

THE EXTENT TO WHICH THE CRITERIA FOR STEM TEACHER ARE AVAILABLE TO THE PALESTINIAN TEACHER

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ABSTRACT

This study investigates the level of readiness of the teachers in Palestine for the implementation of STEM approach to be competent to teach in accordance with its criteria. This manuscript employed the descriptive analytical approach (quantitative and qualitative) to recognize the availability of STEM teacher standards in Palestine. To achieve the study objectives a questionnaire consists of (33) variables including (planning, professional and ethical standards, education and classroom management, educational resources, and evaluation). Interviews were also conducted with STEM coordinators in the directorates of education. What's more, the analysis findings show that the arithmetic mean, standard deviations and the study total field is (3.99) and with a response degree of agree. Hence, the planning field obtained the highest arithmetic mean; followed by professional and ethical standards field. Then comes the field of education and classroom management, next the field of educational resources, and finally the field of evaluation. However, the job variable findings show that all the differences were in favor of the managers greater than the supervisors were. Coordinators have sufficient knowledge about its application in the educational environment. The findings also show that the appropriate teacher to apply this approach is the one who studies scientific subjects (mathematics, science, technology, and engineering); and who links the scientific skills in the topic he/she are teaching with other subjects. However, there are many obstacles, for instance, content overload, the high number of students in the classroom, the school environment, the frequent absence of the teachers, teacher's lack of sufficient experience and skills to apply the STEM approach method.

KEYWORDS: STEM teacher standards, Palestinian teacher

INTRODUCTION:

The STEM sciences can be integrated and put into groups with homogeneous goals and approaches to provide humanity with better knowledge and understanding. However, subjects like (science, mathematics, engineering, and technology) are considered as subjects that are surrounded by many problems and obstacles. These problems are sometimes related to the adopted teaching methods and sometimes linked to the curriculum. Thus, this will cause some students to hesitate from continuing their studies in these fields or specializing in them. This issue led to the appearance of many studies and researches that sought to reveal these problems and to deal with them appropriately. Moreover, many conferences have also been held to avoid these problems and to stimulate students' creative and innovative abilities. Students are being taught mathematics and science as separated subjects, in an isolation from technology. In fact, technology is considered as one of the most important subjects we use in our actual live today. Engineering is also being taught separately as well. Hence, there is a trend to integrate homogeneous subjects that has started shyly in teaching subjects with teaching methods in which some paragraphs are merged into homogeneous subjects.

This is called "STEM Education", [12]. Concepts of STEM education are vary due to different intellectual and philosophical points of view which aim to meet the changes and challenges in the societies by promoting science, technology, engineering and mathematics at all educational levels through practical real-world contexts in both formal and informal classrooms ([22][14] [18]). Thus, there is an urgent need to integrate some or all of the four educational fields and to get rid of the traditional barriers between them including the fact that it is a knowledge that resulted from the integration of the fields of science, mathematics, and engineering design with the technological applications.([8] [21] [11]). This occurs through the application of the practical activities, digital and computer technology activities, and activities centered on specific, directed expertise through the self, experimental laboratory study in pairs and teams, multi-dimensional realistic evaluation[6].based on performance and focusing on the abilities of scientific, creative, and critical thinking [10].

Study Significance

Ref [15] confirmed the importance of STEM process to upgrade the level of teacher's performance in Palestine and to get rid of the poor level of their performance. Thus, this study comes to emphasis what are the required STEM standards to develop the teacher's performance and to bridge the gap between theoretical and practical aspects

Study Problem:

Previous studies and literatures on education ref ([9] [19] [4])revealed that the teacher is the most important constituent in the educational system. Thus This study pays great attention to the standards that a Palestinian teacher must have to become capable and ready for teaching by implementing STEM approach .Therefore the study problem can be formulated in main following question: **To which extend are the teachers in Palestine ready for the implementation of STEM standards?**

The following sub-questions are elicited from the main study question:

- Do STEM teacher standards change according to the differences of the study variables (job title)?
- To which extend are planning standards available for the Palestinian teachers as one of the STEM standards from the point view of the educational supervisor and the school principal?
- To which extend is teaching and classroom management standard available for the Palestinian teachers as one of STEM standards from the point view of the educational supervisor and the school principal?
- To which extend are the educational resources standard available for the Palestinian teachers as one of STEM standards from the point of view of the educational supervisor and the school principal?

-To which extend is the assessment standard available for the Palestinian teachers as one of STEM standards from the point view of the educational supervisor and the school principal?

-To which extend is professional and ethical standard available for the Palestinian teachers as one of STEM standards from the point of view of the educational supervisor and the school principal?

Study Hypothesis:

There are no statistically significant differences at the significance level ($0.05 \geq \alpha$) regarding the availability of STEM standards for the Palestinian teachers attributed to the job variable.

Purpose of the study

The study objectives are summarized as follows:

- 1- Determining the level of readiness of the teachers in Palestine for the implementation of STEM standards to be competent to teach in accordance with its criteria.
- 2- Emphasis on the quality of preparation that must be received by those who join the teaching profession in STEM schools, and accordingly obtain a license or a standards certificate.

Related research

Ref [13] clarified the effect of using STEM-based teaching program on teaching mathematics and on critical thinking skills among secondary school students in the Riyadh Educational District in the Kingdom of Saudi Arabia. The study employed semi-experimental approach. The study sample consists of (88) male and female students. The study findings showed that there were statistically significant differences between the mean scores of the program on various thinking skills in favor of the experimental sample. The findings also showed that there were clear differences between the average scores of students on the critical thinking scale in favor of the experimental group. They also showed that there were no statistically significant differences due to the gender variable (male and female).

Ref [5] conducted a study that clarified the effect of using STEM in teaching science, technology, engineering and mathematics on integrated learning to improve critical thinking skills of students in the Nusa Tenggara region in Indonesia. The paper employed semi-experimental approach. The study sample consists of (27) male and female students. The study findings showed that there were no statistically significant differences in the variables of integrated learning and critical thinking between the experimental group and control group. The findings also clarified that there were statistically significant differences in the use of critical thinking skills among students in the pre and posttests in favor of the posttest and the use of the STEM-based training program. Therefore, the findings showed an increase in the development of critical

thinking by enhancing opportunities to participate actively in learning and by providing hints on the asked questions. Then, the study confirmed that by using STEM approach, the level of critical thinking skills would be enhanced.

Ref [17] investigated the teachers' viewpoint who study science, technology, engineering, art and mathematics on the use of the STEM approach in South Korea. The study designed a survey that targets different schools (public and private). Semis-experimental approach was used in order to achieve its objectives. The study sample consists of (729) STEM teachers in schools that use STEM as an educational approach. The study findings showed that the teachers are facing many challenges such as the need for enough time for planning and applying due to the increased pressure at work. It also showed the need for financial support to implement the activities. The study recommended the urgent need to amend the current curricula to match the requirements of applying the (STEM) approach.

Ref [20] conducted a study that aimed at identifying the impact of STEM-based learning on self-efficacy and the development of the interest in STEM professions. The researcher used the experimental approach where he applied the study tools in the form of note cards to measure self-efficacy and a questionnaire to identify the trend towards STEM careers. The study findings clarified that there were statistically significant differences in favor of the group that received educational experiences in accordance with STEM approach. The findings also showed a learning effect with accordance to STEM approach on increasing the interest in STEM professions.

Ref [3] identified the effectiveness of employing STEM approach in teaching to develop the ability of middle-stage school students to solve problems in Al Qassim region of Unaizah. The study also revealed the response differences of the sample members about the effectiveness of the STEM approach in developing the ability of female students to the variables of educational qualification and the years of experience of the middle-education stage in solving problems. The researcher used the descriptive analytical approach, and a questionnaire was the study tool that was applied on (50) middle school teachers in Unaizah city. The study findings indicated that the relative effectiveness of STEM approach is developing the ability of middle school students to solve problems from the point of view of middle school teachers and obtained a total average (3.82 out of 5), which is equal to 76.34%, and with high degree of agreement on the questionnaire' items for the variables of academic qualification and the years of experience. The findings also revealed that there are no statistically significant differences between the responses of the sample members according to the years of experience. The researcher recommended that there is a need to use STEM approach to achieve an integration between science, mathematics, computer and engineering subjects. The researcher also emphasized on the need to pay attention to prepare intensive training courses for teachers to design and implement the educational units based on the STEM approach.

Ref [16] explored the obstacles that face teachers in applying the integrated STEM approach in the Sultanate of Oman. The study explained the impact of the gender variable on the existence of these obstacles. The study employed the descriptive approach and a questionnaire was used as a tool for collecting data. However, some obstacles were related to the teacher in applying the STEM approach. Other obstacles were related to the learning environment, and content-related obstacles. The study sample consists of 117 science teachers in the Sultanate of Oman who received training to apply STEM approach in their schools. The study findings found a medium to high degree of obstacles in applying STEM approach. The obstacles related to the content came first, and then came the obstacles related to the learning environment, followed by the obstacles related to the teacher. The study findings showed that there were no differences in the responses of science teachers on the obstacles of applying STEM approach due to the gender variable (male, female). The study recommends the need to develop the content of science courses by designing them in accordance with STEM approach, preparing classrooms, providing tools that help students to practice STEM related practices, and developing the performance of science teachers by providing intensive training courses on the model application of STEM approach in teaching science.

Ref [2] conducted a study to explain the professional growth of science and mathematics teachers in light of the STEM integration approach. It also identified the requirements needed to create a diploma program for science and mathematics teachers in light of the STEM approach, developing a proposed vision for the diploma program professional based on these requirements. Thus, the study employed the descriptive analytical approach to describe and analyze the related literatures to the study problem. The study also prepared a proposed scenario for a training program, and determined the requirements for the professional development of science and mathematics teachers in the light of the STEM approach. These requirements are divided into four main points, which are culture knowledge, technical culture, engineering and mathematics. In light of these requirements, a proposed concept was determined for the diploma program for the teachers of science and mathematics. This program is distinguished from many of the existing experiences due to a specific knowledge and skills that will be provided that are shared by more than one division in the university and from multiple faculties other than the educational faculties.

The researcher noticed that many of the related studies focuses on the (STEM) approach, which aims to develop various thinking skills that appropriate the present time. The researcher also noticed a variety in the objectives and purposes of these studies.. The related studies also showed a high level of agreement on the importance of employing the STEM approach in education, and the need to take it in the preparation of curriculum content for science and mathematics subjects in an integrated manner. Consequently, the reviewed previous studies agreed with the current study on the importance of using and generalizing (STEM) approach in the educational process

(teaching learning). Thus, the current study focuses on the (STEM) approach, and identifies the availability of STEM standards by the Palestinian teachers to be able to teach in accordance with STEM approach.

I. METHODOLOGY:

I.1 Participants

The study sample consists of educational supervisors, school principals, and STEM coordinators of the academic year 2021-2022 who were distributed as table (1)

Table 1: The distribution of the study sample according to the job title

| Job Title | Total | N | % |
|----------------------------|-------|-----|-------|
| Secondary school principal | 888 | 349 | %86.4 |
| Scientific supervisor | 149 | 55 | %13.6 |
| Coordinator STEM | 17 | 10 | %58.8 |

I.2 Research model

The descriptive analytical method (quantitative and qualitative) was used by this study to achieve its objectives.

I.3 Instruments

A special questionnaire was designed to determine the level of readiness of the teachers in Palestine for the implementation of STEM standards. The questionnaire consists of (33) paragraphs, including the following three sections: The first section includes the study title and guidelines paragraphs for the respondents. The second section consists of personal data that included the job variable. The third section consists of the paragraphs (33). Interviews were also conducted with STEM coordinators at the education directorates.

I.4 Data analysis

By using, the (SPSS) program as follows:

1. Extracting the mean, standard deviation, and percentage of the questionnaire paragraphs.
2. T-test for independent samples.
3. Qualitative analysis.

I.5 Scale intervals

Using the 5-point Likert scale to identify the answers of the study sample, table (2):

Table 2: An illustration of the scale degree

| Scale degree | Strongly agree | agree | Neutral | Disagree | Strongly disagree |
|-----------------|----------------|-----------|-----------|-----------|-------------------|
| Response Degree | 5 | 4 | 3 | 2 | 1 |
| Mean | 4.21-5.0 | 3.41-4.20 | 2.61-3.40 | 1.81-2.60 | 1-1.80 |

II. Findings:

The findings of the first question that inquires about (What is the availability level of STEM standards by the Palestinian teacher?

This question is answered by calculating the arithmetic averages and standard deviations of the responses of the study sample members with the questionnaire items and its total scope.

Table 3: Mean averages and standard deviations of the study sample responses.

| # | Order | Item | Arithmet ic mean | standard deviation | % | Respo nse |
|-----------------|-------|---|---------------------|-----------------------|------------|--------------|
| 1. | 4 | Using varied and appropriate teaching strategies that explain and clarify the lessons to achieve the desired objectives. | 4.1460 | .68007 | 83% | agree |
| 2. | 5 | Determining the stages of the lesson plan in harmony with the educational objectives and classroom and off-class activities. | 4.1163 | .61723 | 82% | agree |
| 3. | 1 | Determining the educational needs including (encouraging reflection and thinking, the use of dialogue, and planning for information-based teaching). | 4.0866 | .63786 | 82% | agree |
| 4. | 2 | A well-planning method to achieve educational objectives including (the subject in an integrated manner, designing lessons to achieve goals, and setting goals that encourage teamwork and creativity). | 4.0767 | .67684 | 82% | agree |
| 5. | 3 | Designing educational activities including (investigative activities - and activities that help to gain self-independency). | 3.9307 | .73895 | 79% | agree |
| Planning | | | 4.0713 | .54738 | 81% | agree |
| 1. | 4 | Integrate technology with the educational work to provide various sources of | 4.1337 | .69878 | 83% | agree |

| # | Order | Item | Arithmetic mean | standard deviation | % | Response |
|---------------------------------------|-------|--|-----------------|--------------------|------------|----------------|
| | | knowledge that enrich the learning environment. | | | | |
| 2. | 5 | The ability to manage learning time including (achieving the lesson objectives within the dedicated time, having flexibility, managing learners behavior effectively). | 4.0916 | .68954 | 82% | agree |
| 3. | 7 | Recognizing the learners' needs including (recognizing the individual differences between learners in order to create a variety of educational opportunities. | 4.0594 | .74316 | 81% | agree |
| 4. | 8 | Offering a learning environment that stimulates and supports positive social interaction among students. | 4.0495 | .72702 | 81% | agree |
| 5. | 6 | Encourage students to work as a team or in groups (participate all students, and promote the concept of teamwork). | 4.0446 | .70306 | 81% | agree |
| 6. | 3 | Stimulating motivation like (the use of audio-visual gadgets, and other needed equipment). | 4.0223 | .68808 | 80% | agree |
| 7. | 1 | Facilitate effective learning experiences including (encouraging interaction and encouraging students in making decisions). | 3.9480 | .68284 | 79% | agree |
| 8. | 2 | Solving problems including (the application of education, critical inquiry, and critical questioning). | 3.9010 | .76855 | 78% | agree |
| Education and Class Management | | | 4.0313 | .56713 | 81% | agree |
| 1. | 2 | Mastery of the scientific subject (linking the subject with other subjects, and linking it with daily life situations). | 4.2277 | .68128 | 85% | Strongly agree |
| 2. | 3 | Upgrading information in scientific and cultural fields related to the society. | 3.9926 | .72697 | 80% | agree |
| 3. | 1 | Mastering the information studying methods: (following up on developments, using different sources, using structured observation, correcting information, etc. | 3.8911 | .73415 | 78% | agree |
| 4. | 4 | Creating Knowledge (analysis of information, training students to classify information, and acceptance of all new information). | 3.8243 | .71586 | 76% | agree |
| 5. | 5 | Comparisons (comparing sources and evidences, comparing patterns and characteristics, etc.). | 3.7896 | .75729 | 76% | agree |

| # | Order | Item | Arithmetic mean | standard deviation | % | Response |
|---|-------|---|-----------------|--------------------|------------|----------------|
| Scientific Educational Resources | | | 3.9450 | .59414 | 79% | agree |
| 1. | 3 | Student evaluation: (designing achievement tests by referring to the specification table of tests, diagnosing strengths and weaknesses, designing enrichment activities, and others). | 4.0074 | .75706 | 80% | agree |
| 2. | 5 | Feedback: (employing the assessment results to improve the performance, and encourage students to express their opinions through their learning practices). | 3.9356 | .72243 | 79% | agree |
| 3. | 1 | Self-evaluation: (studies and reflects on his/her actions constantly, and uses different methods and tools to evaluate his/her performance). | 3.8812 | .79123 | 78% | agree |
| 4. | 6 | Comprehensive evaluation of learners' performance (mastery of evaluation methods and standards and the performance levels). | 3.8762 | .77141 | 78% | agree |
| 5. | 2 | Designing various evaluation tools: (illustrations, note cards, image, and recordings...). | 3.8738 | .76939 | 77% | agree |
| 6. | 4 | Employs the educational projects as an assessment tool. | 3.7228 | .82298 | 74% | agree |
| Evaluation | | | 3.8828 | .63578 | 78% | agree |
| 1. | 9 | Follows the professional ethics. Observance of the highest <i>ethical</i> and <i>professional</i> standards | 4.3366 | .72567 | 87% | Strongly agree |
| 2. | 2 | Respects the student's personality and abilities | 4.1584 | .67177 | 83% | agree |
| 3. | 8 | Adheres to the work rules and laws assigned to him/her by the school. | 4.1559 | .65173 | 83% | agree |
| 4. | 3 | Professional growth (participation in professional development and training courses, exchange of experiences with colleagues). | 4.0693 | .73895 | 81% | agree |
| 5. | 6 | Effective communication including (cooperation and interaction between the teacher and colleagues, parents, and the surrounding community). | 4.0371 | .73624 | 81% | agree |
| 6. | 1 | Building trust between the teacher and the students (take parts in setting the classroom rules.) | 4.0248 | .71105 | 80% | agree |
| 7. | 7 | Professional growth and permanent development: (permanent development of the professional aspects through the practice of thinking, and continuous | 3.9307 | .72881 | 79% | agree |

| # | Order | Item | Arithmetic mean | standard deviation | % | Response |
|---|-------|--|-----------------|--------------------|------------|--------------|
| | | reflection on his/her educational methods). | | | | |
| 8. | 5 | Do not overuse the available resources. | 3.9282 | .71655 | 79% | agree |
| 9. | 4 | Keep pace with the latest educational theories and practices in the field of specialization. | 3.9109 | .84359 | 78% | agree |
| Professional and Ethical Standards | | | 4.0613 | .57992 | 81% | agree |

Table 4: Means and standard deviations of the study sample responses in the study field and the total field.

| Number | Order | Item | Arithmetic mean | standard deviation | % | Response |
|--------------|-------|------------------------------------|-----------------|--------------------|------------|--------------|
| 6. | 1 | Planning | 4.0713 | .54738 | 81% | agree |
| 7. | 5 | Professional and Ethical Standards | 4.0613 | .57992 | 81% | agree |
| 8. | 2 | Education and Class Management | 4.0313 | .56713 | 81% | agree |
| 9. | 3 | Scientific Subject | 3.9450 | .59414 | 79% | agree |
| 10. | 4 | Evaluation | 3.8828 | .63578 | 78% | agree |
| Total | | | 3.9984 | .53437 | 80% | agree |

As seen in tables (3 and 4) the arithmetic means and standard deviations of the study field and the study total field. It was found that the arithmetic mean reached (3.99), and with an agreeing response degree.

Table (4) illustrates that the highest arithmetic means are the planning field with the mean reached (4.07) and with an agreed degree of response. Then the of professional and ethical standards field with a mean of (4.06) and a response degree of agreement. Next the field of education and classroom management with a mean of (4.03) and with a degree of response (I agree). After that comes, the scientific material field with a mean of (3.94) and with the degree of response, "I agree". At the end comes the evaluation field which has an arithmetic mean of (3.88) and with a response degree of "I agree".

The researcher believes that the reason behind these findings is that planning is of great importance in explaining the scientific content by applying STEM approach. This is also because planning contributes to the use of appropriate and variety of teaching strategies to explain the lessons and clarifies them to achieve the desired objectives. It also allows teachers to define the lesson stages with reference to the educational objectives; in addition to apply activities in and off-class. It also planning helps the

teachers to plan well for the achieving the educational goals including (designing lessons to achieve goals, and setting goals that encourage teamwork and creativity). However, the professional and ethical standards came second in terms of importance; the STEM education system has certain standards that must be followed by the teachers. These standards according to the researcher's opinion are represented in keeping with the new educational theories and practices in the field of specialization.

The researcher also clarified that the standard of education and classroom management is no less important than the previous ones. This is because this system allows achieving the objectives of the lesson during the allotted time, offers flexibility, manages the learner's behavior effectively, contributes to have awareness of individual differences between learners, and offers various educational opportunities. In addition, it raises students' motivation towards education by aural-visual samples and the use of tools and equipment.

The researcher also identifies that the scientific content is also very important where it enables teachers to follow developments, use different sources, use organized observation, correct information, etc., and it links the subject with other study fields. It also links the educational subject with daily life situations. Moreover, it helps in analyzing information, training students to classify information, and accepting all news information.

According to the study sample respondents, the evaluation process comes last in terms of its arithmetic mean. Despite the importance of evaluation for the teacher and students at the same time, it helps the teacher to design achievement tests according to the specification table, diagnose strengths and weaknesses, and design enrichment activities, and so on. Evaluation also encourages students to express their opinions during their learning practices. The researcher attributes this result to the fact that the teacher is dedicated to the written work (planning), which is checked constantly by the educational supervisor and the school principal. That is why it comes in the first degree. The teacher also takes in account the matters that are related to the teacher's personality and ethical and professional criteria. In contrast, the technical aspects ranked third and fourth where it appears that it is less available to the Palestinian teacher. This requires skills that the teacher must master whether in education, assessment or evaluation.

Consequently, the researcher's point of view matches and agrees with ref [3] findings which showed the effectiveness of the STEM approach in developing the ability of middle school students to solve problems from the point of view of middle school teachers with a (high) degree of agreement of the questionnaire items. In contrast, these findings conflict with the study of ref [16] which showed the presence of a medium to high degree of obstacles in applying STEM approach. These obstacles are related to the content, the learning environment, and other obstacles are related to the teacher. However, the results of the current study did not show the presence of obstacles where

the answer were with degree of agree including all areas which means the availability of the required standards.

This manuscript also agreed with ref [20] that identified the impact of STEM-based learning on self-efficiency and the development of orientation and interest in STEM professions. As well as the impact of learning in accordance with STEM approach on the tendency and interest with STEM careers.

Testing Hypothesis

1. The study hypothesis states that: (There are no statistically significant differences at the significance level (α 0.05) regarding the availability of STEM teacher standards for the Palestinian teachers with respect to the job variable. However, this hypothesis is tested by an independent sample t-test to compare two arithmetic means for two independent samples in order to extract the arithmetic means, standard deviations, T calculated(t-value), degrees of freedom, the statistical significance value. Hence, table (5) shows the results of this test as follows:

Table 5: Results of the independent sample T-Test that compare between two arithmetic means for two independent samples and in accordance with the job variable.

| Item | 349) N=(principal | | 55)N=(supervisor | | freedom | (T) Value | Sig. |
|------------------------------------|--------------------|--------------------|------------------|--------------------|---------|-----------|------|
| | Standard Mean | Standard Deviation | Standard Mean | Standard Deviation | | | |
| Planning | 4.1203 | .47047 | 3.7600 | .83391 | 402 | 4.652 | .000 |
| Education and Class Management | 4.1032 | .48144 | 3.5750 | .81316 | 402 | 6.766 | .000 |
| Scientific Content | 3.9948 | .53528 | 3.6291 | .81869 | 402 | 4.336 | .002 |
| Evaluation | 3.6291 | .81869 | 3.4576 | .87207 | 402 | 5.530 | .000 |
| Ethical and Professional Standards | 4.1047 | .53396 | 3.7859 | .76349 | 402 | 3.855 | .000 |
| Total | 4.0546 | .46360 | 3.6415 | .77188 | 402 | 5.520 | .000 |

Sig. at 0.05

Table (5) illustrates that there are statistically significant differences at the significance level ($0.05 \geq \alpha$) on the availability of STEM standards for the Palestinian teachers due to the job variable with respect to the study fields and the total fields. The significance level reached (0.000) which is less than a summed Sig. 0.05. Because of this finding, the job variable hypothesis is rejected.

The researcher clarifies that all the differences were in favor of the principals over the supervisors. This finding is explained with the principals' frequent monitoring of the teachers; as well as and their good knowledge of the available level of STEM standards for their teachers through their continuous communication with them inside the school. In contrast, the school supervisor visits the teacher one time or two times during the completely academic year.

Interview Outcomes:

The researcher interviewed a sample consists of 10 STEM coordinators. The following are the asked questions:

Do you have the required knowledge on how to apply STEM approach in education and in the educational environment? If the answer is yes, we will continue the questions.

When the respondents were asked about their knowledge on applying STEM approach in education and in the educational environment, all of them responded that they have a full knowledge about applying STEM approach in education and in the educational environment. This finding was explained with having training courses that were given to the coordinators to be fully aware of the required knowledge for applying STEM approach in education.

Who is the appropriate teacher for teaching according to the STEM approach?

The study sample members unanimously agreed that the teacher who teaches scientific subjects “mathematics, science, technology, engineering”, and who links the scientific skills with the subject he/she teaches with other subjects in an integrated manner could teach in accordance with STEM approach. In contrast, some individual’s state that any teacher can teach in accordance with STEM approach, and any teacher has the desire can do that. They added that science teachers are more competent to apply STEM approach and this was indicated by the study of ref [20]

What are the most significant STEM skills a teacher must have?

The coordinators indicated that the STEM skills a teacher must possess and understand are analysis, critical thinking, creative thinking, technological skills, and the ability to apply integrative learning. A teacher also must be familiar with the knowledge and skills of the twenty-first century. He/she must also be familiar with the skill of building horizontal adherence between the subjects, communication skill, and project learning skill. The researcher believes that the teacher who possesses such skills can successfully teach in accordance with the STEM approach. Thus, the students in turn will gain these skills as indicated by the study findings of ref [13]

In your opinion, does the teacher realize the relationship between science, technology, engineering and mathematics?

The study sample coordinators clarified that the expert teacher understands the relationship between the different sciences and works on linking them in the classroom. In contrast, not everyone is able to perceive this relationship, and there was a contrary opinion, mostly “No”, however, in order to master STEM, the teacher must be familiar with its standards. Other respondents stated that this issue depends on the teacher preparation programs, the teachers’ attitudes, and the general educational situation. [1] Thus, it is not enough for the teacher to realize that integration..., but it is important to

master the practical aspect of this integration. The researcher believes that teachers' awareness is necessary for the integration between sciences. This is because the awareness helps the teachers to improve their ability to teach higher- thinking skills and critical thinking skills as indicated by the study findings of ref [5]

Do you expect facing any challenges when applying STEM approach in education?

The coordinators explained the challenges that face applying STEM approach as follows: overloaded content, the high number of students in the classroom, the school environment, the frequent absence of the teacher, the teacher's lack of experience and sufficient skills in applying STEM approach appropriately, parents hesitation of accepting change, the fear of change, lack of skills, lack of the recourses; as well as the lack the human competency. Doubtlessly, the views of the coordinators match the study findings in ref [17]

Study Conclusion and Recommendation:

The study findings clarified that the coordinators of STEM program have the required knowledge to apply it in the educational environment. The study added that the appropriate teacher to apply this approach is the teacher who teaches scientific subjects like (mathematics, science, technology, engineering), and who links the scientific skills in the topic he/she teaches with the other subjects in an integrative manner. The study findings also showed that the most important skills that the teacher must possess are the analysis skills, critical thinking and creative thinking, technological skills and the ability to apply integrative learning. In contrast, this paper explained the challenges that hinder applying STEM approach in education. For example, this manuscript states that there are many challenges and obstacles like the high number of students in the classroom, the school environment, the frequent absence of the teacher, the lack of sufficient experience and skills in applying STEM approach ; in addition the challenges of supporting *parents* with children's *STEM education*.

Based on the aforementioned findings, the researcher emphasized on implementing the following recommendations:

1- Preparing and organizing the suitable classroom environment to efficiently apply the strategy of a program based on STEM approach and offering the appropriate learning resources. The effectiveness of teaching with a STEM-based program approach requires good preparation and organization of the classroom environment. This is because without this, its effectiveness is limited.

2 -Taking into account the importance of creating a special class to implement the strategy of a program based on STEM approach at each school and for all of the educational stages where each class is equipped with the necessary tools for applying the program successfully.

3-There should be various teaching tools during the implementation of the teaching strategy in a program based on the STEM approach to ensure the best interaction between the teachers and the students.

4-Training teachers to apply the teaching strategy on STEM approach based program and the various methods that can be used in the classroom.

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