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The Impact of E-Learning Management Systems on Tenth-Grade Students' Academic Achievement in Chemistry

Sabah Jamil Al-Nawaiseh

Department of Educational Technology, Faculty of Arts and Educational Sciences, Middle East University, Amman, Jordan.

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*Corresponding author: Sabah Jamil Al-Nawaiseh

Department of Educational Technology, Faculty of Arts and Educational Sciences, Middle East University, Amman, Jordan.

Abstract

This study aimed to investigate The Impact of E-learning Management Systems on Tenth-Grade Students' Academic Achievement in Chemistry, A quasi-experimental approach was employed by dividing the sample into the experimental and the control groups. The sample included (49) randomly selected 10th-grade students from international independent schools. with 23 students in the experimental group and 26 in the control group. The findings revealed a positive impact on students' chemistry achievement due to the teaching method used for the experimental group, which was studied through the E-learning Management system, indicating that the difference in chemistry achievement was in favor of the experimental group. The researchers attributed this outcome to the features of the E-learning Management system, which allowed students to learn at their own pace and according to their abilities, transcending the constraints of time and space while accommodating individual differences.

Keywords: E-learning Management System; Chemistry; Achievement

1. Introduction

The world is witnessing significant developments in various fields of science, including education, which has seen considerable growth due to the focus on nurturing individuals and developing their abilities, helping prepare a generation capable of keeping up with rapid advancements, equipped with thinking and problem-solving skills, and creativity)Al-Nawaiseh et al., 2024).

Continued scientific progress and tremendous technological development have led educators to search for the best and most effective ways to provide interactive learning environments to attract students' attention and urge them to share experiences and opinions (Al-Said et al., 2024). As the world enters the so-called

digital age, education and learning have become accessible anytime, anywhere, as computer-assisted learning is a modern learning pattern based on programs known as educational software and aimed at excitingly delivering educational material, leading the learner step-by-step towards learning (Ali, 2020).

E-learning is an influential technological advancement, which has contributed to the progress and advancement of states, as confirmed by most educational studies, which pointed out the importance of using technology because of its significant positive implications for promoting education (Szymkowiak et al., 2021).

The issues of low student achievement in chemistry and weak student motivation for learning are considered long-standing modern problems. This is attributed to the fact that most teaching strategies in chemistry rely on direct indoctrination, without taking into account students' interests, abilities, and desires, which has led to a decline in their academic performance (Teppo, Soobard & Rannikmäe, 2021).

Chemistry is a scientific subject rich in concepts and terminology, which needs imagination and creativity (McLeish, 2019). The use of interactive electronic curricula and E-learning Management System may contribute to the acquisition and development of scientific thinking skills among students as well as increase their motivation for learning, as confirmed by most studies when reviewing theoretical literature (Tabieh et al., 2021).

Therefore, This study came from the assumption based on global experiences, which supports that traditional educational systems can be emulated in proportion to the development of educational systems based on the technology of e-learning, which may contribute positively to improving student achievement systematically, as well as developing scientific thinking skills by enhancing their motivation for learning in chemistry, but this study takes into account the acceptance of these new E-learning systems based on the model of acceptance form in the design of current study tools.

2. Theoretical Framework & Literature Review

Education technology plays a major role in the education process, and this importance is reflected in enhancing the level of education, learning, and cognitive development. E-learning systems are online-based applications or technology programs that are used to plan, implement, and evaluate a specific learning process. The smart learning system usually provides the teacher with a way to create and deliver content, monitor student participation, and performance evaluations (Alzahrani & Alhalafawy, 2022). The learning system can provide students with the ability to use interactive features, such as topic discussion, visual meetings, and discussion forums (Cantabella et al., 2019).

2.1 E-learning Management Systems

E-learning is a form of learning, a computer-focused means of transmitting information, the idea is to develop programs that can help the user get knowledge by presenting the necessary facts about a specific problem, e-learning offers a variety of ways to provide information, for example, students can read texts, examine images, and listen to clarification to the point of interacting with the system, this leads to an improvement in the retention of information; individuals remember 10% of what they read, 20% of what they see, and 40% of what they see and hear (Lavrentieva et al., 2020).

E-learning Management systems are the umbrella, the fertile ground for the use of various e-learning tools and the delivery of educational content, and the educational message to learners each by their use, transcending the limits of time and space in an interesting interactive environment, which reflects positively on learners, allows teachers to manage, and to supervise the educational process easily (Al-Otaibi, 2019). Peter & Shane (2016) defined it as server-based application software that manages online e-learning regardless of time and space. However, E-learning forms varied by purpose, or devices used. Amity (2020) referred to two main types: Online e-learning in both types: synchronized or unsynchronized.

Science teachers in general, and chemistry in particular, have a great responsibility to seek solutions that help to deeply understand scientific concepts and knowledge, as scientific concepts are the building block of scientific knowledge, and their meaningful composition in a meaningful way is critical because it is learning based on the accumulation of knowledge that continues (Bellová, Melicherčíková & Tomčík, 2018). It can therefore be noted that science education in general and chemistry in particular, requires allowing students to build their understanding and gain scientific thinking skills and thus shape their knowledge (Awad, 2017).

The theoretical framework for the relationship between education technology and the E-learning Management Systems for chemistry education was still based on system and content development. and the success of its application was based on the experiences gained by chemistry teachers in the development of relevant digital bags, and the direction of both students and teachers towards accepting technological change, noting the ability of the school administration to develop its vision and implement it in the of electronic learning systems for chemistry teachers for various educational stages (Al-Nawaiseh et al., 2024).

To ensure the success of the experience based on the acceptance factors of technological change, students and teachers alike must be trained to use ICT in the educational process, through teaching methods and methods that support their experiences. Therefore, integrated electronic learning systems must be smart in that teaching staff students, parents, and school (Ahmad et al., 2023) share all elements of the educational process.

Many studies have dropped the technology acceptance model and elements, to study students' acceptance of new technologies (Salloum, 2018) (Granić & Marangunić, 2019).

The desired benefit and ease of use were important factors for the acceptance and use of digital technology in education, and computer skills were an important factor in the use of that technology.

2.2 Academic Achievement

The concept of student achievement indicates the extent to which students have achieved their learning outcomes, because of having experienced a certain teaching experience, which reveals to us how advanced students are towards certain goals (Alhadabi, & Karpinski, 2020). Therefore, the level of student achievement is one of the most important educational topics and is one of the most important measures of academic performance learning outcomes, and interest in measuring student achievement has increased, especially with increased accountability for classroom teachers in the light of the overall quality control standards governing the educational process. The teacher's ultimate goal is to improve the academic capacity of students and prepare them for the next stage.

The quality of education, learning achievement, and teacher quality all contain complex elements and a closely related level, through observable and measured qualities, as well as elements that cannot be observed or indirectly observable; Accordingly, student achievement can be linked to educational practices and attitudes, designed to develop students' cognitive and inference abilities more effectively, so that teachers adopt educational attitudes to build knowledge rather than just transfer it (Fauth et al.,2020).

In line with technological developments and their uses in the educational process, many efforts have emerged to explore innovative and effective teaching methods and methods in the classroom and to manage educational attitudes. Learning Management Systems based on modern technologies is an adjunct educational model that has received a lot of attention in recent years (Duin & Tham, 2020). These Systems have provided an opportunity to help teachers and students achieve higher levels of learning goals (e.g. problem-solving and critical thinking skills (Adnot, 2017). However, their adoption may require different settings and specifications to achieve their desired results and enhance the active participation of students (Geng, Law& Niu, 2019). Although the use of learning systems (LMSs) has a long history in smart countries, it is completely new and innovative in developing countries (Cavus, Mohammed & Yakubu, 2021)

Studies indicate that educational systems around the world aspire to activate the role of Learning Management Systems in their curricula with an indispensable orientation in academic and vocational education (Adnot, 2017). The use of Learning Management Systems at higher levels of learner and teacher satisfaction also improves knowledge, self-awareness, understanding of concepts, and achieving curriculum goals (Almoeather, 2020). When Learning Management Systems are used in conjunction with traditional learning, this new model is often called Blended Learning (Suartama et al., 2019).

Many studies indicate the positive effects of co-education, a high degree of acceptance by students and teachers, as well as a positive impact of mixed learning on student achievement. However, activating and using Learning Management Systems requires a significant investment in time, planning, and specialized resources, and it is recognized as important to teachers and learners. Examples of such systems include the Modular Object-Oriented Dynamic Learning Environment(Moodle), a free open-source e-learning program that serves as a source of learning systems, LMSs, or a virtual learning environment, providing an environment that allows students to interact collaboratively as an independent program or can be used in addition to teaching in traditional classrooms (Adnot, 2017).

3. Problem Statement and Study Question

The interest of schools and teachers in the age of technology and knowledge has increased, focusing on providing the student with the opportunity to participate in the learning process, self-reliance to deal with technological means and communications, how to use them in the learning process, as well as providing the student with self-research skills, and extracting the necessary information using computers and the Internet efficiently and effectively (Lynch et al.,2021

Therefore, it has become necessary to choose modern teaching methods, achieve the objectives of the learning process, raise

educational achievement, invest in the usual educational techniques available in schools, as well as use new technologies and methods, the teacher uses to improve the learning process, as a result of the nutrition coming from the field by not activating the technological and technical potential of students and teachers, which has hurt student's achievement, their acquisition of thinking skills, and their motivation to learn (Al Nawaiseh et., al,2022)

Hence, there is a need to adopt an effective electronic learning system that meets the needs of school students and develops their 21st-century skills, as well as the needs of members of the two bodies: administrative and teaching, and parents, to the services provided by this system. Accordingly, the researchers developed an E-learning Management system and measured its impact on academic achievement, acquired scientific thinking skills, and student motivation to learn chemistry, and the study attempts to answer the following question:

Are there statistically significant differences in the academic performance of 10th-grade students in chemistry due to the teaching method the E-learning management system versus the traditional method?

3.1 Study Hypothesis:

H₀: There are no statistically significant differences at the ($\alpha \leq 0.05$) level in the academic performance of 10th-grade students in chemistry due to the teaching method (the E-learning Management System vs. the traditional method.

4. Methodology

4.1 Teaching design for the E-learning Management system:

Although educational systems are important and contribute to improving students' achievement by developing their scientific thinking abilities and motivating their motivation for learning, their effectiveness must be evaluated by developing appropriate models that take into account the technical, cultural, and environmental constraints involved, To assess and refine them in accordance with international standards. After reviewing educational literature and the researcher's review of previous studies on instructional design models such as the al-Ghamdi and Asiri studies (2018), Reda study (2018), and Al Mutahar Study (2017), the researcher designed the E-learning Management System following the TAM model and the ADDIE model. and the ADDIE model.

4.2 Research Design

A quasi-experimental design was used, thereby, using experimental and control groups with pre-and post-tests, A E-learning Management System was used to teach the " Periodic Table" unit in the experimental group. In the control group, the same unit was taught using traditional methods.

4.3 Sample and Data Collection

The study's population comprised all tenth-grade students at secondary schools (16–17 years old) who were studying at the International independent school in Jordan during the first semester of the academic year (2023–2024). Purposive sampling was used to select the study sample, which consisted of 49 participants. Study sample included two groups of students (experimental and control groups) consisting of (26) students taught using the smart-e-learning system, and a group of 23 students who were taught traditionally.

Achievement test: The researchers prepared a specialized achievement test for chemistry for students in the 10th grade in the

periodic table unit, to detect the impact of the smart learning system on achievement. The test consists of twenty-five multiple-choice items, with a total score of 25. The difficulty, ease, and discrimination indices were also calculated for the test items. The difficulty indices ranged from 0.25 to 0.71, which are appropriate and statistically significant. The discrimination indices for all test items were positive, ranging from 0.40 to 0.75, indicating that they were valid for use.

4.4 The Validity and Reliability

The test was presented to eight experts in the fields of chemistry, curricula, measurement, and evaluation. They were asked to provide feedback on the clarity of the test instructions. Their feedback was considered, and the necessary adjustments were made. To ensure the reliability and validity of the chemistry test for the current study, the test was administered to 30 students from the

study outside the study's sample. Cronbach's alpha coefficient reached a value of 0.79. This indicates that the test is well reliable and acceptable for this study.

5. Results

Results related to the answer to the question: "Are there statistically significant differences at the level ($\alpha \leq 0.05$) in the academic performance of 10th-grade students in chemistry due to the teaching method (E-learning Management System, the traditional method)?"

To answer this question, we calculated the averages and standard deviations of the grades of the experimental study groups (E-learning Management System) and the control (traditional method) of testing the academic performance of 10th graders in pre-test and post-test in chemistry.

Table 1. Average scores and standard deviations of the two study groups on the pre-test and post-test in chemistry.

Post-test		Pre-test		Number	Participants
Standard Deviation	Average	Standard Deviation	Average		
4.26	20.08	3.48	10.15	26	Experiment Group
6.29	12.17	2.48	7.39	23	Control Group
6.59	16.37	3.33	8.86	49	Total

Table 1 indicates that there are differences between averages in 10th-grade students' grades in the pre/post chemistry test depending on the teaching method (experimental, and traditional), and to determine if the differences between averages are

statistically significant at the level ($\alpha \leq 0.05$), the accompanying contrast analysis (ANCOVA) has been applied, and the results of the various analysis are as shown in table 2:

Table 2. ANCOVA analysis to find a difference in the grades of 10th graders pre-test and post-test in chemistry

(η^2) Partial ETA Square	Statistical significance	F	Mean Square	DF Degrees of Freedom	Sum of Squares	Source
.00	.96	.003	0.08	1	0.08	Pre-test Result
.324	.00*	22.03	634.69	1	634.69	Teaching Methodology
			28.81	46	1325.02	Error
				48	2087.39	Total Average

* Statistical significance at value ($\alpha \leq 0.05$)

Table 2 indicates statistically significant differences at value ($\alpha \leq 0.05$) in the grades of 10th graders in the chemistry test according to the teaching method (experimental, and normal), with the value of (F) (22,033) and a significant level (0.000), and to know the size of the impact the partial ETA square was extracted at (.324), which explains the ratio (32.4%). The difference in grades for 10th graders in chemistry testing is due to the teaching method, while the rest is due to other uncontrolled factors.

Table 3. Adjusted post-test averages and standard errors of 10th-grade grades in chemistry testing

Standard error	Adjusted average	Participants
1.10	20.09	Experimental Group
1.18	12.15	Control Group

Table 3 shows that the adjusted averages of 10th graders in the chemistry test of the experimental group, which was studied in the

E-learning Management System, amounted to (20.09) and the standard error (1.10). It is higher than the average calculation of the group studied in the usual manner of (12.15) and standard error (1.18), which means that the difference in the attainment test in chemistry was in favor of the experimental group studied in the E-learning system.

6. Discussion and Conclusion

The findings indicated a significant effect. Results showed an impact on the Academic Performance of 10th graders in chemistry as a result of the instructional approach used with the experimental group, which was studied using the E-learning Management System, and the researcher attributes the result to the use of the E-learning Management System, which enabled students in the experimental group to t their own pace and ability. Beyond the constraints of time and location, thereby ensuring the consideration of individual learner differences and diverse characteristics.

These findings can also be attributed to a varied presentation of electronic content through videos and multimedia, such as

presentations, written and spoken texts, as well as images, shapes, concept maps, scientific experiments, educational games, exercises, and other digital tools used in the e-learning system, whether synchronous or asynchronous, deviating from traditional methods, as students play an active role in acquiring knowledge, developing their ability to acquire, understand and analyze information. This may enhance research and investigative skills, collect and analyze data, helping to raise students' achievement. The ability to track learner progress and ensure quick access to correct responses.

The researchers also credit the outcome to the influence of the instructional method (the E-learning Management System, the usual) in the academic performance of the variety of mechanisms of instructional tools and timely feedback the immediate feeding review, and the ability to track learner progress and ensure quick access to correct responses first and foremost, and in the shortest possible time, this result also agrees with the study of the Khreiss (2018), which stressed the importance of generalizing the experience to all classes and materials.

The result is also due to the ease of use of the E-learning Management System, as it does not need any advanced expertise in computer skills, students can use it and activate it simply on their mobile phones or tablets, so it is easy to get information and facts about the educational material, which they study whether it is in the classroom or outside, and can be repeatedly seen what was displayed in the classroom anytime, anywhere, and in the way or style that helps them learn more.

The researcher attributes the superiority of the experimental group to the control of achievement that the teacher's use of the E-learning Management System enabled him to clarify scientific concepts easily by applying them in classroom classes, allowing him to diversify into teaching strategies, thereby getting out of the monotony of the usual methods of teaching, attracting students' attention to the subjects of the lessons provided, and therefore gaining information and concepts easily.

This result aligns with the Salem Study (2019), The Study by Tossy and Titus (2017), and the Amity study (2020). Salloum's study. (2018). Peter and Shane (2016) affirmed the positive impact of e-learning systems on achievement and recommended previous studies using e-learning in education.

7. Recommendations

Based on the study's findings, the researchers recommend that chemistry teachers leverage the positive impact of the E-learning Management System to enhance student achievement, foster the development of scientific thinking skills, and increase motivation among 10th grade students in all chemistry topics. It is further advised that the E-learning Management System Successfully applied to 10th grade students chemistry students, be extended to other topics and stages across schools.

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