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Training Requirements For Teachers To Develop Their Abilities For Applying The Entrance Of The Integrated STEM.

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Abstract

The aim of this research is to identify the most prominent educational and training requirements needed by teachers to develop their teaching abilities in applying STEM Integrated Approach "science,

technology, engineering and mathematics" in teaching mathematics from the viewpoint of educational supervisors. Research has reached some results such as the importance of this approach and that teacher’s need to full preparation to be able to apply this teaching approach. The researcher recommended that the approach should be applied in schools in Arabic countries, for its role in achieving the desired goals in teaching mathematics.

Keywords: Educational supervisors, Mathematics, STEM, Training needs.

Training Requirements For Teachers To Develop Their Abilities For Applying The Entrance Of The Integrated STEM.

A. Introduction

The essence of STEM education is to prepare the 21st century workforce by teaching STEM and related activities so that students can take what they learn in class / lab and apply it to their future jobs in the real world. Educators, industry and the business community should work as a team to develop approaches that will enhance this expectation. Importantly, in addition to curriculum development, this should include collaboration between schools and industry professionals internships, mentoring, and delivering hands-on classroom activities to introduce students to careers in the areas of STEM and core skills (Ejiwale,2013,p.64).

The preparation of teachers for the teaching profession is a top priority in any country, because it is a difficult and crucial profession and may lead to the progress and progress of nations in various fields. As a huge agency, education is of great importance in building strong and developed societies, and the teacher is one of the key factors to achieve this. For these reasons, it is always necessary for

teachers to receive sufficient vocational and educational training to acquire adequate educational knowledge and skills and to be able to devote themselves to the teaching profession. More importantly, if teacher training and professional development programs are provided, they must be offered, directed and evaluated, on a regular basis, by experts in the field (Boudersa, 2016). Teachers are advocates of reform, change, development and innovation. They are responsible for preparing, educating and guiding future generations. The teacher is a guide and organizer of the educational process. It has changed the perception of the teacher today as the main criterion for the preparation of the teacher depends on his ability to achieve responsibilities, including educational objectives of various dimensions in these circumstances prevailing in the era. On this basis, the process of preparing and training teachers has become prominent in the priorities of the development of educational thought in most countries of the world where all educational systems are concerned with the training of teachers in service to increase their efficiency and improve their performance by designing appropriate training programs for teachers in the light of their educational needs. (Al- Tarawna, 2003, p.137), Thus, instructors need more special

educational needs for developing their abilities in learning some subjects by using pedagogical programs such as the STEM Integrated Approach, " Science, Technology, Engineering and Mathematics" in teaching mathematics.

In spite of multiple teaching methods, the approach of integration between Science Technology, Engineering and Mathematics " STEM" is very significant as this term has become a part of educational vocabulary. This type of education imposes another form of classroom because it depends on team spirit, improving communication, concerning with what is useful, and interacting with students in all senses through scientific experience instead of listening to the instructor for more than six hours in some schools, This problem is not only considered as a school one but leads to a big problem in the university system as the students move from a system depending on listening to the teacher into a system depending on research and development. After that we expect he can achieve creativity and innovation.

The conference specialized in Science, Technology, Engineering, and Mathematics reaffirmed preparing students, providing them with necessary skills in Science, Technology,

Engineering and Mathematics, and developing their abilities to deal with today's latest development and challenges.

Several lecturers pointed to the importance and necessity of paying attention to these areas as they assured that successful education model is that provides students with a chance to learn Science, Technology, Engineering and Mathematics in a logical sequence. Thus this model connects these subjects with each other and link them to true requirements lived by many students (Al-Qahtani, 2017, p.23-24), Educational supervisors have a vital role in applying "STEM" Integrated Approach. This study tries to identify the most necessary pedagogical requirements for teachers in applying and achieving the entrance of the integration of Science, Technology, Engineering and Mathematics in teaching this subject " mathematics" from the point of view of educational supervisors in schools.

1. **The purpose of the study:** The study aims at achieving several notable aims including;

a) Stating pedagogical requirements to develop teachers' capacities in using STEM INTEGRATED APPROACH.

b) Illustrating Educational supervisors' points of view from learning process

c) Stressing the importance of the use of STEM INTEGRATED APPROACH ((Science, technology, engineering and mathematics)) in teaching.

d) Theoretical framework.

2. **The importance of training requirements:** Training requirements have a significant role in advancing learning process as Al- Tarawna (2003) said that training leads to improve the general working atmosphere, enable individuals to understand all what is new within considerable technological progress in most areas of life, and provide individuals with different experiences. Thus, they indicate their overall satisfaction with self and work and improve the Ireland morale. Training also helps to create a positive relationship between the Educational institutions and individuals, which leads to integrate the interests of all into an Integrated whole. Training is defined as an organized and planned effort to provide people in the institutions with knowledge, improve and develop their skills and abilities and change their behavior and attitudes in a constructive manner (Dora, 1991).

Necessity is defined as a lack of discrepancy between two situations. In the context of human resources Development, necessity means a gap existing between two performances in a specific job, namely realistic performance and desired performance. This gap occurs due to a lack of man's knowledge, skills, and attitudes. So, the need for training means that organized and planned training can address this inadequacy and discrepancy. So, We can say that need for training can be existed when We apply planned and organized Training to address any inadequacy, discrepancy and gap between two situations, realistic situation and desired one.

3. **The importance of STEM INTEGRATED APPROACH: S**TEM INTEGRATED APPROACH ((Science, Technology, Engineering and Mathematics)) is one of the most significant and effective approaches in Curriculum design for three decades of application in the United States of America, the United Kingdom, South of Africa, and some other countries. This approaches includes some disciplines "Science, Technology, Engineering and Mathematics". It also depends on learning through applying some practical activities, digital and computer technology activities, experience-centered

activities through discovery and inquiry, manual experience activities, scientific and logical reasoning and decision-making.

STEM curricula design focuses on Integrated conceptual experience, problem solving, investigation and intensive applications for practical activities, specific and targeted experience through the self-empirical and laboratory Research in pairs or in groups, multi-dimensional realistic evaluation based on performance and focusing on scientific, creative and critical thinking abilities (Ghanem, 2011) .

STEM Integrated Approach is known as environmental approach for integrating the curricula of Science, Technology, Engineering, and Mathematics. It concentrates on interactive relationship among Science, Technology, Engineering, and Mathematics. Through organizing the Contents of the study in the form of general issues and problems in life, barriers and obstacles among Science, Technology, Engineering, and Mathematics will disappear during study.

Ntemngwa and Oliver (2018) noted that the original project orientation originated from the school administration and was

motivated by the belief that this initial invasion into an integrated STEM could be achieved by integrating technology into their usual education in the classroom. This belief was derived in part from the successes of their students working with robotics, mostly as club or after-school activities. In this study, we documented and analyzed the transformations made by these teachers as their thinking matured from ambiguous initial goals towards later understanding. . An example of the impact of a mysterious goal was a teacher who says she just wanted to integrate robotics into a life sciences lesson, but she did not know exactly how to start preparing for education, Through Thibaut et al. (2018) states that in collaborative learning, students organize their group work, without receiving formal training in social skills for small groups. The teacher does not monitor groups effectively and refers all questions to them, because he wants students to resolve group conflicts on their own

4. **Multi-dimensional teaching Approach" STEM:** STEM is one of the teaching Approaches based on integrative theory among acquired knowledge in Science, Technology, Engineering, and Mathematics. STEM can also achieve integration policy foundations of Education or Educational philosophy used in learning

mathematics in practical way for the integration of Information from four disciplines to achieve a specific goal, solve problems and innovate something new and useful. STEM is an educational curriculum that combines four disciplines: science, technology, engineering and mathematics (Ceylan & Ozdilek, 2015), embodying the skills that each teacher must know from the inside out in current education. Integrating these four disciplines into STEM will allow for the most relevant and relevant learning (Stohlmann et al., 2012).

It is termed as a Multi-disciplinary integration approach based on integration between knowledge starting with inquiry approach and ending with designing and inventing a new innovative Curriculum. It is defined procedurally in current research as one of Multi-disciplinary teaching approach based on integration between mathematics as a core discipline and integrate it with Science, Technology, and Engineering into a new approach in which learning occurs fourth dimensionally through designing simple projects based on integration of knowledge to solve problems in society, Lyn (2016) suggests that STEM is often used in reference to only one discipline, which is common science. Although the integration of STEM disciplines is increasingly supported in the literature, studies addressing multiple

disciplines seem insignificant with mixed results and insufficient guidance for STEM progress. Views vary on how to integrate discipline, with reference to interdisciplinary, interdisciplinary, and interdisciplinary approaches that add to discussions. These approaches include basic concepts and skills that are taught separately in each discipline but are placed within a common theme; introducing pertinent concepts and skills from two or more disciplines with a view to deepening understanding and skills; and adopting a multidisciplinary approach, in which knowledge and skills from two or Most of the disciplines on real world problems and projects with the aim of shaping the overall learning experience.

5. **The importance of educational management:** Educational management is a significant component in teaching and learning processes. This significance is evident in invention and Innovation in educational and teaching fields. Invention and Innovation are highly dependent on the ability of educational supervisors based on scientific understanding and conscious awareness for the latest Innovations that emerged from scientific researches in education. Activities exercised by educational supervisors should focus on two

important trends namely, communication skills and using modern technologies in education. (Al- Tamimi, 2008)

Educational supervisors should pay their attention to problems facing teachers and probably leads to confusion and anxiety and sometimes to hopelessness and despair and help teachers overcome these problems. With regard to students, supervisors should pay attention to different aspects of personality beginning with their desires, interests and efforts to develop their skills and abilities and enjoying their achievements ending with appreciating their attitudes and human values, social and national feelings, estimating liability and facing consequences. (Al bassam, 1975).

B. Literature review.

Study of Al- Tarawna (2003) this study aimed at assessing the Training needs of teachers from the viewpoint of teachers, Educational supervisors and principals of the government schools in the southern ghour directorate of Education. The study used a questionnaire consisting of 34 multiple questions that covered four aspects. A committee of referees verified the validity of the questionnaire and the test- retest reliability coefficient was estimated

to be 0. 95. The subjects of the samples were 100 selected out of 436 teachers, Educational supervisors and principals, the study showed that there is a need for Training in all Education aspects (classroom administration, handling students, and methods and activities, planning and evaluation). The study also indicated that there are non-statistically significant differences due to the interaction between qualification, job, and experience. The study recommended that training programs should be designed for teachers (regardless of their experience or educational qualification) in the following areas: classroom administration and handling students, methods and activities, planning and evaluation, also Study of Rizq (2015) This study aimed at exploring The use of STEM Integrated Approach for developing 21 ST Century Skills and Decision making Skills among First Year Faculty of Education Students (Scientific and literally sections) The study adopted the guasi- experimental design (one group design).The participants were selected were random from first year faculty of education students. The following instruments were used: The 21st century skills observation checklist; Decision making skills scale. Students of the experimental group received training are STEM Integrated Approach (through projects). The data obtained

were statistically analyzes using SSPS Program (version 19). The study result indicated the effectiveness of STEM Integrated Approach in developing 21st century skills and decision making skills among first year faculty of education students. Accordingly, relevant recommendations and suggestions for further research were providing.

Conclusion and limitations

At the end of this paper, we determined that education has a major role in the advancement of societies, and that the developed countries are concerned with education. In that sense, educational approaches are applied in different stages to enhance the educational process. Educational supervisors stressed on the importance of applying STEM Integrated Approach in science, technology, engineering and mathematics in teaching mathematics. To apply this approach, it needs training possibilities "needs" in order to achieve objectives.

C. Results:

The first part: A number of questions were directed to the supervisors; teachers and administrators of the respondents, andGR4

their responses were analyzed and recorded. The most important questions addressed to the respondents were:

1.1. What are the most important teacher needs and support required in their teaching?

About (30%) of respondents said that the teacher has a greater need to know his students and their mentalities. Because there is greater social disintegration in the willingness of students to accept the value of education, it is necessary to understand this difference and work to develop it to be effective, A total of 50 respondents (100%) said that the teacher should understand the students' education in a world in which information, good and bad, is readily available, with the disadvantages and advantages mentioned.

Forty-one respondents (82%) said that curricula that have value in themselves should be developed for as many students as possible and that there is a greater need to develop meaningful professional relationships with students to gain confidence in the teacher's experience Automatically, A group of teachers said about (11%) of respondents said they believed teachers should be flexible in adapting to new ways of learning for students in the 21st century

classroom. As such, they are required for lifelong learners, which may even include obtaining a virtual identity and always updating their skills in order to meet the changing demographics of students in their classes.

One teacher said "We need parents to work with us as partners, something that the recognized teacher is advocating and who can do so by sharing what they know about their children's learning and expressing what they need to learn from us to support their children's learning at home so we need parents who support new ways learning".

1.2. How have teacher participants incorporated STEM specialties into their education so far?

Almost 90% of respondents said that the integration of STEM content, problem-centered learning, inquiry-based learning, and design-based learning and collaborative learning. All these principles are rooted in the social constructivism of learning. In a list of these principles, they are as follows:

The first principle, the integration of STEM content, refers to the explicit understanding of the learning objectives, content and

practices of different STEM disciplines. Because there is no consensus on terminology, no specific strategy (eg multidisciplinary or integrated education) is proposed. Learning refers to problem-focused learning; **the second principle** is that learning environments must involve students in real, open, unorganized and unrealistic problems to increase the effectiveness of the content to be learned, **the third principle**, survey-based learning, refers to learning environments that involve students in questioning, experiential learning and practical activities that allow them to discover new concepts and develop new concepts. Requires the principle of learning based on design, **the fourth principle**, and the use of open design challenges that provide students with the opportunity to learn not only about engineering design processes and engineering practices, but also deepen their understanding of the basic disciplinary ideas, **Finally**, the principle of collaborative learning suggests that students should have the opportunity to communicate and collaborate with one another to deepen their knowledge. All basic principles are supported by a social constructivism of learning, which dictates that students build knowledge effectively and that learning is a shared experience, not an individual experience.

1.3. What are the challenges of achieving STEM education?

About 70% of the respondents said that there is a challenge of instilling love of science early in the life of the student. Early teachers can incorporate STEM lessons into their daily curriculum so that children will develop a stronger understanding of these skills early on.

Science learning can be boring if it does not represent the effects of the theory of separation in the real world. According to a study conducted by the Institute of Engineering and Technology: About 20% of teachers "Most students think that the curriculum is boring and irrelevant to life outside school." Studies show that "practical activities enable students to build a bridge between what they can see and deal with and scientific ideas that explain their observations." Making these linkages difficult is therefore likely to be successful in practical activities that make these links clear. The practical work of the project can also include group discussions, teamwork, communication and peer interaction, all of which are important skills in the 21st century.

About 10% of the respondents mentioned that STEM lessons usually include four basic steps:

1.3.1. Identify a problem in the real world.

1.3.2. Ask questions to troubleshoot the problem (and possibly solve the problem).

1.3.3. Development of solutions.

1.3.4. Explore a practical activity.

About 66% of respondents report that most teachers suffer from a huge workload, which does not give them much time or energy to plan complex STEM lessons. Technology can help here. EPI found that teachers who make their students use technology for classroom projects in all or most of the lessons, working 6 hours per week less than those who only use educational films and educational competitions.

1.4. What support is needed for more integrated approaches to STEM?

About 30% of the respondents describe science as a social phenomenon, where a community of peers seeks to achieve common goals and abide by the joint agreements that form their work. Specifically, the science includes practices that students must learn in order to participate, such as:

1.4.1. Building and refining theories and models,

1.4.2. Collect and analyze data from observations or experiments,

1.4.3. Building and criticizing arguments, and

1.4.4. Using specialized methods of speaking, writing and representing phenomena.

5 teachers said, "To understand the results of science for non-mainstream groups, it is important to take into account not only standard test scores, taking courses, school retention rates or dropouts, but also opportunities for these students to learn with understanding, to develop identity as learner science while developing their own cultural and linguistic identity, (1) the experiences that all students bring from their homes and communities are evaluated, (2) their cultural and linguistic knowledge is combined with the disciplinary learning they face at school, and (3) sufficient educational resources are available to support learning. In the light of these circumstances, she explained that non-gentlemen are able to achieve results similar to those of their dominant counterparts".

About 22% of respondents said that:

- Education should be seen as a complex system with intertwined parts.
- Scopes and contrast pockets are expected, checked for causes and associations, and used as sources of insight, rather than controlled or suppressed.
- Causation cycles or heterogeneity with feedback and interaction are essential elements of learning systems, where learning is a fundamental process.
- Education should be treated as a regulatory system that seeks and is expected to improve continuously.

The second part: This part of the interview included the answer of the respondents to the questions that were received in this section and included five questions which are as follows:

2.1. What are the training requirements in the field of specialization?

In table 1, Came in the first place of the responses of teachers Integrate rigorous academic concepts with specialized lessons in the real world followed by Linking the four academic materials to the real applications that students experience and then an evaluation of

educational sources and materials in terms of their comprehensiveness, accuracy and usefulness to present a particular idea by 86%, 82% and 70%, respectively.

2.2. What are the training requirements for STEM planning?

In table 2, Came in the first place of the teachers' assessment methods that engage students in the self-assessment process followed by Analyze the classroom environment and make decisions in its content to enhance social interactions and then create a productive work environment and then prepare suitable educational activities for teachers with special needs by 88%, 74% and 72%, respectively.

2.3. What are the training requirements for the implementation of STEM education?

In table 3, Came first to teachers 'responses to create a positive learning atmosphere that is clear, mutual respect and supportive, followed by developing students' positive attitudes toward learning material and love of learning, and then the methods of urging students to meditate on their practice and work. 94%, 88%, and 78% respectively.

Table 1. The Training requirements in the field of specialization

Aspects of training	Elements	frequencies	%	Ranking
The training requirement for the field of specialization	Clarify the cognitive links between the four academic subjects	20	40	6
	Evaluation of educational sources and materials in terms of their comprehensiveness, accuracy and usefulness to present a particular idea	35	70	3
	Wide-scale image integration between science curriculum, mathematics, technology and engineering	22	44	5
	Linking the four academic materials to the real applications that students experience	41	82	2
	Integrate engineering and technology practices with math and science classes	12	24	10
	Designing educational situations based on integrated conceptual experience	5	10	12
	Design of technological solutions using scientific skills and mathematical and statistical processes	16	32	7
	Integrate rigorous academic concepts with specialized lessons in the real world	43	86	1
	Provide a learning environment characterized by the integration of science, technology, engineering and mathematics	13	26	9
	A clear understanding of science, technology, engineering and mathematics in an integrative way	10	20	11

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	Interdisciplinary thinking - cross-border - in the four disciplines of science, technology, engineering and mathematics	15	30	8
	Integrated units based on research and investigation.	26	52	4

Table 2. The training requirements for STEM planning

Aspects of training	Elements	frequencies	%	Ranking
Training requirement for STEM planning	Designing mission-specific tasks to increase students' participation and motivation in learning	19	38	6
	Design tasks that are heard for students by using learning from a cognitive field to adapt learning in another knowledge field to a sufficient extent to improve the learning of all cognitive fields	8	16	9
	Prepare suitable educational activities for teachers with special needs	36	72	3
	Develop real, performance-based learning experiences that are relevant to students' lives	29	58	4
	Analyze the classroom environment and make decisions in its content to enhance social interactions and create a productive work environment	37	74	2
	Design learning positions that employ students' knowledge of STEM in life situations	12	24	8
	Design learning environments to help students enjoy and engage in educational tasks	22	44	5
	Design learning guides that encourage students to take responsibility for their learning	17	34	7
	Design evaluation methods that engage students in the self-assessment process	44	88	1

	Designing instructional situations that require innovative measures to help solve life problems	6	12	11
	Designing audio exploratory activities to determine students' needs and preferences	8	16	9

Table 3. The training requirements for the implementation of STEM education

Aspects of training	Elements	frequencies	%	Ranking
Training requirement for implementation of STEM education	Using teaching methods based on survey projects	15	30	19
	Provide learning materials that employ STEM knowledge in life	26	52	11
	Understand students' misconceptions about STEM concepts and try to correct them	37	74	5
	Provide multiple opportunities for students to ask questions	22	44	15
	Encourage students to make predictions and surveys	39	78	3
	Ways to create a positive learning atmosphere that is clear, mutual respect and supportive	47	94	1
	Encourage students to apply creative solutions to the problems they encounter in their daily lives	13	26	20
	Encourage students to make personal and social decisions sound	26	52	11
	Help students acquire their own knowledge and develop their love for learning	37	74	5
	Developing students' positive attitudes toward learning material and love of learning	44	88	2

	Develop students' ability to think across borders in the four disciplines of science, technology, engineering and mathematics	35	70	9
	Enhance students' understanding of STEM concepts and the ability to manipulate them to solve problems in the real world	26	52	11
	Use available environmental resources to speed up student learning	5	10	23
	Helping students to grow massively and not to jump on cognitive growth	9	18	22
	Provide the knowledge material in more than one image to suit the learning methods of students	12	24	21
	Provide lessons that encourage students to observe, question and interpret ideas	22	44	15
	Engage students in reaching knowledge and skills using the survey method	23	46	14
	Helping students develop community spirit, teamwork, and collective responsibility	28	56	10
	Provide a learning environment that helps students to enjoy and engage in educational tasks	37	74	5
	Engage students in individual and group activities, including the nature of the subject matter	22	44	15
	Generating multiple paths enables students to acquire knowledge (knowledge, research, and inquiry)	36	72	8
	Methods of urging students to meditate on their practice and work	39	78	3

	Use learning time management strategies in different learning environments effectively.	19	38	18

2.4. What are the requirements for training in assessment of STEM education?

In table 4, Came in first place in the responses of teachers employing the concept of continuous assessment and gather information about students to evaluate learning outcomes, followed by the use of collective project evaluation methods, and then the use of assessment methods to enhance the knowledge of students and to measure student progress by 74%, 66%, 58%, respectively.

2.5. What are the technological training needs?

In table 5, Came in first place in the responses of teachers Integrate technology into everyday teaching methods, followed by developing students' skills in relying on different sources of learning, especially digital ones, and then 84% of the educational technology that integrated the educational material into the scientific survey 84% , 78%, 74%, respectively.

Table 4. The training requirement for the evaluation field for STEM education

Aspects of training	Elements	frequencies	%	Ranking
The training requirement for the evaluation field for STEM education	Use assessment methods that engage students in self-assessment to recognize their strengths, needs, and encourage them to set their learning goals	11	22	5
	Use diverse assessment methods to enhance their knowledge of students and to assess student progress	29	58	3
	Employ the concept of continuous assessment and gather information about students to evaluate learning outcomes	37	74	1
	Use diverse assessment methods to measure learning skills	21	42	4
	Use of collective project evaluation methods	33	66	2
	Use evaluation methods to modify methods and methods used.	8	16	6

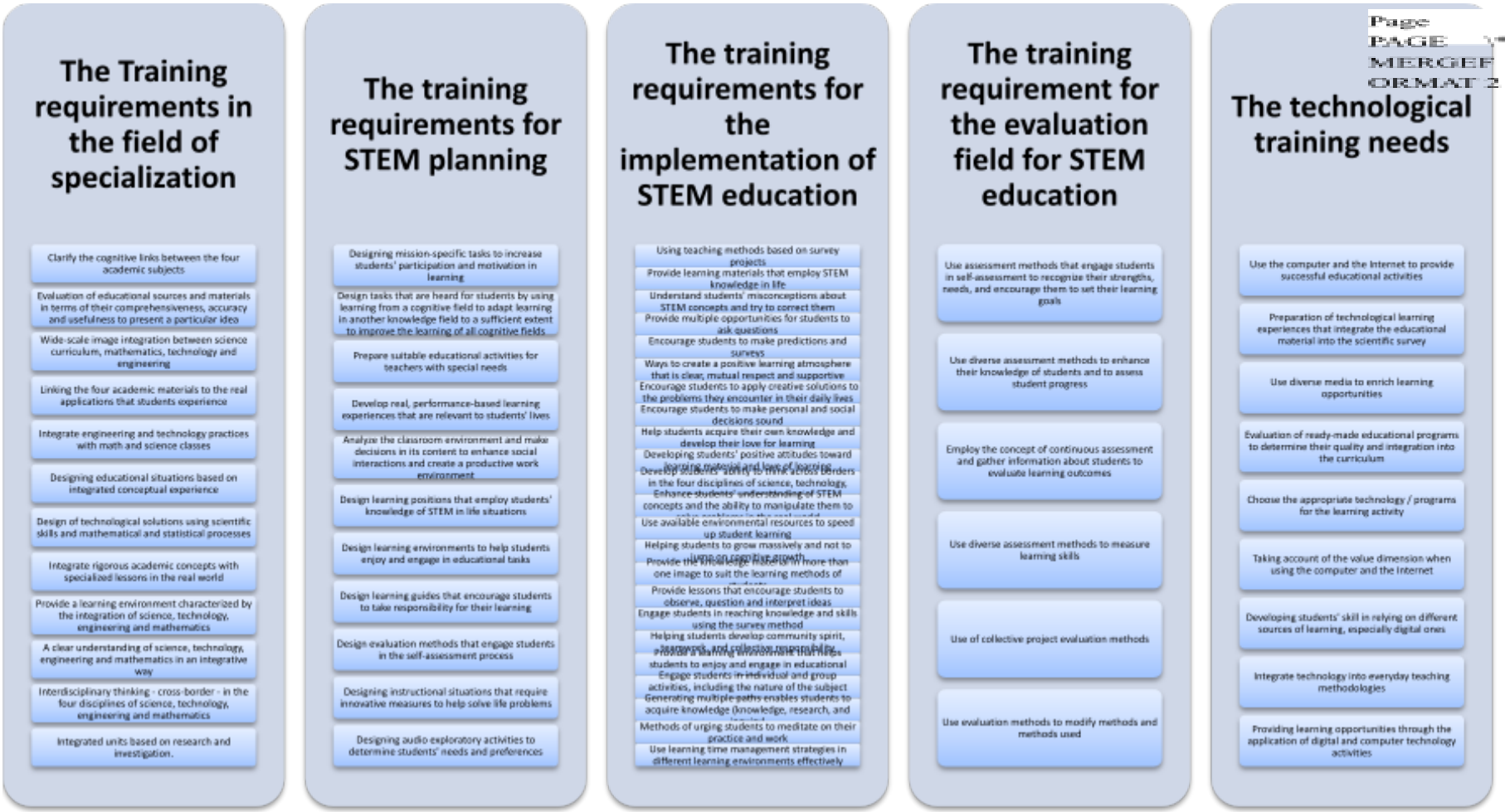
Table 5. The technological training needs

Aspects of training	Elements	frequencies	%	Ranking
Technological training needs	Use the computer and the Internet to provide successful educational activities	16	32	7
	Preparation of technological learning experiences that integrate the educational material into the scientific survey	37	74	3
	Use diverse media to enrich learning opportunities	33	66	4
	Evaluation of ready-made educational programs to determine their quality and integration into the curriculum	22	44	5
	Choose the appropriate technology / programs for the learning activity	10	20	8
	Taking account of the value dimension when using the computer and the Internet	9	18	9
	Developing students' skill in relying on different sources of learning, especially digital ones	39	78	2
	Integrate technology into everyday teaching methodologies	42	84	1
	Providing learning opportunities through the application of digital and computer technology activities.	22	44	5

1. **A study model was developed as follows:**

The following figure illustrates the model from which the study is based on the five above mentioned questions

Fig 1. A study model was developed as follows



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