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An Experiment to Develop Scientific Passion in Secondary School Students Through E-Learning Models

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Abstract
The study aimed to know the effect of e-learning models in developing the scientific passion of the ninth-grade students in Biology teaching. The sample of the study consisted of (164) ninth-grade female students at Aisha Umm AlMomineen Basic School for Girls, which is affiliated with the Directorate of Education of the Kasbah of Amman in the first semester of the academic year 2020/2021. A scale of scientific passion was developed and its psychometric properties were verified. The results showed that there is a high effect of e-learning models in developing scientific passion among ninth-grade students in Biology, which is due to the synchronous e-learning model versus each of the asynchronous, blended and regular e-learning models. As shown, on the other hand, a significant difference between all blended and electronic asynchronous and regular learning models, and in favor of the blended learning model, in addition to the significance of the difference between all asynchronous and regular learning models and in favor of asynchronous learning.

Keywords:
E-Learning Models; Scientific Passion; Biology; Asynchronous learning; Blended learning; Synchronous learning.

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1. INTRODUCTION

At the beginning of the third millennium, the world is witnessing rapid developments that have cast a shadow over all aspects of life but have emerged more and more clearly in the communications and information technology revolution and the digital revolution. This made educational decision-makers and those interested in education; scientists and experts strive with their minds to benefit from this technical and digital progress and to utilize its tools in the educational process.

One of the most prominent manifestations of technical and digital progress is the use of the Internet, and the electronic educational services it provides, as its use in education has become an urgent necessity because of its important advantages. It provides huge sources of information, adds an element of suspense to the educational process, and raises the level of the learner's cognitive and cultural outcome. The use of these technologies has changed the appearance of the educational system with its various components, which has helped in the emergence of new educational patterns, such as e-learning and mobile education, and the development of educational platforms. Various educational institutions around the world have adopted these patterns, and e-learning has spread widely and clearly (Amer, 2015).

Kenawy (2020) also indicates that the Covid-19 virus crisis accelerated the qualitative leap that scientists had predicted in their research for several years, and this transition to e-learning was expected to take place in the year (2050 or 2060), and then its occurrence in the year (2020) was a positive shock. This formed Lederman's belief that adoption and experimentation in emergencies will accelerate the adoption of online eLearning and other forms of technology-supported education (Lederman, 2020).

Basilaia and Kvavadze (2020) see that e-learning is a preparation process that targets to accomplish educational outcomes through the use of technological means that offer sound, image, and films, and interaction between the learner, content, and educational activities at the suitable time and time.

Al-Juhani (2021) stresses that e-learning is a modern educational method that aims to create an integrated educational environment and system through the delivery of information and educational content to the learner, whether it is within the scope of approved educational programs or training courses through means of communication, multimedia, and various information technologies. The recipient of the information becomes as if she is in a traditional classroom where she has the opportunity to learn and interact with the teacher in various ways, and what distinguishes it from traditional education is that it is not restricted by time and time at all.

E-learning also takes one of the following patterns, which are considered the most common in educational literature:

First: Synchronous electronic learning, which means learning in which the student and teacher sit in front of electronic screens at the same time to discuss the learning material through chat rooms, or virtual classes. What distinguishes this type of education is that the student gets immediate feedback, through interaction in real-time for learning, as the benefits of face-to-face interaction cannot be ignored, whether it is in a classroom real or virtual. The discussions are engaging and informative for the whole class, even for those who are not participating, as the student can generate their perceptions by listening to different points of view (Al-Etrebi, 2020; Lal Kumar et al., 2019). It also achieves educational depth, as communication between students and teachers is permanent, ensuring progress and completion of the specified work on time. Assistance and this would maintain a balance in the learning process (Al-Juhani, 2021).

However, one of the challenges of synchronous electronic learning is its need for modern electronic devices, a good communication network, and subsequent technical problems. A good Internet connection is of great importance for both students and teachers, but one technical error may lead to temporary inconvenience or the occurrence of a major error since assignments have to be submitted online, so the student has to meet deadlines. Other times the network is bad and the internet is slow so students miss some important information (Ibrahim, 2017).

Some of the challenges that teachers may face in managing time. The schedule for conducting discussions and dialogues is limited and restricted, as the teacher determines the pace of learning, so all students are expected to learn and perform at the same speed, and this may be unfair for some, such as students who do not have enough time to keep up with the speed learning others (Nimer, 2021).

Based on the foregoing, the researchers define synchronous electronic learning as the learning that takes place when the students and the teacher are in two different places and at the same time, through direct interactive virtual meetings, at a rate of one class per week. This interaction is through using one of the virtual applications approved by the Ministry of Education such as Microsoft Teams, Zoom, or Google Classrooms.

Second: Asynchronous electronic learning, which does not require the student and teacher to be at the same time in front of screens, but by benefiting from previous experiences, or through the availability of educational material on CDs, and communication, may be via e-mail, or through educational forums. In this type of education, the student cannot get feedback, but she can only return to the educational material at any time she wants and organize her study time according to what she deems appropriate. Thus, students decide the speed of learning as this type of learning is characterized by a self-paced pace. Students learn at their own pace and have plenty of time to review notes and study carefully (Amer, 2018).

Despite this, challenges arise when employing asynchronous e-learning represented by isolation and it arises due to the interaction of students with computers and smartphones instead of their direct communication and interaction with each other. While some prefer a lack of interaction, this may become a cause for concern for others, as the lack of this human advantage can make students feel isolated, and also limits the scope for growth resulting from real-time interaction, feedback, and discussions (Khalifa, 2019). It also requires time management skills. Asynchronous education may seem easy, but most students lose interest halfway and fail to complete their assignments promptly. It is not easy to remain passionate about distance learning, especially without direct interaction with teachers and fellow students. (Al-Etrebi, 2020).

The researchers define asynchronous electronic education procedurally as the learning that takes place when the students and the teacher are in two unlike places and at the same time through direct interactive virtual meetings and at the rate of one class per week. This process of interaction is done through using one of the virtual applications approved by the Ministry of Education such as Microsoft Teams, Zoom, or Google Classrooms.

Third: Blended learning, which is seen as “a mixture of learning tools such as face-to-face interaction within the traditional classroom and synchronous and asynchronous learning in an integrated and effective manner” (Frederick, 2007, p, 75). John and Bagels (2012) also point out that blended learning is a hybrid model of e-learning that permits the presence of traditional teaching methods alongside modern e-learning resources and activities in one course.

The researchers define blended learning procedurally as the learning that takes place when traditional

education is combined with asynchronous e-learning. That is, the teacher presents the content of the subject to the students in the classroom in the first week, and the students watch the videos and perform the homework themselves, without direct communication with the teacher through the approved educational platform and at the rate of a class in the second week, which is known as the rotation system according to the plan of the Ministry of Education to return to face-to-face education for the academic year 2020/2021.

Therefore, blended e-learning is characterized by its ability to improve the level of quality, impact, and effectiveness of the educational process, as the teacher is not the only source for obtaining knowledge information. Rather, the student will be able to rely on him/herself and use the web to find the correct information (Younes, 2017).

The adoption of the blended learning method also helps reduce the degree of tension and distress that may accompany the members of the educational process as a result of always being associated with time and place and punishment based on measuring the ability to memorize and memorization only through the application of blended education; the student will feel that she is a productive person capable of obtaining scientific information by him/herself. Then, the degree of her self-satisfaction increases, and her confidence in the ability to acquire knowledge, knowledge, and understanding increases (Amer, 2018).

Basilaia and Kvavadze (2020) indicate that learning and teaching through e-learning environments allow for effective participation of students among themselves on the one hand, and between them and the teacher on the other hand through the exchange of information, messages, and experiences through forums, electronic platforms, and chat rooms. Therefore, this participation has a strong impact on the student's personality in a way that enhances the growth of her passion and crystallizes it accurately.

Passion is one of the positive variables that have been framed recently in the academic and cognitive context after it was widely used in positive psychology. The concept of passion has been linked to positive practices and outcomes, such as a commitment to hard work, goals of achievement, and learning for mastery (Hernández et al., 2020).

Blakistun (2010) shows that fostering a passion for education contributes to providing students with eLearning skills, and helps in the presence of a strong motivation that pushes students towards acquiring knowledge and skill and generates a strong desire to acquire new knowledge. This is a clear indication of the existence of a reciprocal relationship between E-education and passion. Coleman and Guo (2013) also mentioned the term "passion for learning" instead of just "passion" to refer to its connection with education and students' interests in a particular field of study, in addition to teachers' passion for teaching, or their passion for the topic they are looking for.

Altun (2017) points out that there is a strong link between passionate teaching and learning. If learners realize that the teacher talks care of what they are doing, students take the learning process seriously, and at this point, teaching is no longer a forced act but turns out to be an inspiration for learners. If a collaborative learning environment is not formed, respect and trust cannot be built between the teacher and the learners, and if the learners do not know how to adopt the things they have learned in their real life, their motivation to learn cannot be increased.

Passion is related to student performance, intentional practice, aim orientation, motivation to learn, flexibility, and well-being, and as student passion increases, self-efficacy increases and therefore improvement in the outcome (Gilal et al., 2019).

Passion is defined by Vallerand et al. (2003) as a strong tendency toward a self-limiting activity that an individual loves, finds significant, and in which she regularly invests time and energy. Emotional activities become so self-limiting that they are central features of an individual's identity; for example, those who are passionate about playing basketball, writing songs, or conducting virtual science experiments not only participate in these activities, but see themselves as football players, songwriters, or scientists.

Jachimowicz et al., (2018) assert that passion is a strong feeling towards an important personal value or preference that stimulates behavior to express that value or preference. The presence of this strong feeling means that passion is a powerful emotional state, which has beneficial effects on performance through engagement deep into something.

As Sigmundsson et al., (2020) indicate that passion means desire or enthusiasm for something, so it is one of the explanations for why some individuals spend a lot of time, effort, and hard work towards achieving the task, activity, or skill. It should be noted that it can determine the nature of the activities that people are passionate about. When science is a passion for a human being, and learning is the goal she seeks to achieve; then she is distinguished by her scientific passion.

Carbonneau et al., (2008) define scientific passion as practice, research, and achievement in science. It is the first happiness of a person, as the passion for this activity does not stop at the limits of engaging in it, but goes beyond it until it becomes an inherent part of the human identity and a way to define herself.

Scientific passion is also a tendency of the individual towards a particular activity. There are two key

components of passion; the emotional component, which comprises the individual's strong admiration for activity, and the cognitive component, which includes the integration of this activity into the identity of the individual, which leads to the individual achieving a set of emotional outcomes, including satisfaction, integration, and happiness. (Curran et al., 2015).

It also becomes clear that the psychological structure of scientific passion consists of three elements and the interactions between them. The first is the astonishment that the individual experiences when facing the unknown, which provides her with the desire and energy to search for the answer so it is the backbone of all research and the beginning of all knowledge. Therefore, it must be invested and fetched frequently in order to motivate the mind to continue searching. The second element is the love of questioning, which expresses an innate willingness that is born with the human being, and it is the tool of certainty based on the doors of the search for truth, which grows by training, and its mental motivation is based on what is called the passion for curiosity that is manifested in the behavior of the individual whom her questions about the world around her do not stop. The third element is curiosity, which is the first driver of an individual's behavior toward knowledge and understanding, and thus the discovery of the elements of the environment and the desire to explore the surrounding world. Also, scientists consider curiosity as one of the stages of information processing; It is an influential factor in various aspects of individual learning and the search for knowledge, and its role in the creativity of individuals. Those who think innovatively are distinguished by their scientific passion, searching for everything new, and reconsidering the familiar (Carbonneau et al., 2008; Mageau et al., 2009).

The importance of passion for the student is that it helps to achieve positive results, as it provides the student with the necessary positive energy to overcome the challenges she faces and helps in achieving the largest possible amount of the learning and teaching process, thus improving the level of students' performance and their attitude towards education in general, and in a manner that achieves the principle of the transmission of the impact of learning and the resistance to forgetting, which ensures sustainable learning for life (Youssef, 2020; Al-Ajmi, 2017).

In addition, passion contributes to stimulating many factors that lead the student to success, such as innovation, achievement, time management, ambition, invention, professional success, positive trends, independence, and enjoyment of life (Al-Hawari and Ghayath, 2018).

The process of developing passion in general and scientific passion in particular among students can be clarified by focusing on the following five steps as mentioned by (Youssef, 2020; Dalpe, 2019; Krebs & Zvi 2020). The first is that students do not deal with academic subjects, especially scientific ones, as tests only, which means that dealing with academic subjects must be linked primarily to the search for knowledge. When we talk about the passion for learning, we can mention the search for knowledge as a strong example of the passion for learning, since the search for knowledge is one of the things that we all care about, asking about the universe and its greatness, trying to understand physical laws, solving mathematical problems, or installing devices the human body and its functions, or the anatomy of living things are all examples of things some do because she loves them and loves to know about them.

Furthermore, attention must be paid to an understanding before memorizing as a second step because understanding helps the student to understand what she learns, and the breadth of her perceptions in dealing with things around her. Besides, understanding helps to develop a passion for learning, and it will make the student learn many things, even if she thinks that she will not use them later, but this information will be positively reflected on her personality, so the student must continue the journey of searching for knowledge, by asking questions, and searching for answers by herself to make her an active learner, love science more because in this case, she plays the role of the researcher and the investigator, not just a recipient.

As for the third step, it lies in defining the beliefs and ideas that help the student develop her passion (such as believing in her ability to develop her passion, believing that a person can find time to practice her favorite activities, and achieving her goals if she wants to, ... etc.) and write down these thoughts, and put them in a place you always see, to remember them and be constantly aware of them, and be sure to protect yourself from thoughts and beliefs that may hinder the development of your passion.

The fourth step is to identify the beneficial practices that you do in your life and help you develop your passion (such as managing priorities, maintaining determination despite failure, eliminating distractions that waste time, etc.) so that you can maintain and develop them continuously. Practices that you will continue to develop, guarantee you more success.

While the last step requires devoting more time to developing your skill, practicing activities related to your passion, and making sure that you manage and invest your time in an effective and balanced manner.

This is a clear indication that arousing students' passion for educational attitudes and activities is an important factor in the success of the learning and teaching process. Therefore, it is necessary to arouse the students' passion in a way that attracts their attention and add an atmosphere of fun and enjoyment to the

scientific material, especially since the scientific materials are characterized by rigidity, which requires the teacher to practice how to arouse and develop the students' passion with positive effects on their interests, tendencies, abilities and life practices in general. And their passion for scientific activities in particular.

Based on the previous, it can be said that scientific passion is the student's strong tendency towards her favorite, meaningful, and valuable scientific activities in which she finds herself. She invests most of her time and energy and finds in their pleasure and luxury until it becomes part of her identity to achieve a purposeful and balanced life. This is measured by the degree she obtains on the scientific passion scale prepared for this purpose after completing the study of the prescribed educational material.

Given the conditions that the entire world is currently experiencing, such as the spread of the Coronavirus (Covid-19). Educational institutions have moved towards e-learning, using electronic educational platforms, the Internet, smartphones, and computers to communicate with students remotely to ensure the continuity of the learning and teaching process.

This is in addition to the technological changes of the era and digital technology. In light of the great technological development and with the spread of modern means of communication, it has become necessary to review the educational systems of the elements of the entire educational system to take advantage of these developments, and to employ them in the educational process; e-learning plays an essential role in the success of the educational process.

Therefore, the Ministry of Education relied on the National Strategy for Human Resources Development (2016-2025) concerning the axis of basic and secondary education, which refers to the promotion of the use of technology to modernize education and learning. The strategic plan of the Ministry of Education (2018-2022) emerged from it, which emphasized the quality of the education system through the component of information and communication technology in education, represented in the preparation of electronic content and developed learning resources, and the continuation of the development of learning management and electronic content management, which reached its climax in 2019; it has established Darsak platform, a free Jordanian distance learning platform, that provides school students from the first grade to the second grade of secondary education through educational lessons through video clips organized and scheduled according to the Jordanian education curriculum, provided by a group of distinguished teachers, to follow up on their learning materials by the teachers. Academic studies, as well as the size of the developments that have taken place on the platform as a result of the feedback; to become an interactive electronic platform by the start of the school year 2021/2022.

The Ministry of Education has also prepared a back-to-school guide for the 2020/2021 school year, which clarifies the four approved models of education, which are the same ones dealt with in this research (Ministry of Education, 2020).

Thus, the importance of this research lies as a qualitative addition to educational literature, given the novelty of the topic of passion globally and its scarcity in the Arab world, within the limits of what was viewed through search engines, not to mention its framing in the field of education, in addition to that it is the first Arab research to address scientific passion in the field of education after it was widely used in positive psychology. Therefore, the problem of the study is determined to investigate the effect of e-learning models on developing scientific passion among ninth-grade students in Biology.

2. LITERATURE REVIEW

Different studies dealt with passion in the field of education and teaching. In this regard, Ratelle's study (2021) clarified the part of the binary model of passion in explaining the academic performance of university students, by identifying indicators of defining passion towards individual studies and comparing the academic performance of students as a function of the definition of passion. The levels of academic performance vary according to the four passion indices: high, moderate, low, and ideal. Highly motivated students (with high and idealistic profiles) stated the most positive indicators of academic performance while students at the low level showed the worst levels of academic performance; Therefore, it is recommended to understand the educational factors that support the development and development of passion among students.

Al-Daba'a (2021) aimed to reveal the level of academic passion in light of the binary model among students of the Master's Program in Special Education at King Khalid University according to some demographic variables. Findings indicated that the level of academic passion and harmonious passion was high whereas obsessive passion was medium. Therefore, it is recommended to hold educational seminars and workshops to develop students' awareness of the importance of a harmonious passion for their studies.

Jarrah and Al-Rabee (2020) intended to reveal the relationship between academic passion and academic burnout concerning variables: gender, profession, academic program, and income level. The sample of the study was (230) students enrolled in the masters and doctoral programs at Yarmouk University. Results

showed that the level of passion by revealing the relationship between academic passion and academic burnout varies, so it is recommended to instill a spirit of hope among student teachers in a better academic future, which helps to keep the student passionate about his studies.

Taha (2020) examined the causal relationships between optimism, hope, academic passion, and academic integration among a sample of (212) third-year students registered for the academic year (2018-2019) at the Faculty of Education, Ain Shams University. Results confirmed the presence of direct effects statistically significant for optimism on the two dimensions of academic passion; hence, it is advised to develop the academic passion among students about optimism, hope, and academic integration.

Ruiz-Alfonso and Leon (2019) aimed to reveal the correlation between teaching quality and students' harmonious passion, deep strategy to learn, and cognitive curiosity in mathematics. The sample of the study was (1003) high school students in Spain. Findings showed that the quality of teaching, in particular, lies in presenting the ideal challenge, focusing on the educational process, and providing positive feedback in line with the students' harmonious passion. It also showed that the prediction of students' harmonious passion at the individual and class levels is done through students' deep learning strategy and students' cognitive curiosity.

By reviewing the previous literature, it was noted that the employment of passion in the field of education has recently begun at the global level, with the scarcity of studies at the Arab level. The previous studies agreed that they dealt with passion in general in the field of education and teaching as in the study such as (Ratelle & Bélange, 2021) and (Ruiz-Alfonso & Leon) while the study of (Jarrah and Al-Rabee, 2020) combined academic passion and academic burnout, and the study of (Taha, 2020) combined between academic passion and academic integration.

While this study dealt with passion in the field of education and framed it in the scientific field in particular to know the effect of e-learning models in developing scientific passion among students of the ninth-grade in

Biology. In light of the orientation of educational institutions in Jordan to e-learning due to the exceptional circumstance, it is the spread of the Coronavirus (Covid-19) adopting the quasi-experimental method in studying these variables.

3. METHODOLOGY

To reach the purpose of the study, the quasi-experimental approach was used. The study sample consisted of (164) female students of the ninth grade at Aisha Umm Al-Muminin Elementary School for Girls. A sample consisting of (4) sections was randomly selected, and then randomly distributed to the four groups. Table (1) illustrates the distribution of study sample members according to the type of treatment.

Table 1. Distribution of the Study Sample by Type of Treatment

Group	Type of Treatment	No.
First	Synchronous e-learning	41
Second	Asynchronous e-learning	42
Third	Blended Learning	41
Fourth	Regular Education	40
Total		**164**

There was also a need to develop a scale of scientific passion because there are no Arab scales for scientific passion. It has been developed based on several sources, including theoretical literature and the theory of (Vallerand, 2010) about passion in general. Some scales were prepared in various areas of passion, such as (Sigmundsson et al., 2020; Vallerand et al., 2003), as well as asking open questions to a random sample of ninth-grade students, including What does scientific activity mean to you? Do you have a passion for this activity? What is the evidence for that? Does your passion for scientific activity bring happiness and well-being? What are the manifestations of that? Accordingly, the concept of scientific passion was procedurally defined, and (25) items describing scientific passion were formulated. A five-graded Likert scale was used, ranging from (strongly agree) to (strongly disagree), which represents the numbers (5-1) in order. In order to verify the psychometric properties of the scientific passion scale, the internal consistency of the scale was calculated by finding the correlation of the degree of each item with the total score of the scale, using Pearson's correlation coefficients. Table (2) shows this.

Table 2. Correlation Coefficients of the Items of the Scientific Passion Scale with the Total Score of the Scale

Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient
1	.460**	6	.584**	11	.484**	16	.596**	21	.627**
2	.470**	7	.550**	12	.527**	17	.508**	22	.586**
3	.479**	8	.477**	13	.508**	18	.588**	23	.548**
4	.541**	9	.546**	14	.596**	19	.543**	24	.558**
5	.466**	10	.481**	15	.562**	20	.586**	25	.596**

It is evident from Table (2) that all the reliability coefficients between the total score of the scale and the item score ranged between (0.460-0.627), and all coefficients were statistically significant at the significance level ($\alpha = 0.01$). This indicates that the internal consistency between the items constituting the scale is acceptable and that it is structurally valid, and is valid for application to the members of the main study sample.

The reliability of the scale was also verified by calculating the internal consistency coefficient in terms of the alpha-Cronbach equation on the scale as a whole. After applying the scale to an exploratory sample consisting of (40) students from the study community and from outside the study sample, its value was (0.803), and thus it can be said that the scale has appropriate and acceptable reliability values for application to the main study sample.

Statistical analysis software (SPSS) was used to analyze the data, mean scores and standard deviations were calculated. A one-way ANCOVA test was used to extract effect size, and a Scheffe test for dimensional comparisons was also used.

4. RESULTS AND DISCUSSIONS

To respond to the study question, what is the effect of e-learning models (synchronous e-learning, asynchronous e-learning, blended learning) and regular education on developing scientific passion among ninth grade students in Biology?

Mean scores and standard deviations of the responses of the ninth-grade students in Biology to the post application of the scientific passion scale were calculated according to the electronic and regular education models. The results are revealed in Table (3).

Table 3. Mean Scores and Standard Deviations of the Responses of the Ninth-Grade Students in Biology to the Post-Application of the Scientific Passion Scale according to E-Learning and Regular Education Models

Education Models	No.	Mark	Pre-application		Post-application	
			Mean Score	Standard Deviation	Mean Score	Standard Deviation
Synchronous E-Learning	41	5	3.65	0.31	4.31	0.31
Asynchronous E-Learning	42		3.67	0.33	4.03	0.32
Blended Learning	41		3.65	0.32	4.22	0.32
Regular Education	40		3.65	0.32	3.67	0.32

Table (3) shows the mean scores for the post-application of the scientific passion scale for the groups that were taught according to the e-learning and regular education models. The average scientific passion for the students who were taught according to the synchronous, asynchronous, and blended learning models, respectively, reached (4.31), (4.03), (4.22), while the average scientific passion for the students who were

taught according to the regular education strategy was (3.67). The standard deviations for the four groups were (0.31), (0.32), (0.32), (0.32), respectively. It is noted that there are apparent differences between the averages of the post-application of the scientific passion scale in the four groups. The highest averages were for the first experimental group who studied according to the synchronous e-learning model, followed by the third experimental group who studied according to the blended learning model, then the second experimental group who studied according to asynchronous e-learning, and the lowest was for the fourth control group, who studied according to the regular education. Therefore, the standard deviations are different for the four groups, but these differences need to be tested for their statistical significance, which led to the use of (One-Way ANCOVA). These results are offered in Table (4).

Table 4. Results of a One-Way ANCOVA to Examine the Effect of E- and Regular Learning Models on Developing a Scientific Passion for the Ninth-Grade Female Students in Biology

Source of Variance	Total Squares	df	Squares Means	*F*	Sig.	Eta square value
Pre-application of the Test	14.521	1	14.521	1295.377	0.000	
Education Models	9.875	3	3.292	293.646	0.000*	0.847
Error	1.782	159	0.011			
Total	26.03	163				

* Statistically significant at ($\alpha \leq 0.05$).

Table (4) indicates that there is a statistically significant effect at the significance level ($\alpha \leq 0.05$) of elearning models (synchronous e-learning, asynchronous e-learning, blended education) and regular education in developing scientific passion among ninth-grade students in Biology, as this result can be inferred through the calculated (F) value of (293.646) with a significance level of (0.000) which is less than the level of significance (0.05), and therefore rejecting the first null hypothesis which states that "there is no statistically significant effect at the level of significance." ($\alpha \leq 0.05$) for e-learning models (synchronous e-learning, asynchronous elearning, blended education) and regular education in developing scientific passion among ninth-grade students in Biology, and accepting the alternative hypothesis which states that "there is a statistically significant effect at the significance level ($\alpha \leq 0.05$) of e-learning models (synchronous e-learning, asynchronous e-learning, blended e-learning) and regular education in developing scientific passion among ninth-grade students in Biology ".

The table also shows that the value of the ETA square (practical significance) for the e- and regular education models in developing scientific passion among the ninth-grade female students in Biology indicates that the effect size has reached (0.847), which is a size with a high impact, and it means that its percentage (84.7%) of the discrepancy in developing scientific passion is due to e-learning models, and the remaining percentage (15.3%) is due to other factors not investigated in the current study.

Because of differences due to the effect of e- and regular education models in developing scientific passion among ninth-grade students in Biology, the modified mean scores and their standard errors were extracted. Table (5) shows these results.

Table 5. Results of the Modified Mean Scores and Standard Errors of the Responses of the Ninth- Grade Students in Biology to the Post-Application of the Scientific Passion scale according to E- and Regular Education Models

Education Models	No.	Mark	Modified Mean Score	Standard Error
Synchronous E-Learning	41	5	4.32	0.02
Asynchronous E-Learning	42		4.02	0.02
Blended Learning	41		4.22	0.02
Regular Education	40		3.68	0.02

Table (5) shows the modified mean scores for the post-application of the scientific passion scale for the groups who were taught according to the e-learning and regular education models. The average scientific passion of the students who were taught according to the synchronous, asynchronous, and blended e-learning models, respectively, reached (4.32), (4.02), (4.22), while the average scientific passion of the students who were taught according to the regular education strategy was (3.68). The standard errors of the four groups were one (0.02).

The researchers used the Sheffe test for post hoc comparisons. To reveal the source of these differences. Table (6) shows these results.

Table 6. Scheffe's Post-Comparison Test Results to Determine the Source of Differences in the Development of Scientific Passion among Ninth-Grade Students in Biology according to E- and Regular Education Models

Education Models	Mean Score	Synchronous E-Learning	Blended Learning	Asynchronous E-Learning	Regular Learning
		4.32	4.22	4.02	3.68
Synchronous E-Learning	4.32	-	0.10*	0.30*	0.64*
Blended Learning	4.22		-	0.20*	0.45*
Asynchronous E-Learning	4.02			-	0.34*
Regular Learning	3.68				-

* The difference is statistically significant at ($\alpha \leq 0.05$).

The results of the Scheffe test shown in Table (6) indicate that the source of the differences in the development of scientific passion among the ninth-grade female students in Biology is due to the synchronous eLearning model versus both asynchronous, blended and regular e-learning models, and in favor of the blended learning model when compared with the asynchronous and regular e-learning models, and in favor of the asynchronous e-learning model when compared with the regular education model.

This result can be attributed to the fact that the synchronous e-learning model, with its interactive multimedia-supported learning, enhanced the students' passion for the learning process itself, saturated their tendencies, interests, and abilities, and created the desire to continue learning and spend more time. The interactive, collaborative and competitive e-learning environment contributed to creating new knowledge and ideas about their favorite, meaningful, and valuable scientific activities that are consistent with other life

activities in which they found themselves, which brought them pleasure and well-being until it became part of their identity.

This result can also be clarified by the fact that the synchronous e-learning model requires the use of digital culture tools. The student's participation in the journey of searching for knowledge for their passionate scientific activity through forums, electronic platforms, digital libraries, search engines, and chat rooms affected the students' personalities in a way that accurately enhanced their passion and crystallized. In addition to the interaction with others, the immediate feedback that the students receive from the teacher about their educational progress, and the correctness of their answers to the evaluation questions asked, which made the students feel positive and self-confident and gave them a sense of independence. This made them accept learning with passion and spend long periods in learning without feeling bored, as the students' interest in a favorite scientific activity resulted in an internal and external motivational force that pushed them to engage in that activity with a strong passion.

Moreover, these differences came in favor of the third experimental group that studied using the blended eLearning model versus both asynchronous e-learning and regular education. This result can be clarified by the fact that the blended e-learning model consists of face-to-face instruction in the traditional classroom, either individually or collectively, and asynchronous e-learning, and thus it combines the advantages of both of them. The student in the blended e-learning is self-learning in line with her abilities and capabilities and the nature of the activities she is passionate about, and with the presence of a digital electronic environment that presents the study material and various activities through technological means that provide sound and image, and films that take into account her learning style, and with an interaction between the student and the content and the timely educational and educational activities. This made the student feel her responsibility towards learning, and her desire to continue the scientific activity that was the source of pleasure and happiness, and to reinforce this learning and passion in the classroom the following week, through the feedback and reinforcement that she gets from the teacher, interaction with others and opportunities to form friendships and enhance interactions and social engagement.

Furthermore, these differences came in favor of the second experimental group that studied using the asynchronous e-learning model compared to regular education. The result can be attributed to the freedom and flexibility that the asynchronous e-learning model enjoys. There are no restrictions on time or place, as it allows the student to determine the date of her study according to what suits her within an electronic learning environment rich in the interaction between her and her favorite activity. If she participates in an activity of her own free and freedom and acquires cognitive and performance skills and a sense of competence and achievement, then she becomes passionate about this activity, especially if it satisfies her basic psychological needs, and enhances her sense of self and independence in learning.

This result of the current study is consistent with the result of (Ratelle & Bélanger, 2021), which showed the presence of four indicators of passion among students while the level of obsessive passion is medium, and there are statistically significant differences in harmonious passion in favor of females. Besides, Jarrah and AlRabee (2020) showed that the level of harmonious passion among the sample members was high while the level of obsessive passion was average.

This result is also in agreement with the content of the results of Taha's study (2020), which resulted in direct statistically significant effects of optimism on the two dimensions of academic passion. The study of Ruiz-Alfonso and Leon (2019), which concluded that the quality of teaching specifically lies in In presenting the optimal challenge, and providing positive feedback in line with the students' harmonious passion.

5. CONCLUSION

There is an average effect of e-learning models compared to regular education in developing scientific passion among ninth-grade students in the subject of Biology. The interrelationship between e-learning and passion can be explained in that interactive multimedia learning enhances the individual's passion for the learning process itself, satisfies her inclinations, interests, and abilities. It also creates the desire to continue learning and spend the most time, and the collaborative interactive e-learning environment contributes to the creation of knowledge and new ideas. While the student has passion, this pushes here to acquire e-learning skills, master its tools and navigate the web, armed with digital culture and its skills in the ever-changing knowledge society.

6. RECOMMENDATIONS

Develop a strategic plan to promote e-learning, digital culture, and digital transformation in educational institutions to invest in modern communication technologies in supporting and developing educational technologies.

Include standards of scientific passion in curricula and textbooks, and plan training programs to develop the capabilities of the teaching staff on how to develop them among students.

Planning training programs to direct the students' passion in line with their studies and future jobs through educational and career guidance.

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