

Blended Learning and Academic Achievement: A Meta-Analysis

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Abstract

The purpose of the present research was to conduct a meta-analysis of Iranian studies on blended learning and academic achievement. As the third generation of distance education, blended learning integrates the strengths of face-to-face and online approaches. The methodology involved estimating the effect size for the relationship between blended learning and academic achievement. Out of 231 studies conducted between 2010 and 2017, 20 experimental and quasi-experimental studies were selected as the sample using purposive sampling based on 9 eligibility criteria. Data were analyzed using structured meta-analysis and were interpreted using Cohen's *d* for gauging small, medium, and large effect sizes. The results showed that the relationship between blended learning and academic achievement is significant, as the effect size for this relationship was 0.591, which is above medium in Cohen's approach. Overall, the findings suggest the real positive effects of blended learning on learning outcome.

Keywords

Blended Learning, Distance Education, Academic Achievement, Meta-Analysis.

Introduction

Education is the starting point and the foundation of any overarching transformation [51]. Educational institutions use a variety of teaching methods depending on their specific circumstances, including traditional and online methods [44]. Traditional face-to-face instruction can no longer respond to the massive demands for education in information-based societies. However, the infusion of Information and Communication Technologies (ICTs) into learning and teaching has enabled the rapid growth of online and distance learning. Although these new approaches have been able to eliminate time and space constraints, they have failed to deliver the human interactions that characterize face-to-face instruction. In addition, delayed feedback from instructors, unavailable technical support from instructor, and lack of self-regulation and self-motivation are some of the negative experiences with online education [56]. As a result, e-learning has not yet fully replaced formal, face-to-face instruction (Salehi and Salari, [55, 22].

An effective way of improving learning is to use a mixture of traditional and electronic approaches, which is commonly referred to as blended learning. Blended learning is broadly defined as replacing seat time in courses with online activities to achieve learning objectives (Van Der Linden, 2014). It can be considered a variant of the third generation of distance education. The first generation is "correspondence study", where students and teachers communicate with each other through mail. The second generation is "multimedia distance teaching" or broadcast /teleconferencing", where television and radio broadcasts are used by the students and teachers for communication. The third generation is "interactive, web-based instruction", where resources of the World Wide Web enhance communication, not only between students and teachers, but among students as well [49].

Blended learning is a modern education program that combines online digital media with traditional classroom methods. It is a mixed method of content delivery that aims to optimize

learning outcomes and be cost-effective [22]. Wilson and Smilanich define blended learning as “the use of the most effective training solutions, applied in a coordinated manner, to achieve learning objectives that will attain the desired business goals.” combines online delivery of educational content with the best features of classroom interaction and live instruction to personalize learning, allow thoughtful reflection, and differentiate instruction from student to student across a diverse group of learners [53, 54]. It integrates face-to-face and online learning to help enhance the classroom experience and extend learning through the innovative use of information and communications technology. Blended strategies enhance student engagement and learning by adding online activities to the course curriculum, and improve effectiveness and efficiencies by reducing lecture time. Blended learning should be viewed as a pedagogical approach that combines the effectiveness and socialization opportunities of the classroom with the technologically enhanced active learning possibilities of the online environment with both synchronous and asynchronous communication methods.

It has been suggested that blended learning improves learning effectiveness, increases access to programs and materials, provides greater convenience and flexibility (time and space), and is more cost effective than virtual universities (e.g. Graham, Ajam et al.) [4, 21]. Blended education model have become increasingly extensive in a wide array of learning domains [34]. Blended instruction shifts the emphasis from the traditional teacher-centered approach where the focus is on what and how the teacher chooses to teach to a learner-centered approach where the learner is center-stage [48]. Blended assessment, i.e. online (automatically scored objective tests) and offprint exams (written classroom assessments) has also been shown to be useful for evaluation process [6]. Garrison and Vaughn consider blended learning “the thoughtful fusion of face-to-face and online experiences ... such that the strengths of each are blended into a unique learning experience” [20]. They argue that blended learning is a fundamental redesign that transforms the structure of, and approach to, teaching and learning. Also, according to Garrison and Kanuka, a blended learning design represents a significant departure from face-to-face and a fully Internet-based learning and represents a fundamental reconceptualization and reorganization of the teaching and learning dynamic [19].

Blended learning may be the best solution for meeting the needs of learners with different learning styles. As a collaborative approach, blended learning allows learners to work together to achieve their goals. Blended learning should be approached as a redesign of the instructional model with these characteristics: (a) shift from lecture to student center instruction; where the student becomes both active and interactive in the learning process; (b) increased interaction between student-teacher; student-student; student-content; student-outside resources; and (c) integrated formative and summative assessments for students [16]. As a strategic approach, blended learning leads to improved student learning and inter action, increased flexibility and access in content creation and delivery, and higher organizational commitment in the learning and teaching process [10]. According to Garrison and Kanuka, blended learning is an effective and low-risk strategy which positions universities for the onslaught of technological developments that will be forthcoming in the next few years [19]. In a study on future projections of blended learning, more than seven in ten respondents anticipated that they would offer more than 40 percent of their courses in a blended format by 2013 [13].

The purpose of the present research is to conduct a meta-analysis of the research on blended learning and academic achievement in Iran. The majority of Iranian studies have shown a positive relationship between blended learning and learning outcomes (e.g., Javadi and Bakhchisara; Shah Viren et al., 2016; Kazempour; Mehraban; Rouhi et al.; Khoshkab; Kushania and Amir-Teimouri; Mahmoudi et al.; Ahmadi and Nokhostin Rouhi; Ajam et al., Izadi; Moradi Mokhles et al.; Salehi and Salari; Seyyedi and Yaghubi; Shahvali et al.; Zarei and Toofannejad; Mosalinejad et al., [2, 3, 4, 22, 26, 28, 29, 30, 32, 35, 38, 40, 41, 47, 57]). However, some studies have reported inconsistent or even contradictory results, and, to our knowledge, the effect size for the relationship between blended learning and academic achievement has not been previously measured. Therefore, the present research uses a meta-analysis methodology as a holistic approach to fill this gap in the literature. Effect size is measured using Cohen's *d*. Meta-analysis is chosen to combine data from

different studies and provide new insights that cannot be gained from each individual study [23]. Synthesizing the results of previous studies (as the unit of analysis) can sometimes be much more useful and effective in painting a complete and unambiguous picture of a subject than conducting new research [24].

The most important unit of analysis in these studies has been the significance of the tests that have been performed. However, this in and of itself does not provide any information about the size of the effect of blended learning on academic achievement. Although several meta-analyses have been conducted on blended learning (e.g. Means et al.; Bernard et al.; Liu et al.) [11, 33, 37], there is no meta-analysis of the Iranian literature on blended learning. Given these discussions, the present research addresses the following questions:

- Does blended learning really affect academic achievement?
- If so, what is the size of the effect of blended learning on academic achievement?

Methodology

In this research, meta-analysis is used to determine the effect size for the relationship between blended learning and academic achievement. In meta-analysis, the basic principle is to calculate effect sizes for individual studies, convert them to a common metric, and then combine them to obtain an average effect size [18]. The population consists of 231 studies on blended learning and academic achievement in Iran between 2010 and 2017 that have been indexed on the databases of the Science and Information Research Center, the National Scientific Documentation Center, the Scientific Information Database (SID), Noor Specialized Magazines (Noormags), Magiran, and the National Library, or have been presented at national and international conferences. The keywords used in database search include 'blended learning', 'learning improvement', and 'academic achievement'. Using purposive sampling, 20 experimental and quasi-experimental studies are selected as the sample using purposive sampling based on a number of eligibility criteria. These include relevance to the subject and validity and reliability of tests and instruments used, and reports and reviews are excluded as per the principles of meta-analysis [1]. Information such as the title, author(s), year of publication, instrument, test validity and reliability, population and sample, and significance levels are extracted [7].

The most common indicators for measuring effect size are Pearson r for correlation and Cohen's d for mean difference [27]. In this meta-analysis, the results of identified studies are synthesized [7] and different statistics are converted into Cohen's d (Hooman, 2008) to measure the real effect size for the relationship between blended learning and academic achievement. Next, data are analyzed using descriptive and inferential statistics (i.e. standard error, mean error, variance, upper and lower bounds, and z-score). Finally, fixed and random effects models are used for meta-analysis and Cohen's system is used to interpret the results. Cohen's d is determined by calculating the mean difference between two groups, and then dividing the result by the pooled standard deviation. Table 1 shows Cohen's system for interpreting effect sizes [14].

Table 1. Interpretation of Cohen's d for effect size

Indicator	Condition	Value	Interpretation
Cohen's d	Mean difference between two groups	0.3	Small
	Mean difference between two groups	0.6	Medium
	Mean difference between two groups	0.9	Large

Findings

Before inferential analysis, first the statistical methods used in the literature to examine the relationship between blended learning and academic achievement are described (Table 1).

Table 2. Frequency and percentage of statistical methods used in the literature

Statistical Method	Frequency	Percentage
One-way analysis of variance (ANOVA)	5	25%
Dependent and independent samples t-tests and one-way ANOVA	1	5%
Multiple correlation coefficient	2	10%
Independent samples t-test and multivariate ANOVA	2	10%
Independent samples t-test and correlation coefficient	1	5%
Covariance analysis and chi-square test	2	10%
Independent samples t-test and one-way ANOVA	1	5%
Dependent samples t-test	1	5%
Multivariate ANOVA	5	25%
Total	20	100%

The data in Table 1 show that one-way ANOVA and multivariate ANOVA are the most commonly used statistical methods in the Iranian literature on blended learning and academic achievement (seven and four times respectively). For better clarification and to more accurate comparisons, a meta-analysis checklist is created for the selected articles (Table 2).

Table 3. The eligible sample for meta-analysis

Author(s)	Location	Year	Test	Sample Size
Banihashem et al.	ARDABIL	2014	MULTIVARIATE ANOVA	30
Mosalinejad et al.	Jahrom	2010	Dependent and independent samples t-tests and one-way ANOVA	41
Moradi Mokhles et al.	ASADABAD	2013	MULTIVARIATE ANOVA	80
Kushania & Amir-Teimuri	Pakdasht	2015	One-way ANOVA	108
Khoshkab	SHAHRUD	2015	ONE-WAY ANOVA	62
Mehraban	Tehran	2016	Multiple correlation coefficient	3
Rouhi et al.	BABOL	2016	DEPENDENT SAMPLES T-TEST	30
Mahmoudi et al.	Semnan	2016	Multiple correlation coefficient	70
Kazempour	RAMSAR	2012	MULTIVARIATE ANOVA	386
Ahmadi & Nokhostin Rouhi	Tehran	2014	One-way ANOVA	30
Salari & Karami	TEHRAN	2014	MULTIVARIATE ANOVA	90
Zolfaghari et al.	Tehran	2010	Covariance analysis and chi-square test	17
Emadi and Ahwakshsh	HAMEDAN	2015	INDEPENDENT SAMPLES T-TEST AND MULTIVARIATE ANOVA	56
Motamedi et al.	Tehran	2012	One-way ANOVA	20
Mehdizadeh & Fathi	ILAM	2012	ONE-WAY ANOVA	30
Khosravi et al.	Tehran	2014	Covariance analysis and chi-square test	58
Jahedi & Mesbah	SHIRAZ	2014	INDEPENDENT SAMPLES T-TEST AND ONE-WAY ANOVA	642
Badi'i & Farajollahi	Isfahan	2016	Multivariate ANOVA	60
Moafian et al.	LAR	2014	INDEPENDENT SAMPLES T-TEST AND PEARSON CORRELATION COEFFICIENT	49
Zeraati et al.	Mazandaran	2015	Independent samples t-test and multivariate ANOVA	202

The first question of the research is about the presence of a positive relationship between blended learning and academic achievement. To answer this question based on the principles of meta-analysis, first the effect size for the entire selected sample is determined and then the combined fixed and random effects are calculated (Table 3).

Table 3. Meta-analysis of the research on blended learning and academic achievement in the random effects model

Study	SEM	SE	Variance	Lower Bound	Upper Bound	z	p
Banihashem et al. (2014)	0.239	0.129	0.023	0.223	0.732	4.781	0.021
Mosalinejad et al. (2010)	0.432	0.390	0.034	0.172	1.021	0.984	0.032
Moradi Mokhles et al. (2013)	0.521	0.234	0.035	0.132	0.909	2.122	0.012
Kushania & Amir-Teimuri (2015)	0.130	0.034	0.021	0.182	0.897	11.89	0.001
Khoshkab(2015)	1.108	0.109	0.102	0.174	0.827	1.012	0.007
Mehraban (2016)	0.349	0.339	0.017	0.199	0.423	2.022	0.003
Rouhi et al. (2016)	0.249	0.435	0.082	0.042	0.857	6.715	0.021
Mahmoudi et al. (2016)	0.905	0.247	0.029	0.091	0.441	3.301	0.036
Kazempour (2016)	0.550	0.190	0.020	0.117	0.902	2.513	0.000
Ahmadi & Nokhostin Rouhi (2014)	0.298	0.398	0.062	0.084	0.272	1.369	0.004
Salari & Karami (2014)	0.127	0.098	0.098	0.108	0.948	1.231	0.002
Zolfaghari et al. (2010)	0.356	0.309	0.041	0.318	1.072	1.820	0.009
Emadi & Ahwakhsh (2015)	0.397	0.275	0.009	0.392	0.855	1.723	0.023
Motamedi et al. (2012)	0.344	0.332	0.029	0.247	0.443	2.290	0.043
Mehdizadeh & Fathi (2012)	0.188	0.179	0.167	0.056	0.630	0.978	0.012
Khosravi et al. (2014)	0.447	0.439	0.190	0.126	0.923	9.630	0.010
Jahedi & Mesbah (2014)	0.577	0.212	0.079	0.230	0.716	2.992	0.002
Badi'i & Farajollahi (2016)	0.489	0.290	0.032	0.225	0.990	1.732	0.000
Moafian et al. (2014)	0.913	0.412	0.029	0.024	0.321	1.153	0.002
Zeraati et al. (2015)	0.732	0.324	0.043	0.298	0.732	1.023	0.000
Combined Fixed Effects	0.591	0.086	0.001	0.430	0.712	10.648	0.000
Combined Random Effects	0.591	0.086	0.001	0.430	0.712	10.648	0.000

According to the data in Table 3, the combined fixed and random effects that are calculated based on standard error at the 96% confidence interval (CI) as well as the calculated effect size (less than 0.6) indicate that the following studies are significant: Banihashem et al.; Mosalinejad et al.; Moradi Mokhles et al.; Kushania and Amir-Teimuri; Mehraban; Rouhi et al.; Zolfaghari et al.; Ahmadi and Nokhostin Rouhi; Salari and Karami; Mehdizadeh and Fathi; Emadi and Ahwakhsh; Motamedi et al.; Badi'i and Farajollahi; Jahedi and Mesbah and Kazempour [8, 29, 32, 40, 41, 42, 59, 32]. That is because effect sizes below 0.6 are statistically significant. On the other hand, the effect size for the studies by Khoshkab, Mahmoudi et al., Moafian et al. and Zeraati et al. is above 0.6 and are not statistically significant [8, 9, 30, 39, 58, 25, 47].

The second question of the research is about determining the size of the effect of blended learning on academic achievement. Here, the Cohen model is used to interpret the results.

Table 4. Meta-analysis of the relationship between blended learning and academic achievement

Description	Sample	Population	Combined Fixed Effects	Combined Random Effects	Variance	95% CI	Chi-square (χ^2)	df	Sig.
Blended learning and academic achievement	20	231	0.591	0.591	0.239	0.430-0.712	0.571*	19	0.081

Table 4 shows that the mean effect size for the relationship between blended learning (combined fixed effects) and academic achievement is 0.591. Since the estimated effect size is between the confidence interval (0.430-0.712), the positive relationship between blended learning and academic achievement. However, Cohen's model is used for a more accurate interpretation of the effect size for this relationship (Table 5).

Table 5. Interpretation of the effect size for the relationship between blended learning and academic achievement using Cohen's model

	Variance	Cohen's <i>d</i>	Pearson Coefficient (<i>r</i>)	Correlation	Effect Size (ES)
Cohen's Model	0.01	0.2	0.03		Low
	0.09	0.6	0.3		Average
	0.25	0.6	0.3		High

Table 5 shows that the calculated effect size based on Cohen's model is slightly above average. Therefore, there is a significant relationship between blended learning and academic achievement.

Discussion and Conclusion

The purpose of this research was to conduct a meta-analysis of the Iranian studies on blended learning and academic achievement. As the third generation of distance education, blended learning combines the effectiveness and socialization opportunities of the classroom with the technologically enhanced active learning possibilities of the online environment with both synchronous and asynchronous communication methods. Also as a strategic approach, blended learning leads to improved student learning and interaction, increased flexibility and access in content creation and delivery, and higher organizational commitment in the learning and teaching process [10]. With a more logical, flexible, and balanced approach to the teaching and learning dynamic compared to traditional and online approaches, blended learning is one of the best educational techniques in the ICT age.

The present research uses a meta-analysis methodology to provide a holistic view of the subject. Meta-analysis is an effective tool for synthesizing the results of separate studies, which allows for more accurate and reliable conclusions. This study addressed two questions: does blended learning really affect academic achievement, and if so, what is the effect size for this relationship? To answer the first question, the combined fixed and random effects for a sample of 20 Iranian studies (from a population of 231) was calculated from the effect size of each individual study (standard error of mean, standard error, variance, and lower and upper bounds). The resulting effect size for the relationship between blended learning and academic achievement was 0.591. The calculated effect size is between the confidence interval (0.430-0.712), and thus the presence of a significant relationship between blended learning and academic achievement is confirmed. Blended learning increases the effectiveness and quality by effectively combining different modes of delivery, models of teaching and styles of learning [46], providing a mixture of learning tools and identifying key factors in successful content

delivery (Izadi), and creating new learning experiences and opportunities within open online courses (Stacey and Gerbic) [26, 50]. In addition, blended learning increases responsibility, social interactions, student self-confidence and self-motivation, access to professors and learning materials, and time and space flexibility, thus enriching learners' experiences and increasing their satisfaction with his mode of instruction [4]. Our findings are consistent with the results of Procter, Izadi, Stacey and Gerbic, Ajam et al., Garrison and Vaughan and Watson [4, 20, 26, 46, 50, 53].

To answer the second question, Cohen's model was used to interpret the results. The 0.591 effect size is slightly above average in the Cohen system, indicating a moderate relationship between blended learning and academic achievement. Therefore, we can argue that blended learning has a significant positive effect on academic achievement. Blended learning improves academic achievement by combining structured and unstructured learning, individual and group learning, face-to-face and online learning, self-directed and instructor-directed learning, surface and deep learning, and context-based and non-context-based learning. This approach to instruction transforms the structure of, and approach to, teaching and learning and represents a fundamental reconceptualization and reorganization of the teaching and learning dynamic. Therefore, it has the advantage of changing the attitude of professors, content designers, and education authorities to not only change the quantity, but also the quality of education, i.e. its systems, structures, and processes. Fink considers blended learning to be the best opportunity for individual and organizational learning [17]. This finding is consistent with the results of Najafi, Ajam et al., VanDerLinden and Drysdale et al. [4, 15, 44, 45, 52].

One of the limitations of this research was the lack of meta-analyses in the Iranian literature on blended learning and academic achievement. The only exception was the study of Manian and Karimi, which mainly a content analysis of international studies on the subject [36]. This issue limited us in comparing our findings, as the present research was, to our knowledge, the first meta-analysis of Iranian studies on blended learning and academic achievement. Therefore, the present study helps fill this gap in the literature. Nonetheless, the population of this meta-analysis limits the generalizability of the results for the education system of Iran and other countries, and the findings must be interpreted with caution.

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