before the experiment was 45.85 raise up to 60.30 after teaching Light and Life Unit according to Integrative STEM approach, to determine the effect size the value of η^2 was computed as shown in table 2 the values of η^2 for all the scientific practices were all more than 0.14 which means that teaching science according to Integrative STEM approach has a big effect size in improving the scientific practices among ninth-grade students.

VI. Discussion

This study was conducted to determine the impact of teaching design according to Integrative STEM Approach on improving scientific practices among ninth-grade students. Study results showed that there is a positive impact in raising the level of scientific practices of female students of the Pre-post group after the study of STEM designed unit. The reason for this is to: - The philosophy of STEM is the integrated practical application of science, mathematics, engineering and technology, which means focusing on the practical scientific and practical dimension, -STEM combines the four main sciences (science, technology, engineering, mathematics) on the one hand and science learning strategies from surveying, project learning, planning and modeling, which led to the improvement of the practices of scientific students in the implementation of various educational activities,- Break down teaching stereotypes through interactive activities and enrich content by research, interaction and design skills Raise student contributions and improve their performance, - Combining the Integrative STEM approach between thinking and implementation skills The students are encouraged to find an active role to participate according to their preparation and abilities.

The results of this study are consistent with other studies that examined the impact of STEM, The study of Al-Maliki (2018), in which the impact of teaching according to Integrative STEM approach in the improvement of scientific research skills according to IntelISEF standards ($\eta^2=0.75$), and the study of Shammari (2018), which concluded the effectiveness of the STEM, AlDaod (2017) study, which shown that the effectiveness of teaching and according to Integrative STEM approach in the development of the habits of mind and decision-making skills was ($\eta^2=0.99$) in the students of the third medium, and the study of Ahmad (2016), which also reached the effectiveness of the development of problem-solving skills and the trend towards science , And the Experimental Study AlKhabty (2016) which concluded the efficacy-oriented development The first five problem solving skills of primary school giftedness in Jeddah. The study of Shihaimia (2015) showed that there are statistically significant differences and a large effect of teaching according to Integrative STEM approach in the development of creative thinking .

VII. Recommendation

1. Using the integrative STEM approach in the design of integrated detective teaching (science, technology, engineering, mathematics) in different educational stages by applying one type of integration (coordination, complementing, linking, communication and mixing).
2. Science standards for the next generation are all integrated, teaching in the light of the integration of concepts with scientific ideas and practices to obtain better outputs.
3. Train teachers to teach in an integrated approach among them within the disciplines of STEM science, technology, engineering and mathematics.

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