

The Impact of a Blended Learning Environment on the Achievement of Intermediate School Students in Mathematics

Saddam Mohammed Hameed¹, Riyadh Jumaah Algailani²

Abstract

This study investigates the influence of a blended learning environment on the academic achievement of intermediate school students in mathematics within Iraq. Employing an experimental design, two comparable groups were formed: an experimental group experiencing blended learning and a control group. The sample consisted of 63 students, with 31 in the experimental group and 32 in the control group, purposefully selected from Al-Ilm Al-Nafi Secondary School for Boys in Erbil, affiliated with the Ministry of Education. To address the research objective, an achievement test comprising 30 items was developed to assess the average performance and retention of subject content among first-grade students in mathematics. The test's validity, reliability, and psychometric properties were meticulously established. Utilizing the statistical software SPSS, data analysis was conducted. The primary findings unveiled a statistically significant discrepancy, at a significance level of 0.05, between the mean scores of the experimental and control groups in the post-achievement test. This disparity favored the experimental group, immersed in the blended learning environment. Drawing from the research outcomes, several conclusions were drawn, most notably that the integration of a blended learning approach contributes substantially to an enhancement in student achievement. By focusing on these findings, the study underscores the potential of blended learning to elevate academic achievement. This bears significant implications for educational practices, highlighting the importance of leveraging technology-enhanced methods to optimize student learning outcomes in mathematics and beyond.

Keywords: *blended learning environment, achievement, mathematics, Intermediate school, Iraq education.*

Introduction

The current era is characterized by the proliferation of information across various fields of natural and human sciences. This proliferation necessitates learners to acquire a diverse set of scientific capabilities and skills, enabling them to adapt to the demands and necessities of this era. Additionally, they must be equipped to contribute effectively to creativity and productivity in various domains (Al-Arabi & Fakhri, 2013).

To achieve this, it is imperative to establish an advanced educational system that aligns with international educational standards. Education serves as the foundational cornerstone for societal progress and development. In the midst of this rapidly changing technological landscape, the cultivation of students who are not only capable of perpetual learning but

¹ PhD Curriculum and teaching methods, University of Mosul / College of Education for Human Sciences, dr.saddam1999@gmail.com, <https://orcid.org/0009-0008-2237-6937>

² Master of mathematics of teaching methods, Representation of the Ministry of Education in Erbil, abobillalaljalani@gmail.com, <https://orcid.org/0009-0007-8564-6773>

also of becoming proactive contributors and responsible citizens is of paramount importance (Al-Hamidi et al., 2022).

This aspiration demands that our students possess practical, interconnected, and comprehensive knowledge. One of the foundational pillars that underpin the astounding cognitive and technical advancements of this era is mathematics (Al-Khayyat, 2012). Historically hailed as the 'queen of sciences,' mathematics continues to play a pivotal role. Therefore, educators and specialists must maintain an unwavering commitment to crafting educational environments that facilitate students' grasp of mathematical concepts and elevate their levels of achievement.

Based on the foregoing, the research problem arises in answering the following question: What is the effect of a blended learning environment on the achievement of first-grade students in intermediate mathematics compared to the normal method?

The educational system serves as a cornerstone in contemporary societies, extending beyond the mere transmission of information and sources to students. It also encompasses the manner in which this information is delivered. Much like other services, the educational system consistently seeks fresh tools and pedagogical approaches, harnessing modern technology to enhance the learning experience (Mubarez & Fakhri, 2013). The process of integrating learners into the educational framework is designed to foster meaningful learning and enduring comprehension, forging a profound connection between learners and educational content. This integration transpires within an interactive educational environment that leverages educational technology, thereby amplifying the efficacy of education and facilitating the attainment of educational objectives.

In the era of information and communication technology, education has undergone a fundamental transformation. Contemporary education diverges from traditional methodologies of the past, embracing technology as an essential component, exemplified by the integration of computers into the learning process. The prosperity and advancement of nations and peoples are intrinsically tied to their capacity to acquire knowledge (Al-Arabi et al., 2016). Mathematics plays a pivotal role in this progress, as it underpins various cognitive processes.

The way in which an individual approaches problem-solving in mathematics, as well as addressing societal challenges within the context of aspiring toward a scientifically advanced society, holds significant importance. Given the pivotal role of mathematics and its impact on an individual's life journey, there has been a notable increase in both student and parental interest in elevating mathematical achievements. This is due to its profound significance in a student's academic progression, as it reflects their comprehension of mathematical concepts throughout each educational stage (Sbitan, 2010).

Mathematics assumes a central role in both scientific and practical applications in daily life. Its indispensable contribution to extensive technological advancements and modern industries is universally acknowledged. Consequently, mathematics stands as the foundational cornerstone for any scientific progress. The precision and ingenuity within mathematics have been integral to the current state of scientific achievements. Therefore, the teaching of mathematics has become an imperative in the era of the information revolution, as its integration has permeated various disciplines, including natural sciences and even the humanities.

Essential to sound thinking and a prerequisite for any thinker or philosopher, mathematics demands accuracy and confidence in one's cognitive processes (Al-Mashhadani, 2011). Throughout history, humanity has recognized the urgent necessity of mathematics as a potent tool for addressing pressing concerns, offering apt solutions, and devising effective treatments.

The development of any civilization, in any nation and era, hinges on a fundamental task of mathematics: the translation of real-life issues and phenomena into the language of

mathematics for analysis and study. This process aims to derive suitable solutions, enabling the anticipation of future outcomes and temporal trends. Just as all sciences rely on various mathematical disciplines, it is widely acknowledged that progress and advancement of sciences are closely intertwined with mathematical treatment (Al-Khayyat, 2012).

This necessity underscores the significance of establishing effective educational environments for mathematics instruction. Such environments should be structured to not only impart mathematical knowledge but also to stimulate students' cognitive faculties (Awwad & Zamil, 2010). Among these instructional environments, the integrated educational setting emerges as an essential approach. This approach involves redefining and designing the educational process and methodologies to align with technological advancements. It aims to cater to the capabilities and aspirations of the new generation, harmonizing education with the evolving technological landscape.

In the context of these technological transformations and the wealth of modern electronic educational resources, contemporary students require innovative instructional methods. These methods should shift from conventional approaches to more adaptable techniques, placing the student at the center of the educational experience. Consequently, education evolves into a more impactful endeavor (Al-Harthy & Al-Arini, 2023).

Numerous studies have substantiated the effectiveness of the blended learning approach in enhancing the quality of the educational process and producing outcomes aligned with the demands of the labor market and digital transformation. For instance, studies by Khalifa (2023), Al-Sajini (2023), and Ajwa et al. (2023) have all demonstrated the positive impact and efficacy of blended education. Additionally, a study conducted by Al-Hamidi et al. (2022) established the correlation between blended learning and the development of students' motivation levels towards learning.

These studies collectively advocate for the integration of blended learning as a strategic approach within educational institutions. The significance of achievement, encompassing cognitive, behavioral, and emotional progress, is inherent in the learning process. As Ismaili (2011) notes, achievement is both a product and an indicator of learning, underscoring its role in fostering positive behavioral changes and facilitating students' effective interaction with their environment.

Further evidence supporting the efficacy of blended learning in elevating student achievement emerges from the study conducted by Al-Qahtani (2018). Similarly, the research by Al-Qathami and Flemban (2019), focusing on learning environments' influence on mathematics achievement, highlights the importance of educating educators about leveraging these environments to attain desired educational outcomes. In the realm of mathematics education, Al-Zahrani and Zaidan (2018) demonstrated the pivotal role of technology-infused educational environments in enhancing students' performance, particularly in challenging subjects like engineering and measurement.

In the realm of mathematics education, Al-Abdullah (2020) showcased the effectiveness of blended educational environments in fostering elevated levels of student achievement. This underlines the significance of well-designed study units aligned with blended learning principles.

The present research seeks to ascertain the impact of a blended learning environment on the academic performance of first-grade students in intermediate mathematics. To validate the research objective, the researcher formulated the following null hypothesis: 'There is no statistically significant difference at the 0.05 significance level between the mean scores of the achievement test for the experimental group, which utilized a blended learning environment, and the control group, which followed the traditional teaching method.' Additionally, there are several search limitations:

1. **Objective Scope:** The study focused on the scientific content covered in the second part of the mathematics book for the first intermediate grade, as outlined in the Ministry of Education's fourth edition.
2. **Target Audience:** The participants were first-grade intermediate students attending secondary and intermediate schools under the Ministry of Education's representation in Erbil during the academic year 2022-2023.
3. **Time Frame:** The study was conducted during the second semester of the academic year 2022-2023.

Literature Review

Theoretical background:

1. **Blended Educational Environment:** The concept of blended learning environments is a modern concept in the field of education. This approach emerged in the early twenty-first century, as prior to this period, the integration of technology into the education process, both inside and outside the school, was not as robust (Osman, 2023, p. 213). Subsequently, blended learning environments emerged as a response to the increasing adoption of e-learning tools in education, often without due consideration to the necessary prerequisites. This led to a need for educators to structure and regulate this usage. Blended learning environments meld the benefits of online learning tools via the Internet with the advantages of traditional face-to-face interactions. In this context, electronic tools are employed to deliver the educational content, while the teacher in the classroom facilitates student preparation, provides guidance, oversees activities, addresses questions, and offers pertinent feedback through real-time engagement (Wally, 2016, p. 2).

Blended education is known by various terms, such as hybrid education, blended learning, co-teaching, and instructor-mediated education. Although these definitions may provide clarification, they all share a common element—a mode, form, or style of education that amalgamates distance e-learning with traditional face-to-face instruction within a unified framework (Al-Sayed, 2021, p. 161) (Abu Musa and Al-Sous, 2012, p. 6). Blended education encompasses a broad spectrum of activities, ranging from traditional classroom instruction with direct teacher-learner communication to entirely internet-based interactions. There are three distinct modes that characterize the level of technology integration in teaching and learning:

- The first scenario: involves utilizing technology to streamline educational management and provide the necessary resources to support learners. This could encompass furnishing students with information and materials, which might involve sharing lecture notes or facilitating basic administrative functions like sending email messages.
- The second scenario: involves leveraging technology to enhance educational activities with materials that might not be readily accessible in a conventional educational setting. This includes utilizing technology to facilitate communication and collaboration among teachers and students, as well as peer-to-peer interactions, along with incorporating technology in the assessment process. For instance, a teacher might incorporate electronic educational content, such as an instructional video, within a traditional classroom environment to complement in-person instruction.
- In the third scenario: technology is harnessed to facilitate self-directed learning or to be an integral component of self-paced learning. This approach incorporates interactive and collaborative learning activities, often culminating in a fully online educational experience (Shawahin, 2016, p. 7).

Given the aforementioned scenarios, the blended educational environment serves to mitigate the limitations of both the traditional face-to-face educational setup and the purely electronic educational setting. This is achieved by combining the physical presence of a teacher in the classroom, delivering structured academic content using traditional tools like blackboards, and incorporating the potentials of e-learning. These possibilities extend beyond the classroom, fostering skill development and competency enhancement among students. Consequently, blended education transforms learning into an active and ongoing constructive process, both within and beyond the traditional classroom environment.

2. Achievement: Academic achievement stands as a paramount objective that societies aspire to realize through educational programs. Achievement serves as a primary gauge of the educational process's success and its attainment of predetermined objectives. It is employed as a yardstick to evaluate the effectiveness of education, including its role in nurturing the diverse talents and capacities present within society. This, in turn, facilitates the harnessing of these capabilities for societal benefit. Consequently, achievement holds significant prominence within the comprehensive educational journey, representing a pivotal educational outcome eagerly pursued by learners. The knowledge and experiences that students acquire in an academic subject represent predefined objectives, and their attainment is assessed through achievement tests designed for this purpose. The daily activities of individuals, families, and societies are unequal in their relation to educational concepts. None is as integral to educational outcomes as the individual, who is the true producer of achievement. Furthermore, achievement bears substantial significance for both individual and societal advancement. It serves as a vital educational goal, aimed at equipping individuals with the knowledge and understanding needed for their cognitive growth and personal development.

The objectives pursued by the educational system extend beyond the realm of knowledge, encompassing the cultivation of positive values. This holistic approach to education is meant to empower individuals to embrace ethical and constructive values that contribute to their holistic development. If these needs are not met and satisfied, they can lead the learner to a state of frustration, which, in turn, might result in the disruption of the educational system. This has been exemplified by the unfortunate dropout of many students from school (Ahmed, 2010, pp. 94-95), (Al-Shayeb, 2017, p. 34).

Previous studies:

- Study: (Al-Fuhaid, 2015): "The Implementation of Blended Learning in Teaching Natural Sciences at the Secondary Level: A Perspective of Science Teachers and Supervisors in the Qassim Region, Kingdom of Saudi Arabia." This study aims to assess the practical application of blended learning techniques among science teachers (biology, chemistry, physics) at the secondary school level. It also seeks to determine the extent of available resources and equipment to facilitate its implementation. Methodology: The study employs a descriptive research approach. The participant pool consists of 200 science teachers and supervisors (covering biology, chemistry, and physics) at the secondary education level. The study employed a questionnaire as the primary data collection instrument. Data analysis involved using statistical methods such as the arithmetic mean, standard deviation, one-way analysis of variance, t-test, Pearson's correlation coefficient, and Cronbach's alpha, conducted through the statistical software package (SPSS). The findings indicated a notable consensus among the sampled participants, including both supervisors and teachers, regarding the significance of employing blended learning in teaching natural sciences at the secondary level. While teachers perceived its importance as high, supervisors rated it as moderate.

- Study: (Al-Hamidi et al., 2022): Assessing the Efficacy of Blended Learning in Enhancing Achievement and Motivation Among Students at the College of Basic Education in the State of Kuwait.

This study aims to evaluate the extent to which blended learning proves effective in elevating academic achievement within the instructional materials production curriculum. Additionally, it seeks to gauge the impact of blended learning on fostering motivation for learning among female students enrolled at the College of Basic Education in Kuwait.

Methodology: The study adopts a descriptive approach coupled with a semi-experimental methodology.

The study sample comprised 72 female students, divided into two groups: an experimental group consisting of 32 female students, and a control group comprising 40 female students.

For the purpose of post-measurement, a cognitive achievement test was administered, alongside a measure of motivation to assess students' enthusiasm for learning within the educational materials production workshop.

Data analysis involved utilizing the Crowe-Nabach alpha equation and conducting a t-test for two independent samples.

The research aimed to explore the effectiveness of blended learning in enhancing both academic achievement and motivation levels among female students.

Methodology and Procedures

The researcher opted for the experimental approach due to its precision and efficacy in producing accurate results. This approach stands out for its ability to control the various factors that might impact the phenomenon under investigation. In this study, the experimental approach was employed to evaluate the effect of a blended learning environment on the academic achievement of first-grade students in mathematics.

Research Population and Sample: The research population consisted of 3,721 students enrolled in 7 intermediate schools and 56 secondary schools during the academic year 2022-2023. These educational institutions were under the jurisdiction of the Ministry of Education in Erbil. For male students, the population was divided into two distinct groups: an experimental group comprising 31 students and a control group consisting of 32 students.

Research Instrument: To achieve the research objectives, an achievement test was meticulously developed. This test, consisting of 30 items in its final version, underwent comprehensive validation, reliability testing, and verification of its psychometric properties.

Experimental Procedure: After establishing the research population, selecting the research sample, ensuring equitable allocation into the two groups, confirming each step, finalizing the curriculum content, creating and validating the research instrument (the achievement test), assessing its reliability, computing psychometric attributes, and crafting teaching plans for both groups, the experiment was initiated on Monday, February 20, 2023. The experiment spanned a duration of 47 days.

Statistical Methods: For data analysis, the researcher utilized the Statistical Package for the Social Sciences (SPSS) in conjunction with Microsoft Excel to process the research statistics.

Results and Discussion

Presentation and discussion of results: The research hypothesis posited that there exists no statistically significant difference at the 0.05 significance level between the mean scores of the students in the experimental group, who were exposed to the blended learning environment, and the students in the control group, who were taught through the conventional method. To validate this hypothesis, the researcher calculated the arithmetic mean and standard deviation of the scores from both research groups in the achievement test. The t-test for two independent samples was subsequently applied. The results of this analysis are presented in Table 1

Table 1: T-Test Results for the Average Scores of the Experimental and Control Groups in the Achievement Test

indication	significance level	T value		df	standard deviation	arithmetic mean	number sample members	variable	the group
		Tabular	Calculated						
Statistically significant	0.05	2.000	4.175	61	3.32407	23.1290	31	An educational environment that employs a virtual studio	Experimental
					4.42865	19.0000	32	method regular	control

It is clear from the previous table that the calculated t-value amounted to (4.175), which is greater than the tabular t-value, which is equal to (2.000) at the level of significance (0.05) and the degree of freedom (61). Thus, this null hypothesis is rejected and the alternative hypothesis is accepted, and this means that there is a significant difference Statistics between the mean scores of the students of the experimental group and the students of the control group in the achievement test in favor of the experimental group, In the context of teaching, the direct presence of a teacher in the classroom had a noticeable impact on the achievement of students in the experimental group. This teaching approach not only enabled the experimental group's students to retain their learning more effectively compared to the conventional method, but also led to a higher level of achievement when contrasted with the achievements of students in the control group, Additionally, the utilization of technology in education, specifically through the integration of modern technologies for creating electronic educational content, played a significant role. The content was thoughtfully designed to engage students and mirror their mental processes when grappling with mathematical concepts. This approach involved highlighting the unique features of each concept, elucidating the interconnections between them, and clarifying the symbols employed to represent these concepts. Moreover, the utilization of appealing colors further contributed to enhancing the achievement level of students within the experimental group. The researcher also holds the belief that the instructional strategies embedded within the teaching plans, which allow students to capture their thoughts and queries concerning each presented concept, played a positive role in fostering greater interaction. These strategies facilitated engagement among students with the electronic educational content delivered to them within the classroom setting. Furthermore, these strategies helped eliminate any uncertainties or overlaps between concepts, as students could seek clarification on any doubts immediately after the educational content was presented directly by the teacher/researcher in the same classroom, This phenomenon, in turn, plays a pivotal role

in aiding students in retaining their learning over extended periods and solidifying accurate concepts within their minds. This finding aligns with the study conducted by Al-Abdullah in 2020, which highlighted the efficacy of blended learning in elevating student achievement levels in mathematics. Similarly, the outcomes of the studies by Al-Qahtani (2018), Al-Hamidi et al. (2022), Koutsampelas, et al. (2020) and Ajwa et al. (2023) were congruent with these findings, underscoring the impact and effectiveness of blended learning environments in advancing achievement and enhancing cognitive aspects.

These studies collectively validate the utility of various educational programs grounded in modern technology to heighten student achievement in mathematics. These programs prove instrumental in assisting students in surmounting the challenges associated with learning mathematics compared to traditional educational settings.

To determine the magnitude of the impact of the independent variable (integrated learning environment) on the variance observed in the dependent variable (achievement), the researcher computed the effect size using the eta-square equation (η^2) derived from the calculated t-value. The outcomes of the effect size calculation are presented in Table 2.

Schedule (2) Results of measuring the effect size of an eta square " η^2 "

The amount of effect	impact criteria			calculated value	The Worker	variable
	big	middle	small			
very big				0.2222	η^2	method
	0.14	0.06	0.01			

From the preceding table, it is evident that the calculated effect size value for eta square (η^2) surpassed the threshold of 0.14. This outcome indicates a significantly large effect size, aligning with Cohen's benchmarks associated with the method (Cohen, 1988:286).

Conclusions:

Utilizing a blended learning approach for teaching mathematics has proven to be more effective in enhancing student achievement when compared to the conventional method. This amalgamation of electronic and traditional educational resources aligns well with students' cognitive capacities and responds to the demands of the contemporary era. Moreover, it harmonizes with modern curricular perspectives. Therefore, it is advisable for educational institutions to embrace blended learning as a strategic approach to education. This adoption should be complemented by the provision of essential devices and technologies to facilitate its effective implementation.

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