Mapping the Development of ICT from the Trend of Blended Learning: A Systematic Literature Review of the Blended Learning Trend in Education

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Abstract: With the rapid rise and maturity of online learning, blended learning has become one of the main trends in education reform and development in the future. Therefore, visualizing the knowledge structure of blended learning is necessary for future research. This study establishes a knowledge structure through document co-citation analysis and multidimensional scale analysis by analyzing a total of 395 documents from 2015 to 2020. The results of this study objectively predict the trend of blended learning research. Research themes are prominent in blended learning environments, online learning, motivation and motivation regulation, and academic achievement. Relevant studies reflect the significance of information communication technologies in supporting the development of blended learning. This study has important reference significance for blended learning practitioners and researchers to address blended learning challenges.

Keywords: Blended learning, ICT, document co-citation analysis, educational research

1. Introduction

With the maturity of network technology and the growth of people's demand for high-quality education, blended learning (BL) has become one of the research directions of educational technology, with potential in the information-based education reform process. Blended learning consists of face-to-face sessions and learning materials that are supported by information communication technologies (ICT) (Tshabalala et al., 2016, p.43). Exploring the trend of BL is the significance for studying the development of ICT from another perspective. This study searched the literature review in the Web of Science (WOS), Google Scholar, ERIC, and SCOPUS by reviewing the searched literature articles of the BL category.

The literature review in these databases discusses four aspects. The first aspect is about professional skills training for teachers. Philipsen et al. (2019) proposed a teacher professional development framework in the BL. Other scholars have used systematic literature review to analyze this framework and provide more supplements (Lockee, 2021; Portillo, 2021). The second one is related to the BL in medical health education. From the perspective of the period, the review articles accounting for medical health education have a relatively large number (six documents). Relevant literature research has developed from evaluating the application of BL (Mccutcheon et al., 2015) to starting from practice, studying the performance of student learning outcomes (Coyne et al., 2018; Vallée et al., 2020). The third aspect discusses challenges. Boelens et al. (2017) and Rasheed et al. (2020) reported the challenges of BL, such as collaborative learning, instructional design and the online component. The last one is about students' self-regulation ability. Anthonysamy et al. (2020) described the importance of self-regulated learning skills for BL.

Therefore, the past literature review of BL rarely analyzes the entire knowledge domain visually. In this literature review on BL, the researchers conducted a visual analysis from three aspects, namely, BL research trends, theoretical background, and subtopic classification differences. This study

aims to discuss the focus and research status of BL research topics. On the basis of the research results, this study reveals the evolutionary background of BL theory and constructs a visual knowledge map between related themes.

2. Methodology

2.1 Data Sources

In this study, international academic journals were search from WOS, Google Scholar, ERIC, and SCOPUS. This study applied inclusion criteria to the search procedures. The inclusion criteria included research topics (BL/hybrid learning), publication time (January 1, 2015 to December 31, 2020), research background (educational research), journal quality (high-impact journals), and abstracts (clearly discussed in the BL).

Depending on the retrieval criteria, we retrieved 395 documents in English. Keywords were extracted by BICOMB2.01 (Bibliographic Items Co-occurrence Matrix Builder 2.0), and word frequency was counted. Keywords with word frequency greater than three were selected as the final data sources.

2.2 Method

This review used systematic analysis method to uncover relevant research of BL in the past. The design of the flow diagram is shown in Figure 1. It shows the process of analyzing the literature.
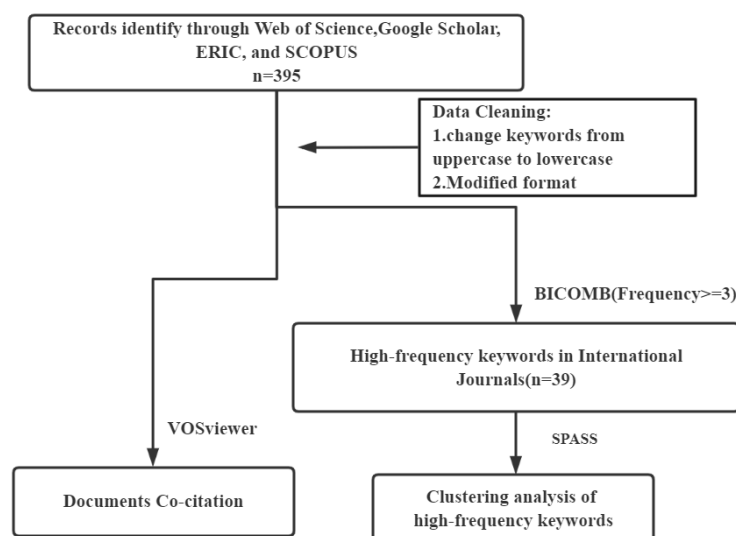

Figure 1. Research process diagram.

3. Results

3.1 Research Trend Analysis

The analyses of the changing trends in the number of journal papers with BL themes help grasp the characteristics and development speed in this field. Therefore, this study obtained 395 valid documents articles in English, and the total trend chart of literature were generated (Figure 2). The number of international articles has been steadily increasing in recent years, reaching the largest at 129 in 2020. Thus, BL research has been continuously concerned by worldwide researchers and developed rapidly. According to the index trend line and determination coefficient (R^2=0.9879), the number of BL articles will maintain a continuous growth trend in the future.
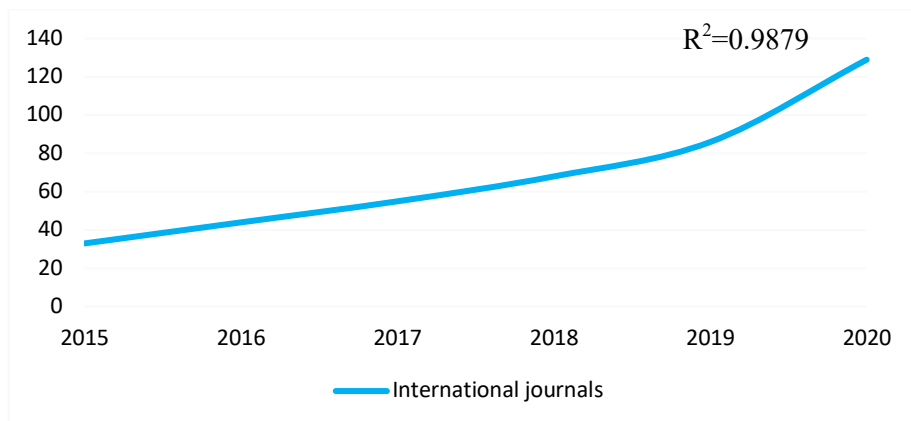
Figure 2. Trends of total literature volume in international high-quality journals of BL.

3.2 Theoretical Background Analysis

The multi-citation clustering of articles related to highly cited BL can better reflect the knowledge structure of the BL research field. VOSviewer has its own clustering technique (Van Eck & Waltman, 2017). This study uses documents that have been cited no less than seven times for clustering, as shown in Figure 3. Based on the citation relationship between clusters, the high-frequency clustering of BL research theories can be classified into four categories, namely, BL courses, learning satisfaction, communication and inquiry, and student experience.
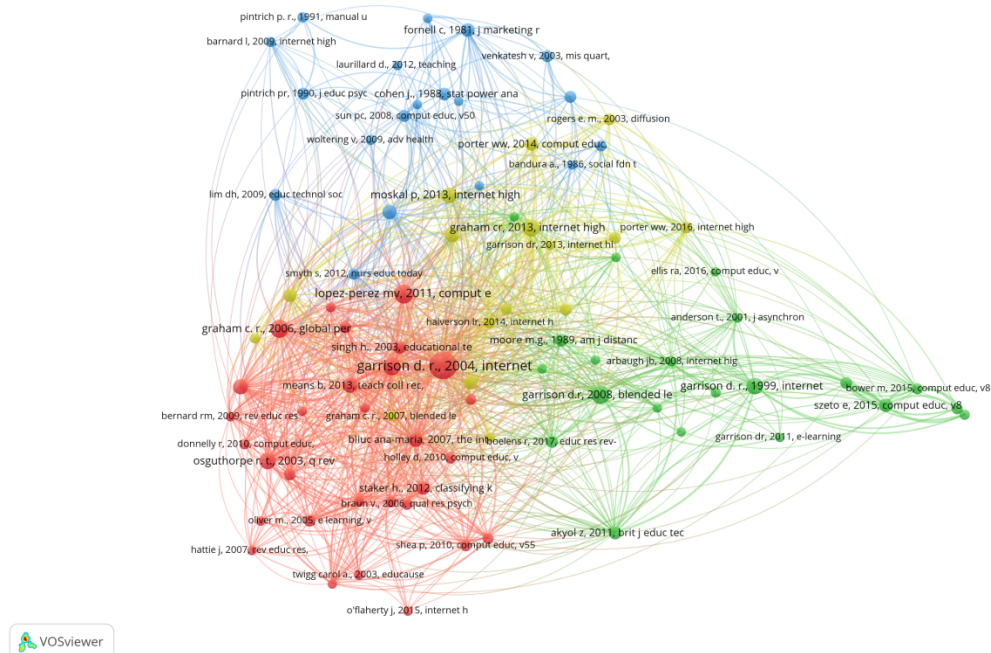

Figure 3. Document co-citation cluster map of international journal documents.

BL course (in red as described in Figure 3): In this category, the documents represented by Brown (2016), Garrison (2004), Osguthorpe and Graham (2003), and Porter et al. (2016) received the highest citation frequency. In this type of highly cited literature, the topic of discussion mainly revolves around the BL course. BL course is the integration of online and face-to-face learning. Online learning complements the students' learning process. Moreover, in view of this definition, other highly cited scholars have discussed the details of the composition of the BL course. For example, an international component of online content can encourage individual participation and minimize students' background influence of course participation in small groups (Mittelmeier et al., 2017). If electronic

devices are utilized in BL, then more consideration should be given to providing electronic device use services to ensure the realization of sustainable interaction and deep learning in the course. Setting the learning analysis function in the BL course can realize the mining and analysis of the meaningful process of BL. Setting up the learning analysis function in the process of BL can achieve the mining and analysis of significant processes. At the same time, the implementation of mixed discussion in BL courses can enhance the recognition of the value of learning for college students. However, in terms of cooperation, Han and Ellis (2020) argued that to have a more successful BL experience, students need to choose partners with the same learning tendencies.

Learning satisfaction (in blue): This cluster focuses on BL practice courses in medical education. As shown in Figure 4, the research of Cook et al. (2010), Smyth et al. (2012), and Woltering (2009) are relatively close in this cluster with a high correlation. The study also examined student satisfaction and affirmed the positive influence of BL on improving students' learning outcomes. Moreover, within this range, the article "A study of student satisfaction in a blended e-learning system environment" is the most frequently cited descriptive literature. Although this study did not take medical education as an object of study, the authors proposed four prerequisites for improving student BL satisfaction (Wu et al., 2010). From the perspective of citation frequency, relevant research subjects generally agree with this view.

Community inquiry (in green): Garrison et al. (1999) proposed the model of community inquiry in the process of BL. In this model, Garrison not only emphasized community interaction but also stated the role of social media. Social media will lead to sustainable change in community communication. Therefore, in this cluster, the viewpoints of documents with high citation frequency also engage in more in-depth discussion around the two aspects. On the one hand, BL environments provide students with an inquiry community. In this community, problem-solving, collaboration among students, perceived learning outcomes, and overall satisfaction are enhanced (Roux & Nagel, 2018; Westerlaken et al., 2019). On the other hand, students have great expectations and preferences for the quality and usability of social media (e.g., audio, video, and interactive platforms; Morris et al., 2019).

Student experience (in yellow): The article "Blended learning systems" is the most frequently cited document in this cluster. Therefore, BL research in this cluster follows the concept of BL, the objectives of the BL environment, and the implementation framework of BL proposed by Graham and other relevant scholars (Graham et al., 2013; Osguthorpe & Graham, 2003). Around this theoretical basis, the clustering research conducted in-depth discussions from the perspective of student experience on cooperative learning, social existence, satisfaction, and user needs of new learning tools (Morris et al., 2019).

3.3 Research Theme Analysis

Clustering analysis of high-frequency keywords can result in the topic structure of BL, however the position of each research topic is unclear. With the help of multidimensional scaling analysis (MDSA), we can further determine the location of each research topic and the keywords within the group. These positions can explore the trends of international research hotspots of BL. MDSA describes the relationship among multiple keywords to analyze the high-frequency words generally distributed as points in the MDSA graph. Their similarity is usually drawn by the relative position between each discrete point. Keywords with a high degree of similarity will gather together to form a category. At the same time, the keywords closer to the middle will have a more core position. The more they are at the edge, the narrower the research topic is or the transition to other themes. In the present study, we imported a dissimilarity matrix, which we previously prepared in SPSS. Moreover, we generated an MDSA atlas using ALSCAL, as shown in Figure 4. From the overall perspective, the BL research presents the characteristics of relatively scattered overall and relatively concentrated parts. However, the degree of the core within the theme is not high, and all studies are marginalized. That is, the state presented by the BL research is highly correlated with the influence of its definition. BL is also often interrelated with other topics. Therefore, the overall graph shows a transition trend.

(1) "Mobile learning," "self-regulated learning," "motivation," and "attitude" are in Region A. In this group, the distance between attitude and learning strategies is close to the center of the theme. In the analysis of the influencing factors, Kintu and Zhu (2016) believed that learners' attitudes toward the affinity of BL intrinsically affect students' satisfaction. According to the analysis of the results, students generally hold a positive attitude toward BL (Taghizadeh & Hajhosseini, 2020). This positive attitude

improves students' satisfaction and communication skills (Shorey et al., 2017). In terms of learning strategies, Vanslambrouck et al. (2018) proposed that BL helps students change their learning strategies. The importance of appropriate learning strategies for new information processing should not be underestimated in the learning process of new knowledge impart using BL methods (Eagleton, 2017). Mobile learning, self-regulated learning, and motivation are relatively close to one another. We summarized BL research supported by mobile technology. Using mobile technology to create a BL environment can realize the immediacy of learning and communication (Barrett & Liu, 2019). Therefore, the purpose of BL using mobile technology is to promote the improvement of cooperation, interaction, and communication between students in language learning. The learning motivation of students has a positive influence during the progress of BL (Alkış & Temizel, 2018). As a result of the small number of the group, articles about BL supported by mobile learning in recent years are limited, which may transfer to other topics in future research.
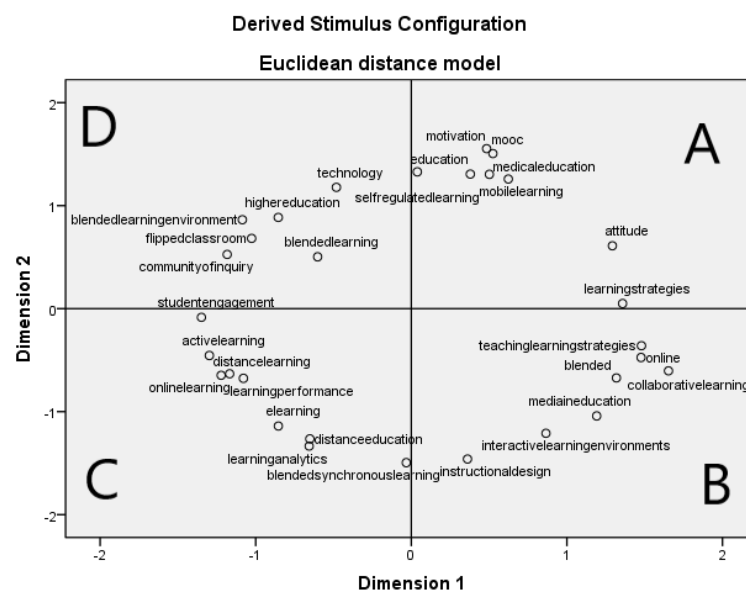

Figure 4. MDSA map of high-frequency keywords in international journal databases.

(2) Keywords such as "teaching–learning strategy," "collaborative learning," and "media in learning" are in Region B. The research topics in this group mainly focus on BL represented by media technology, and it focuses on the design and implementation of collaboration between students and teaching methods. Dridi et al. (2020) verified through MOOCs that collaborative learning environments help students cope with the challenges of blended courses. Furthermore, the course management system (Moodle) in BL can realize the construction of deep knowledge by collaborative learning than chatting tools (Sun et al., 2017). In future studies, this group will be more theme-centered. Scholars will gradually focus on the integration of attitudes and learning strategies.

(3) Keywords such as "online learning," "distance learning," and "learning achievement," are located in Region C. This type of group focuses on the BL supported by Internet technology. In this region, learning activity, online learning, and learning performance are close to one another and the center. Therefore, in this group, scholars are more inclined to study the application of learning platform (e.g., learning management system), students' abilities (e.g., communication and self-regulation abilities), learning analysis (e.g., hidden Markov model and condensed sequence clustering detection model) and students' academic performance under this model (Bervell & Arkorful, 2020; Ramirez-Arellano et al., 2019). The BL method analysis and synchronous learning in this group are far from the center. The related topics of these categories are relatively narrow and tend to combine with other themes in future research.

(4) Keywords such as "blended learning environment," "high education," and "flipped classroom" are located Region D, which is focused on the BL environment. The distance between each keyword in this quadrant is extremely close. The BL environment is concentrated in colleges and

universities. Particularly, flipped classroom, as a BL mode, has a large number of related research papers. Scholars have mainly studied the effect of applying this model, such as the effect of a flipped classroom on students' thinking (Sadik & Abdulmonem, 2020), the influence of a flipped classroom on teachers and students' learning workload (Alcaraz et al., 2019), and the change in students' self-efficacy (Thai et al., 2020). In future research of mixed learning, the construction of the BL environment will still become the research topic in this field.

4. Discussion

On the basis of the analysis of the selected literature, the theoretical background influencing the subsequent research of BL mainly revolves around the definition of BL and the implementation framework. From the perspective of the definition of BL, some scholars agree on a broader range of definitions of BL, which not only emphasize the combination of online and face-to-face but also include the integration of different technologies, theories, and teaching strategies (Friesen, 2012; Lalima & Dangwal, 2017). However, with the development of BL research, the definition of BL has three common points. First, web-based support makes online learning possible. Second, online learning is a supplement to face-to-face learning. Third is the promotion of the in-depth integration of information technology and curriculum. However, the definition should not withdraw from the context. In other words, although the essence of BL research is limited to the combination of face-to-face and online learning, it narrows the research scope of BL. This simple definition is not to say that BL is simply a description of the operation of web-based BL. Especially in the BL implementation of the strategy, we still need to provide it with a theoretical basis (e.g., constructivism, behavioral, and cognitive science). It can make the development of BL gradually have its research core. Furthermore, it enables innovative learning situations, and optimizing students' learning has become the common goal of BL.

From the perspective of the implementation framework, the research of different scholars is different. First, Graham (2013) summarized the implementation framework from the BL implemented by some institutes. Through the analysis of the implementation process of BL, the implementation phase of BL is divided into three parts, namely, awareness/exploration, adoption/early implementation, and mature implementation/growth. Wu (2016) explored into the practice of BL. He designed the framework from the perspective of curriculum design. Although the research perspective of the BL implementation framework is different, they focused on the construction of the BL environment, emphasizing the importance of goal setting and BL. Therefore, in future research on the implementation framework of BL, scholars can consider comparing the mutual mapping or differences between the frameworks of BL under cultural backgrounds, which will better guide the implementation of the instructional design of BL.

Finally, common research tendencies exist among the relevant studies on key research topics. For example, online learning research related to BL will focus on the research on the proportion of online learning in BL, the construction of online learning resources, the analysis of online learning achievements, and obstacle factors. In the future, research on related topics will still incline to the development of students' abilities and resource construction. Flipped classroom, which has a high frequency of keywords, is also a hotspot topic in the research of BL. The research content focuses on the positivism research paradigm, teaching strategies, and teaching effects combined with the BL environment. The adjustment of learning motivation and academic performance are still hotspots in the research of BL. However, mobile learning shows a trend of marginalization, and most of the research content focuses on the use of mobile technology to promote learning exchanges and communication. The creation and application of mobile learning resources in BL should be considered in the future.

5. Conclusion

Given the impact of the COVID-19 pandemic on education, BL will introduce practice opportunities. Therefore, understanding the status of BL research is significant for the future development of BL. The conclusions and findings of this study have a reference value for researchers to understand the current situation of BL. The results show that the development of information technology has influenced the

development of blended learning. At the same time, the findings point out the direction to continue to practice BL research in the future. Of course, the comprehensiveness of the literature is still relatively lacking. For example, documents in fundamental education are relatively few; thus, the research conclusions were directly affected by the data sources. Future research would be richer in different databases and document types to have a more comprehensive understanding and grasp of the research progress of BL.

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