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A study of the effects of blended learning on university students' critical thinking: A systematic review

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Abstract:

One of the basic, constructive needs of humans, which plays a major part in their development is critical thinking. As education is one of the factors in shaping individuals' critical thinking, the present study addresses the effects of blended learning and its subcategories on university students' critical thinking (and its subcategories). The present article is a review study. Data were collected using valid search engines and databases. The keywords which were used included blended learning, integrated learning, blended training, integrated training, critical thinking, critical thinking disposition, and critical thinking skills, as well as the subcategories of blended learning, that is, the flex model, the self-blended model, the enriched virtual model, and the rotation model and its subcategories (the station rotation model, the lab rotation model, the flipped classroom model, and the individual rotation model). The results of 14 sources, out of the selected 15 sources, showed that blended learning and its subcategories, that is, the flex model, the self-blended model, the enriched virtual model, and the rotation model and its subcategories contribute to university students' critical thinking of disposition and skill. One of the essential skills which must be given more serious attention in learning in the twenty-first century is critical thinking. Having the benefits of both lecturing and e-learning, blended learning is a more effective and practical method for promoting critical thinking in university students.

Keywords:

Critical thinking, distance learning, online learning, systematic review

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Introduction

In today's competitive world, critical thinking is one of the abilities which all individuals must have.[1] Critical thinking is a vast, comprehensive process that begins with a problem and continues until a solution is found.[2] Regarded as one of the primary skills in the twenty-first century,[3] critical thinking is an essential competence in all professional and academic fields.[4] Critical thinking consists of the two domains of disposition and skill. The importance of creativity is high in order to provide innovative solutions for decision-making and problem solving.[5,6] A critical thinker can accurately analyze data to arrive at correct conclusions or use alternative methods to solve problems.[4] Thus, development and evaluation of critical thinking are significant in teaching and learning.[7] However, due to information overload and quick advances in technology, the goal of education has moved toward mere transfer of information at the cost of raising intelligent and creative individuals.[8] Karakoc Najafi *et al.* concluded in their study that critical thinking skills should be emphasized in university education.[9]

The integration of technology into face-to-face learning has raised great interest. Due to its efficacy in allowing for flexible, timely, and continuing learning, blended learning is regarded as the most

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effective and popular approach to learning.[10] As blended learning combines classroom learning with online learning,[11,12] it has the benefits of both conventional learning and electronic learning.[10] Blended learning is regarded as a practical learning model for increasing the skills of learners in the twenty-first century.[13] This type of learning transforms students from passive learners to active learners who seek knowledge.[14] Blended learning consists of the subcategories of the flex model, self-blended model, enriched virtual model, and rotation model and its subcategories.[15–18] These modern, dynamic methods of learning promote students' ability to investigate and identify their own learning needs, to perform critical thinking, to play an active role in their learning process, to have better initiative in different situations, and to improve their problem solving skills.[19] According to Wahyuni, blended learning had a significant impact on improving students' critical thinking skills.[20] However, the results of the study of Hajrezayi *et al*. showed that the contribution of blended learning to students' critical thinking was not significant.[21] Harrington *et al*. suggested that there was need for more research into the effects of the flipped classroom model (one of the subcategories of blended learning) on students' critical thinking and problem-solving skills.[22] Teaching critical thinking is the most important effort that should be made in nursing education.[1,2] Some experts believe that education is just teaching thinking to the learner. On the other hand, there is a need to review current educational strategies and making more use of active learning strategies has been repeatedly emphasized.[19] Accordingly, in the present study, the researchers conducted an extensive systematic review of previous studies of the effects of blended learning and its subcategories on critical thinking (and its subcategories) which are among the essential skills in the twenty-first century.

Materials and Methods

Study design and setting

The present systematic review was conducted according to the guidelines of the QUOROM statement checklist,[23] an evidence-based system which controls reporting in systematic reviews and meta-analyses.[24]

Information sources and search strategy

The researchers looked for relevant studies published between 2010 and 2020 in the databases of PubMed, Science Direct, Google Scholar, Google, Scopus, Magiran, SID, and ElmNet. The search was carried out within the framework of PICOS (population, intervention, comparison, outcomes and study).[25] "P" represented the students, "I" represented the effects of blended learning and its subcategories on critical thinking (and its subcategories) in students, "C" represented a comparison between the effects of blended learning (and its subcategories) and conventional learning on critical thinking (and its subcategories) in students, "O" represented the efficacy or non-efficacy of blended learning and its subcategories in improving critical thinking (and its subcategories) in students, and "S" represented quantitative, experimental, and semi-experimental studies and systematic reviews. The search syntax and keywords in the database are presented in Table 1.

Search concepts and keywords

The keywords were selected from MeSH and the keywords used in published systematic reviews. The keywords which were used in the search in Iranian and foreign databases consisted of blended learning, blended training, integrated learning, integrated training, combined learning, combined training, hybrid learning, hybrid training, critical thinking, critical thinking disposition, and critical thinking skills, as well

Table 1: The outline of the conducted search in all the databases (2010-2020)

("blended education" and "critical thinking") or ("blended learning" and "critical thinking")
("blended education" and "critical thinking disposition") or ("blended learning" and "critical thinking disposition")
("blended education" and "critical thinking skills") or ("blended learning" and "critical thinking skills")
("combined education" and "critical thinking") or ("combined learning" and "critical thinking")
("combined education" and "critical thinking disposition") or ("combined learning" and "critical thinking disposition")
("combined education" and "critical thinking skills") or ("combined learning" and "critical thinking skills")
"flex model" and "critical thinking"
("flex model" and "critical thinking disposition") or ("flex model" and "critical thinking skills")
"self-blended model" and "critical thinking"
("self-blended model" and "critical thinking disposition") or ("self-blended model" and "critical thinking skills")
"enriched virtual model" and "critical thinking"
("enriched virtual model" and "critical thinking disposition") or ("enriched virtual model" and "critical thinking skills")
"rotation model" and "critical thinking"
("rotation model" and "critical thinking disposition") or ("rotation model" and "critical thinking skills")
"station rotation model" and "critical thinking"
("station rotation model" and "critical thinking disposition") or ("station rotation model" and "critical thinking skills")
"lab rotation model" and "critical thinking"
("lab rotation model" and "critical thinking disposition") or ("lab rotation model" and "critical thinking skills")
"flipped classroom model" and "critical thinking"
("flipped classroom model" and "critical thinking disposition") or ("flipped classroom model" and "critical thinking skills")
"individual rotation model" and "critical thinking"
("individual rotation model" and "critical thinking disposition") or ("individual rotation model" and "critical thinking skills")

as the subcategories of blended learning, that is, the flex model, the self-blended model, the enriched virtual model, and the rotation model and its subcategories (the station rotation model, the lab rotation model, the flipped classroom model, and the individual rotation model).

Selection of studies

After a search on the databases, the articles which met the inclusion criteria were selected for review. To be included, the articles had to (1) be about the effects of blended learning and its subcategories or compare blended learning and conventional learning in terms of their impact on critical thinking (and its subcategories) in students, (2) have been conducted on university students of any major, (3) have been conducted between 2010 and 2020, and (4) be in English (the articles which were in other languages were translated by professional translators). The exclusion criteria were the article (1) being a letter to the editor, a review, a lecture, or a poster, (2) having been conducted on other-than-college-student learners, (3) having addressed blended learning and its subcategories in combination with other methods of learning, and (4) having a low impact factor. After selecting articles based on the inclusion and exclusion criteria, two of the authors checked the titles and abstracts of the articles. In the next stage, the selected articles were closely read. All possible disagreements over the selection of articles were discussed until the authors reached an agreement. When the selection of the articles was finalized, one of the authors extracted data from the articles that met the inclusion criteria.

Extracting the data

The quality of the selected articles was evaluated according to the criteria suggested by Gifford *et al*.: 6 criteria for quantitative studies, 11 criteria for qualitative studies, 8 criteria for semi-experimental studies, and 7 criteria for experimental studies. The criteria were measured on a 2-score scale (0 and 1). The cutoff point was 4 and below for quantitative studies, 6 and below for experimental and semi-experimental studies, and 8 and below for qualitative studies.[26,27]

Quality assessment of articles

The checklist of the Critical Appraisal Skills Programme was used to evaluate the quality of studies. This checklist included eight different items, and the selected checklist here consisted of 10 questions that divided articles into three levels of quality: high, medium, and low.

Results

Of the 256 articles which were found, 67 were repeated and, therefore, omitted. After examining the titles and abstracts of the remaining 189 articles, the researchers omitted 96 articles. The remaining 93 articles were read closely and finally 15 articles were verified [Figure 1].

Of the 15 selected articles, the majority had been conducted in Asian countries—South Korea (4), Indonesia (4), Iran (3), Malaysia (1), and Saudi Arabia (1)—and 2 were American studies. Most of the studies had been conducted on nursing students (7 articles) and the rest had addressed English students (2 articles), dental technology (1 article), electronic engineering (1 article), educators (1 article), chemistry (1 article), plant tissue culture (1 article), and aeronautics (1 article). Information about the articles is presented in Table 2 under the following headings: author, year and country, type of study and method of data collection, participants and research results. Of the 15 articles which were examined, 14 reported that blended learning and the subcategory of flipped classroom were effective methods for developing university students' critical thinking and 1 article reported the opposite.

Discussion

The majority of the studies had been conducted in Asian countries. These studies address the effects of blended learning—a combination of traditional learning and electronic learning—on university students' critical thinking. As mentioned above, most of the reviewed studies[11,28–40] showed that blended learning was an effective method for improving students' critical thinking. The results of studies by Hasanah,[11] Bolandifar,[34] Nasution,[37] Hajrezayi,[39] and Mosalanejad.[40] verified that blended learning had a significant positive impact on university students' critical thinking skills.[41] These studies showed that, compared to traditional methods of learning, blended learning was more effective in improving students' critical thinking skills. The greater effectiveness of blended learning could be attributed to the fact that it allowed students to participate more in the learning process, as well as the fact that it possessed the benefits of both traditional learning and electronic learning, which enabled students to better analyze, interpret, and evaluate subjects. However, Alotaibi's study reported that the contribution of blended learning to university students' critical thinking skills was insignificant. In this study, a lack of proper teaching material and the students' lack of interest might have led to the learners' poor critical thinking skills.[42] The students' insufficient familiarity with blended learning, unavailability of computers, and infrastructure issues might also explain the results of the above-mentioned study.

Addressing the effects of flipped classrooms on university students' critical thinking disposition,

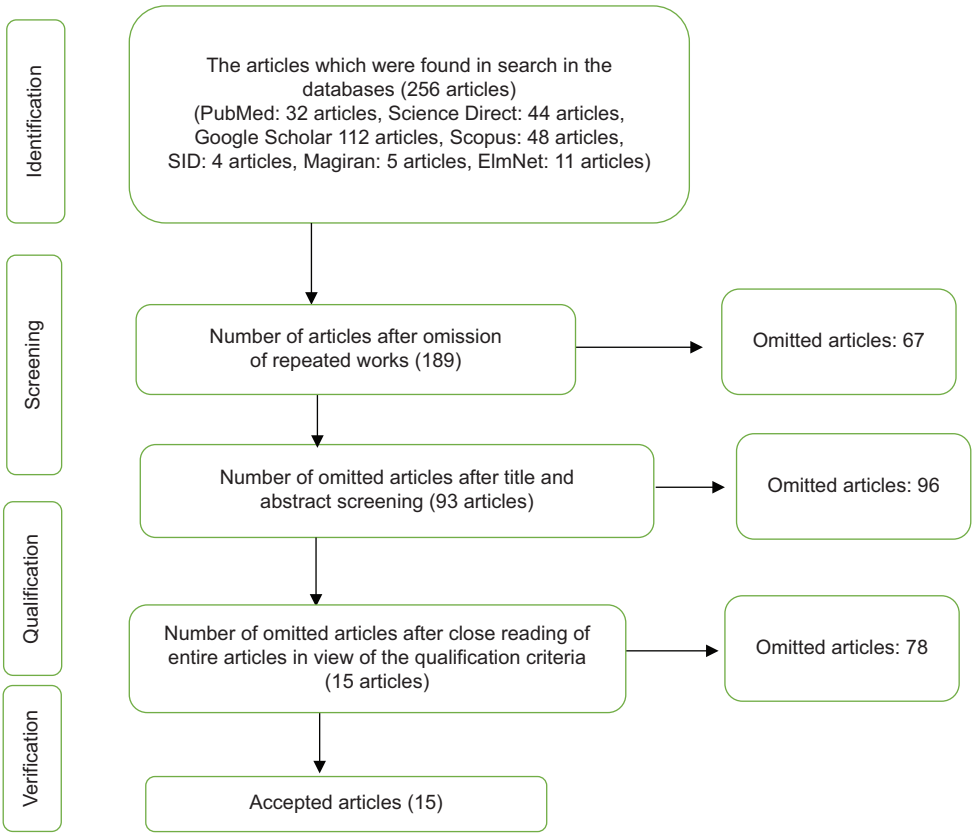

Figure 1: The process of systematic review

the studies of Cha,[28] Kim,[29] Dehghanzadeh,[32] Jung,[33] Lee,[35] and Dusenbury[38] showed that flipped classroom learning, a subcategory of blended learning, had a more significant positive impact on university students' critical thinking disposition than traditional learning does. Moreover, the results of the studies of Asmara,[30] Munzil,[31] and Matthews[36] verify that flipped classroom learning is a more effective method than traditional learning for improving students' critical thinking skills. The effectiveness of the approach could be attributed to the fact that, being a subcategory of blended learning, flipped classroom learning had the advantages of both traditional and electronic learning; also, by removing the limitations of those two methods, flipped classroom learning made a greater contribution to the improvement of students' critical thinking skills. The findings of these studies showed that flipped classroom learning had a positive impact on the critical thinking of students of different majors[11,28–40] and could, therefore, be employed in various academic fields.

Limitations and recommendation

The present study was one of the first review studies that investigated the effects of blended learning on critical thinking as reported by articles in several databases. All the subcategories of blended learning were examined in this study. The researchers also tried to include a variety of academic fields. However, blended learning was not compared with other modern methods of learning. Accordingly, it is suggested that future studies compare the effectiveness of blended learning with other modern methods of learning.

Conclusion

In the present study, 15 articles related to the effects of blended learning and its subcategories on critical thinking (and its subcategories) in university students were reviewed. The results showed that, by combining the two methods of lecturing and electronic learning, blended learning and its subcategory of flipped classroom enable teachers to use the advantages of both approaches and encourage student-centered learning. This causes blended learning to be a more effective method for improving students' critical thinking, in terms of both disposition and skills.

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Table 2: A summary of the reviewed articles

Author/country/participants/year	Type of study/method of data collection/results
Hasanah/Indonesia/92 electronic engineering students at Makassar University/2020	Quasi-experimental/Demir's questionnaire/Compared to lecturing, blended learning has a more significant impact on university students' critical thinking[11]
Cha/South Korea/82 nursing students at Chosun University/2020	Quasi-experimental/Yoon's Critical Thinking Disposition instrument/Flipped classroom learning is more effective than traditional learning in improving students' critical thinking disposition[28]
Kim/South Korea/74 nursing students at Dankook University/2020	Quasi-experimental/Yoon's Critical Thinking Disposition instrument/Flipped classroom learning results in higher critical thinking disposition scores than traditional learning does[29]
Asmara/Indonesia/60 English students at Central Java State University/2019	Quasi-experimental/Researcher-made questionnaire/Compared to traditional learning methods, flipped classrooms improve students' critical thinking skills more.[30]
Munzil/Indonesia/67 chemistry students at Malang University/2019	Quasi-experimental/Ennis's Critical Thinking Skills questionnaire/Flipped classrooms are more effective than traditional methods of learning in improving students' critical thinking skills[31]
Dehghanzadeh/Iran/43 nursing students at Azad University of Rasht/2018	Quasi-experimental/Ricketts' Critical Thinking Disposition questionnaire/Flipped classroom learning has a positive impact on students' critical thinking disposition; students recommend this method of learning for development of critical thinking[32]
Jung/South Korea/104 dental technology students at Daegu University/2017	Quasi-experimental/Guglielmino Learning Readiness Scale/Flipped classroom learning makes a significant contribution to development of students' critical thinking.[33]
Bolandifar/Malaysia/42 English students at Putra University/2017	Quasi-experimental/Cornell's Critical Thinking Test/Blended learning is more effective than lecturing in improving students' critical thinking skills and comprehension[34]
Lee/South Korea/140 nursing students at Gyeongsang University/2016	Quasi-experimental/Yoon's Critical Thinking Disposition instrument/Flipped classrooms have a more significant impact on students' critical thinking disposition than traditional classrooms do.[35]
Matthews/U.S./24 nursing students at a liberal arts university in North Carolina/2016	Quasi-experimental/Watson-Glaser Critical Thinking Test/Flipped classrooms contribute to students' critical thinking skills, which can result in a more professional workforce[36]
Nasution/Indonesia/94 plant tissue culture students at Medan University/2016	Quasi-experimental/Ennis's Critical Thinking Skills questionnaire/Blended learning is more effective than traditional learning methods in improving students' critical thinking skills[37]
Dusenbury/U.S./109 aeronautics students at Midwestern University/2016	Quasi-experimental/California Critical Thinking Skills Test/Compared to lecturing, flipped classroom learning is more effective in promoting students' critical thinking disposition[38]
Hajrezayi/Iran/61 nursing students at Ardebil University of Medical Sciences/2015	Quasi-experimental/California Critical Thinking Skills Test/Blended learning is more effective than lecturing in improving nursing students' critical thinking skills; teachers are recommended to rely more on this learning approach[39]
Mosalanejad/Iran/41 nursing students at Jahrom University of Medical Sciences/2014	Quasi-experimental/Watson-Glaser Critical Thinking Test/Blended learning is more effective than traditional learning in improving students' critical thinking skills; blended learning is recommended for medical and paramedical sciences[40]
Alotaibi/Saudi Arabia/58 students at King University's School of Education/2013	Quasi-experimental/Watson-Glaser Critical Thinking Test/Blended learning does not have a significant impact on students' critical thinking skills[41]

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Conflicts of interest

There are no conflicts of interest.

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