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Titled

The effect of using the blended learning strategy on academic achievement

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Dedication

To the one who instilled in me the love of knowledge and encouraged me since childhood... to the one whose name I carry with pride, the esteemed educator... my beloved late father.

To the essence of love and dedication... to the one whose prayers were the secret of my success... and whose tenderness was the balm for my wounds... to the one who taught me to seek knowledge... my dear late mother.

Thanks, and appreciation

Praise be to God, first and last, for His abundant grace. I thank God who aided me, guided my steps, inspired my ambitions, and bestowed upon me the privilege of completing this thesis.

I extend my sincere gratitude and appreciation repeatedly to Professor Dr. Mohamed Saeed, who generously shared his vast knowledge and noble character with me. He was an exemplary supervisor, diligent in guiding the work with insightful ideas and valuable information. May God reward him well.

And God is the grantor of success.

I have noticed that no one writes a book in one day without thinking the next day: "If only this were different, it would have been better; if only this were added, it would be appreciated; if only this were prioritized, it would be best; if only this were omitted, it would be more beautiful." This reflects one of the greatest lessons and demonstrates the inherent shortcomings of humanity.

Imad Al-Isfahani

SUMMARY

This study aimed to explore the impact of blended learning and the use of virtual laboratories in teaching chemistry to secondary school .Blended learning is a method that combines traditional classroom learning with online learning , providing an integrated learning environment .The study include an analysis of the benefits of the method on the level of theoretical understanding and practical application among students, in addition to evaluating the impact of virtual laboratories that provide interactive chemical experiments and simulations of various chemical reaction .

The result showed that blended learning enhances students' understanding of chemical concept by combining the flexibility of online learning with direct instruction in classroom .Virtual laboratories also contributed to improving interactive experiences them to apply chemical theories more effectively.

The study recommendation adopting blended learning and virtual laboratories as an essential part of the chemistry curriculum , due to their positive impact in enhancing students' academic achievement and increasing their interaction with the subject matter.

Introduction:

Information and communication technology plays an important role in all aspects of life and has entered the educational system to address many challenges faced in the learning process, as well as to enhance the quality of education in order to achieve the best educational outcomes, particularly during the evaluation phase. Since today's generation is a technological one, education must adapt to this and benefit from various electronic applications to engage students in the learning environment. Therefore, the ministry established an electronic portal that includes everything a student needs and provided training for teachers on various teaching methods and strategies, such as flipped classrooms, virtual laboratories, and YouTube channels for explaining lessons and documenting experiments and assessments. This also allowed for discussions and evaluations to be conducted with parents.

E-learning has helped clarify the subject matter in detailed steps and short tasks that are manageable for learners. It has also encouraged students to learn anytime and anywhere according to their circumstances. At Stanford University, e-learning was implemented, and after ten years, it was found that about 50% of students enrolled in the program were able to complete it. This was attributed to the lack of social interaction between learners and instructors. As a result, traditional classroom sessions were added alongside e-learning, leading to a completion rate of 94%. This indicates that e-learning will not replace traditional education, human teachers, or the classroom setting.

Thus, the concept of blended learning emerged, combining traditional and e-learning. Blended learning has saved time for both teachers and

students, providing flexibility for learners to access educational content anytime and anywhere. It has addressed individual differences among students, encouraged self-directed and collaborative learning, and allowed learners to conduct experiments that are difficult to carry out in traditional labs electronically. Additionally, it has provided students with greater opportunities for interaction and participation.

The study Problem:

The researcher, as a specialist in chemical engineering, observes the following:

1. *Weak achievement in chemistry among third-year secondary students due to individual differences. The teacher explains the lesson in a traditional manner, which may not suit most students. It was discovered that the phenomenon of success in tests is often due to rote memorization before the exam without true understanding.*
2. *Weak practical skills due to teachers not conducting chemical experiments in front of students and students not performing these experiments themselves. Additionally, the lack of certain laboratory equipment and chemicals needed for conducting experiments contributes to this issue.*
3. *Lack of lasting impact from learning chemistry. Studies have shown that a person remembers only 13% of what they heard after a month, while they remember 70% of what they see and hear and 95% of what they actively engage in.*
4. *Students' reluctance to study chemistry arises from their anxiety when learning the subject, leading them to memorize it without understanding. Therefore, a teaching method is needed that contributes to developing positive attitudes towards studying this subject.*
5. *Students are not inclined toward self-directed learning in chemistry due to its perceived difficulty, relying solely on what the teacher explains. Furthermore, there is a lack of connection between the lessons and their applications in various aspects of life.*

The importance of studying:

1. ***Improving Scientific Understanding****: Blended learning combines traditional and electronic education, allowing students to have a more comprehensive and interactive learning experience. This helps simplify complex chemical concepts and makes them easier to understand.*
2. ***Enhancing Interaction and Participation****: By using interactive technologies such as simulations and virtual reality, students can engage more effectively with educational materials, increasing their participation and interest in the subject.*
3. ***Saving Learning Time****: Blended learning can save time by offering educational materials online, allowing students to study at their own pace and review content as needed.*
4. ***Developing Technical Skills****: Through the use of technology in education, students learn how to use digital tools and develop important technical skills that will benefit them in their academic and professional journeys.*
5. ***Promoting Collaborative Learning****: Blended learning provides platforms for collaborative learning, where students can work together on projects and group activities, enhancing teamwork and communication.*
6. ***Improving Access to Resources****: Blended learning allows students to access a wide range of educational resources online, including instructional videos, scientific articles, and interactive programs, further supporting the learning process.*

7. ***Responding to Individual Needs****: Blended learning programs can be designed to meet the individual needs of students, allowing them to learn at a pace and in a style that suits them.*

By integrating traditional education with modern technology, blended learning can make a significant difference in how chemistry is taught and achieve better educational outcomes.

Objectives of the study:

The objectives of the current study are as follows:

1. ***Improving Education Quality**: To assess the effectiveness of blended learning in enhancing students' understanding of complex chemical concepts compared to traditional education.*
2. ***Developing Student Skills**: To promote critical thinking and problem-solving skills among students by using interactive learning tools and simulations in chemistry education.*
3. ***Measuring Educational Efficiency**: To compare learning outcomes between students who study using blended learning and those who study through traditional methods, in order to measure the efficiency of blended education.*
4. ***Increasing Interaction and Participation**: To encourage students to engage and interact with the course material by applying an educational strategy that combines educational activities and digital resources.*
5. ***Achieving Personalized Learning**: To design and implement customized educational activities that meet individual student needs and monitor the impact of these activities on their academic progress.*
6. ***Enhancing Collaborative Learning**: To examine the role of blended learning in promoting collaborative learning among students and developing their teamwork and communication skills.*
7. ***Achieving Continuous Assessment**: To develop continuous and diverse assessment tools to measure student progress and analyze the results of these assessments to improve the educational process.*

8. ***Balancing Theoretical and Practical Education****: To achieve a balance between theoretical and practical aspects in chemistry by integrating laboratory and virtual activities, and studying their effect on student learning.*
9. ***Improving Student Motivation****: To study the impact of blended learning on motivating students and increasing their interest in chemistry through interactive activities and diverse content.*
10. ***Promoting Effective Use of Technology****: To investigate how to use various modern technological tools effectively to support chemistry learning and identify best practices for integrating technology into education.*

By achieving these objectives, the research can contribute to the development of effective educational strategies based on blending, which will enhance the learning experience for students in chemistry and improve their academic performance.

Study hypotheses and questions:

– Research Questions

1. *What is the impact of using the blended learning strategy on the academic achievement of secondary school students in chemistry?*
2. *What is the impact of using the blended learning strategy on the development of practical skills in chemistry among secondary school students?*
3. *What is the impact of using the blended learning strategy on the retention of learning in chemistry for secondary school students?*
4. *What is the impact of using the blended learning strategy on students' attitudes toward studying chemistry in secondary school?*

B – Research Hypotheses

In light of the research problem and questions, and by benefiting from the results of previous studies related to the study variables, the following hypotheses can be formulated:

1. *There are statistically significant differences at the level of ≤ 0.05 between the mean achievement scores of students studying with blended learning and those studying with traditional methods in the post-test, in favor of the experimental group.*
2. *There are statistically significant differences at the level of ≤ 0.05 between the mean pre-test and post-test achievement scores for students studying with blended learning, in favor of the post-test.*
3. *There are statistically significant differences at the level of ≤ 0.05 between the mean scores of students studying with blended learning*

and those studying with traditional methods in the practical skills observation checklist, in favor of the experimental group.

4. *There are statistically significant differences at the level of ≤ 0.05 between the mean pre-test and post-test scores of students studying with blended learning in the observation checklist, in favor of the post-test.*
5. *There are statistically significant differences at the level of ≤ 0.05 between the mean scores of the experimental group in the traditional chemistry lab and the virtual lab in the observation checklist, in favor of the virtual lab.*
6. *There are statistically significant differences at the level of ≤ 0.05 between the mean delayed test scores measuring the retention of learning between the experimental group and the control group, in favor of the experimental group.*
7. *There are statistically significant differences at the level of ≤ 0.05 between the mean delayed test scores and the post-test scores measuring the retention of learning for the experimental group, in favor of the delayed test.*
8. *There are statistically significant differences at the level of ≤ 0.05 between the mean scores of the experimental group and the control group in the scale measuring attitudes toward studying chemistry, in favor of the experimental group.*
9. *There are statistically significant differences at the level of ≤ 0.05 between the mean pre-test and post-test scores of students in the experimental group in the scale measuring attitudes toward studying chemistry, in favor of the post-test.*

Study Approach:

The current study used an experimental approach that focuses on whether the independent variable (blended learning) has an effect on the dependent variables (academic achievement, retention of learning, development of practical skills, self-directed learning, attitudes toward studying chemistry, and attitudes toward blended learning in teaching). This approach is based on pre-test and post-test experimental treatments ***through the following two groups:***

A. ***Experimental Group****: This group consists of students who study the content of the chemistry unit using blended learning.*

B. ***Control Group****: This group consists of students who study the same content using the usual methods in schools.*

The following table illustrates the experimental design of the study.

The limits of the study:

Spatial Boundaries*: Secondary schools in Alexandria Governorate.*

Temporal Boundaries*: A study unit from the chemistry textbook for third-year secondary students.*

Human Boundaries*: Third-year secondary students.*

Subject Boundaries*:*

1. *The use of blended learning in teaching the unit on electrochemistry prescribed for third-year secondary students.*
2. *Measuring the academic achievement of third-year secondary students in the electrochemistry unit at levels of thinking (recall, comprehension, application).*
3. *Measuring students' attitudes toward learning chemistry using the blended learning strategy.*
4. *Measuring students' skills in conducting laboratory experiments when using the blended learning strategy in teaching.*

Introductory Chapter

Theoretical Framework and Scientific Concepts

***Introduction**:*

This chapter aims to introduce the concepts related to blended learning, direct achievement, practical skills, retention of learning, and attitudes toward studying chemistry. The goal is to reach a comprehensive theoretical conceptual framework that serves as the basis for the field study. This chapter is divided into two sections: the first section addresses the theoretical framework, discussing the dimensions, advantages, strategies, success factors, learning theories underlying blended learning, challenges it faces, and steps for its implementation. The second section covers the scientific concepts of the terms used in the study.

Section One: Theoretical Framework

***Introduction**:*

Various forms of e-learning have emerged to meet the circumstances and needs of learners, providing different communication tools. This has led to making the learner the focus of the educational process instead of the teacher. Consequently, active learning and cooperative learning strategies have been activated, positively impacting the provision of educational services and contributing to achieving educational goals more effectively. Blended learning is one of the modern approaches that utilize information technology to design new educational situations.

Blended learning is generally defined as an educational system that takes advantage of all available technological resources and media by combining multiple methods and tools for learning, whether electronic or

traditional (Abu Khatwa, 2009). Ismail Hassan (2010) defines it as a teaching method aimed at helping learners achieve the targeted learning outcomes by integrating traditional forms of education with e-learning formats both inside and outside the classroom. Krause (2007) describes it as learning environments that achieve effective integration between various teaching methods, educational models, and learning strategies as a result of adopting a systematic strategic approach to utilizing technology and integrating it with the best features of face-to-face interaction.

First: Blended Learning

Definition of Blended Learning

Blended learning (Blended Learning) is known by many names, including mixed learning, hybrid learning, integrated learning, compound learning, multi-approach learning, and multi-methods learning. The variety in these terms arises from differing perspectives on the definition and nature of blended learning.

Khamis (2003) defined it as an integrated system aimed at assisting the learner throughout all stages of their learning, combining traditional education with various forms of e-learning within the classroom.

Aleksey and Chris (2004) defined it as a type of education that utilizes an effective combination of multiple delivery methods, teaching strategies, and learning styles that facilitate the processes of teaching and learning. Blending is based on mixing traditional methods, where students meet face-to-face with their teacher, with e-learning approaches.

Oliver and Trigwell (2005) viewed blended learning as the comprehensive integration of both traditional education and e-learning, alongside

educational approaches such as behavioral, constructivist, and cognitive methods, to enhance educational outcomes. It involves educational technology, educational tasks, and tools within both e-learning environments and conventional education.

Schumann (2007) explained that blended learning represents the skills of both the learner and the teacher in utilizing information technology, which includes the ability to use multimedia to acquire, process, store, distribute, and disseminate information in various formats—textual and visual—using electronically operated devices that combine computers, communication devices, and information networks.

Ismail (2009) defined it as the employment of technological innovations to integrate objectives, content, learning activity sources, and methods of information delivery through both face-to-face and e-learning approaches to create interaction between the teacher, who acts as a guide for students, using technological innovations that do not necessarily require specific electronic tools.

Al-Qabani (2010) stated that there are four perspectives on defining blended learning:

- *The integration of the Internet as a form of e-learning with traditional education.*
- *A process that combines e-learning in all its forms—computer-based or internet-based—with traditional education, so that it does not rely solely on one or the other, but both together.*
- *A blend of the characteristics and features of both traditional education and distance learning in a comprehensive format.*

- *The integrated blending of the various elements that make up e-learning and traditional learning modes.*

Keeng and Bonk (2011) defined it as an educational approach that transitions between classroom environments and modern technologies, allowing students to benefit from a learning experience that includes personal interaction and digital content. Habonson and Graham (2012) described it as an educational approach that merges face-to-face learning with online learning (digital technologies), providing students with a flexible learning experience that enables them to access digital educational content and interact, whether face-to-face or online.

***Ataa and Kinsara (2011)** assert that blended learning is related to the integration of one or two dimensions of traditional and electronic education types. The patterns of integration include online learning and traditional education, constructivist and non-constructivist learning, core curricula and enrichment curricula, and the acquisition of knowledge and practical application among traditional classroom activities like lectures and laboratories, as well as online learning activities like virtual classes, interviews, and discussions.*

In this context, it can be said that blended learning consists of two main components: e-learning and traditional education, which together exhibit a set of advantages derived from their components.

Blended learning incorporates several benefits of e-learning, including solving educational problems related to increasing student numbers, addressing individual differences, and transforming the teacher's role from a mere transmitter of knowledge to an inspirer, guide, and supervisor. This type of education can provide multiple sources of knowledge through

access to various online resources, improving learning effectiveness by supplying students with all necessary materials.

As for the advantages taken from traditional education, they include immediate feedback for students and the opportunity for face-to-face interaction between students and teachers during learning. Additionally, it offers flexibility in addressing content topics based on varying circumstances surrounding the learning process and provides numerous auditory and visual learning opportunities.

Definitions of blended learning vary according to its methods of implementation, but most agree that it is a mix of e-learning and traditional education. This blending involves appropriately employing traditional teaching tools and methods alongside e-learning tools and methods, according to the educational situation. There are no minimum or maximum limits on the number of tools or methods from either type that can be integrated; this is determined by the educational context.

The researcher believes that blended learning is an educational approach that integrates technology of all kinds within or outside the traditional classroom to eliminate conventional teaching methods characterized by rote learning from the teacher and memorization without understanding from the learner. Additionally, it aims to enhance the technological skills of both the teacher and the student, raise the academic achievement of students, foster self-directed and cooperative learning, and save time and effort in achieving the desired educational goals.

Reasons for the Emergence of Blended Learning

There are several issues related to relying solely on traditional education, as well as challenges in depending exclusively on e-learning. For instance:

- *The large number of students and inadequate infrastructure (schools, laboratories, tools) makes it difficult to rely solely on traditional education.*
- *Traditional teaching methods depend on printed textbooks, which lack audio-visual aids or animated illustrations, reducing academic achievement. Furthermore, when curricula are updated, it is challenging to do so without incurring high printing costs.*
- *The digital divide in information and communication technology among students makes exclusive reliance on e-learning problematic.*
- *While modern technical means contribute to improving the educational process and achieving its goals, they do not replace traditional education.*
- *The presence of a human teacher in the classroom is crucial for communication with students and enhances social interaction.*
- *E-learning often lacks social interaction, providing few opportunities for students to develop discussion and debate skills, as well as leading to issues like attendance and exam fraud.*
- *The educational content can be tailored to meet each student's needs, allowing them to learn at their own pace and focus on areas where they need improvement.*
- *It encourages the use of technology, enhancing students' skills in this area and preparing them for a job market that requires advanced technical skills.*

- *Students can learn anytime and anywhere, increasing access to education and making it more convenient for those with busy schedules or who live far from educational institutions.*
- *The use of electronic tools allows for continuous assessment of student performance and provides immediate feedback, improving the educational process and identifying areas that require reinforcement.*

Furthermore, blended learning facilitates communication among all parties in the educational process and provides resources that help achieve knowledge. It is highly effective and efficient in delivering educational materials and supports educational outcomes, possessing the capability to convey knowledge to students smoothly and flexibly. Utilizing blended learning serves as a strategy to motivate students toward knowledge and academic education, carrying with it positive psychological dimensions that reflect on learners.

Chapter Three

Discussion of Results and Recommendations

This chapter presents a discussion of the results according to the hypotheses, followed by a series of recommendations based on the findings of the study.

Section One: Discussion of Results

1. ***Results Related to the First Hypothesis:*** *The results of the T-test showed a statistically significant difference in the post-achievement in chemistry attributed to the teaching method (blended vs. traditional), favoring the experimental group that studied using the blended learning strategy.*
2. ***Results Related to the Second Hypothesis:*** *The T-test results indicated a statistically significant difference in the pre- and post-achievement in chemistry for the experimental group taught using blended learning, favoring the post-application. This highlights the suitability and success of the blended learning method in teaching.*
3. ***Results Related to the Third Hypothesis:*** *The T-test results revealed a statistically significant difference in the observation checklist measuring practical skills between the experimental and control groups, favoring the experimental group (which studied through blended learning). This can be attributed to the blended learning approach, which enhances students' practical skills in virtual laboratories, allowing them to conduct experiments first in a virtual setting before trying them in a traditional lab, thus reducing errors and saving time and effort compared to those studying via traditional methods.*

4. ***Results Related to the Fourth Hypothesis:*** *The T-test results showed a statistically significant difference in the observation checklist measuring practical skills for the experimental group pre- and post-test, favoring the post-test. This is due to the blended learning method, which increases students' practical skills in virtual laboratories, allowing them to conduct all required experiments without the hassle of chemical shortages or equipment availability.*
5. ***Results Related to the Fifth Hypothesis:*** *The T-test results indicated a statistically significant difference in the observation checklist measuring practical skills for the experimental group between the traditional and virtual labs, favoring the virtual lab. This is due to the blended learning approach, which allows students to repeat experiments, alter variables, and study their effects, thus enabling them to conduct dangerous experiments that cannot be performed in traditional labs, facilitating better understanding of complex concepts.*
6. ***Results Related to the Sixth Hypothesis:*** *The T-test results revealed a statistically significant difference in the delayed achievement test for chemistry measuring retention of learning between the control and experimental groups, favoring the experimental group. This is attributed to the blended learning method's significant role in helping students retain information longer through understanding rather than rote memorization.*
7. ***Results Related to the Seventh Hypothesis:*** *The T-test results indicated a statistically significant difference in the delayed achievement test for chemistry between the post-test and delayed test for the experimental group, favoring the delayed test. This shows*

that the blended learning method greatly aids in retaining information for a longer period through comprehension.

8. ***Results Related to the Eighth Hypothesis:*** *The T-test results revealed a statistically significant difference in the attitude scale towards learning chemistry between the experimental and control groups post-test, favoring the experimental group. This indicates that the blended learning approach encourages students, while traditional methods do not foster a positive attitude towards studying chemistry.*
9. ***Results Related to the Ninth Hypothesis:*** *The T-test results showed a statistically significant difference in the attitude scale towards learning chemistry for the experimental group between the pre- and post-test, favoring the post-test. This further confirms that the blended learning method promotes a positive attitude towards studying chemistry among students.*

Section Two: Recommendations

Based on the findings of the study, the researcher recommends the following:

1. ***Utilize Blended Learning Strategies:*** *Implement blended learning strategies in teaching chemistry across all grade levels, while observing the impact of this approach on other variables.*
2. ***Conduct Further Research:*** *Undertake additional studies on blended learning strategies in other subjects beyond chemistry to assess their impact on various educational outcomes.*
3. ***Train Educators:*** *Provide training for teachers of chemistry, physics, biology, and mathematics on blended learning strategies to enhance their effectiveness and improve student achievement in assessments.*
4. ***Enhance Infrastructure:*** *Establish the necessary infrastructure for blended learning by developing human resources and equipping computer labs adequately to support effective implementation.*
5. ***Reduce Traditional Methods:*** *Minimize the use of traditional teaching methods to alleviate boredom and increase student engagement.*
6. ***Inclusive Education:*** *Implement blended learning for students with special needs, ensuring an appropriate environment for its application.*
7. ***Learning Management System:*** *Develop a Learning Content Management System (LCMS) to facilitate the administration of blended learning.*
8. ***Electronic Assessment Programs:*** *Provide electronic evaluation systems (E-Evaluation) to enhance assessment practices.*

9. ***Improve Computer Skills:*** *Enhance students' proficiency in using computers.*
10. ***Integrate Electronic Curricula:*** *Incorporate electronic courses at various educational levels.*
11. ***Build Informative Electronic Curricula:*** *Create electronic curricula that offer students a wealth of information.*
12. ***Promote Positive Attitudes:*** *Focus on fostering positive attitudes toward the use of blended learning in teaching chemistry.*
13. ***Teacher Guidelines:*** *Include guidelines in the chemistry curriculum for teachers on how to effectively implement blended learning to achieve educational objectives.*
14. ***Educational Software Development:*** *Prioritize the development, evaluation, and enhancement of educational software.*
15. ***Virtual Laboratories:*** *Utilize virtual laboratories for teaching practical topics and activities in chemistry and physics courses.*
16. ***Address Material Needs:*** *Ensure the necessary resources, such as computers and projectors, are available to activate virtual laboratories effectively.*
17. ***Update Virtual Lab Software:*** *Continuously update virtual lab software to resolve technical issues and provide the latest resources.*
18. ***Integrate Traditional and Virtual Labs:*** *Foster integration between traditional labs and virtual labs to equip students with essential practical skills.*
19. ***Reassess Chemistry Content:*** *Review and improve the content of secondary chemistry curricula to enhance the use of virtual laboratories.*
20. ***Experimental Learning:*** *Activate experimental teaching methods through the use of virtual labs to engage students more effectively.*

21. ***Combine Practical Work:*** *Ensure coordination between virtual and real laboratory work, encouraging the use of computers in labs to precede actual experiments.*

These recommendations aim to enhance the educational experience and improve student outcomes in the context of blended learning, particularly in the field of chemistry.

The reviewer:

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