The Research on the Theme and Development Trend of Mobile Learning in China in the Past Ten Years

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Abstract: Mobile learning has become a normal learning mode. It not only seeks innovation in terms of learning time and learning space but also has in-depth research in technical support, learning design, learning model and teaching practice. This paper has used UCINET, SPSS and Citespace to analyze the mobile learning literatures of recent ten years and analysed research topics and development trends of mobile learning using time-space analysis of literatures, social network analysis, analysis of highly cited documents and multidimensional scaling.

1. Introduction
The concept of mobile learning was first proposed in the journal in 1998. In 2000, Desmond Keegan (Ireland) first discussed mobile learning in the article of Distance education, e-learning, and mobile learning and put forward that the next generation of distance learning will be mobile learning from the perspective of distance education[1]. In recent years, with the development of mobile internet and communication technology, mobile learning has gone beyond the scope of distance learning and has become a normal learning mode. The learner uses a mobile terminal such as a smart phone to learn independently at any time and any place according to his own needs. This paper adopts social network analysis software UCINET, SPSS, Citespace to analyze related literature, aiming to obtain the research theme and development trend of mobile learning so as to provide reference for related research.

2. Data Source
In the Chinese journal database (CNKI), [SU=“mobile learning”] is used to find the research literature of nearly ten years (by December of 2018), and 3356 valid articles are retrieved. The number of papers published has shown a steady increase every year, as shown in Figure 1.
3. Research Ideas and Methods
This paper uses bibliometric statistics to analyze the research literature on mobile learning from 2008 to the present, from research teams, institutions, levels, disciplines, topics, and trends. On this basis, research gap is sought to provide ideas for the next study. Therefore, the paper firstly bases on CNKI to obtain research literature data from 2008 to the present, and then uses Citespace software to analyze authors and research institutions in the literature. Through the creation of keywords, co-occurrence network relationship maps to classify mobile learning research topics. Through the statistical analysis software SPSS, multidimensional scale analysis of mobile learning research hot-spots in the next few years is obtained.

4. Data Analysis and Results
Since the publication of the first mobile learning literature in the journal in 2000, the number of relevant research literature has increased steadily every year, and it has reached 512 in 2016, which shows that mobile learning is getting more and more attention. The following is an in-depth analysis of mobile learning from four aspects: spatial and temporal distribution of literature, social network analysis of high-frequency keywords and multi-dimensional scale analysis.

4.1. Spatial and temporal distribution of literature

4.1.1. Analysis of published literature. The most sources of journals are China Education Info, Computer Knowledge and Technology, Software Guide of Education Technology, China Education Technology & Equipment and Modern Education Technology, accounting for 2.9%, 2.8%, 2.5%, 2% and 1.8% of all literatures, respectively. They cumulatively make up for 12% of all journal articles. These five journals are relatively focused on mobile learning, with more than 60 publications per journal.

4.1.2. Analysis of literature research disciplines. From the perspective of research disciplines, there are 1690 papers on education theory and education management, accounting for 50.6% of the total literature, computer software and applied literature accounting for 18.5%, foreign language literature accounting for 10.3% These three disciplines account for 79.4% of all literature. It can be seen that mobile learning research mainly involves theoretical, technical and applied research in language teaching.

4.1.3. Analysis of literature hierarchy. From the research hierarchy, mobile learning research is concentrated in basic research (38.9%), industry guidance (14.1%), higher education (14%), engineering technology (8.6%), and basic education and secondary vocational education (7.6%).

4.1.4. Analysis of literature funds. Some research literature has been funded by research funds at the provincial level or above. Among them, there are more national education science planning projects (36), the National Natural Science Foundation (25), and the National Social Science Fund (18).
4.1.5. Analysis of research institutions. Mobile learning research has formed several relatively stable research institutions. The top five published schools are Beijing Normal University (45), Northwest Normal University (35), Shaanxi Normal University (30), and Bohai University (29) and Liaoning Normal University (27).

4.1.6. Analysis of research team. Mobile learning research has also formed a relatively stable research team. Among them, it includes the research team with Fang Haiguang as the core, one with Li Yushun, Fang Haiguang and Huang Ronghuai as the core, one with Wang Minjuan as the core, and one with Su Yangna as the core.

4.2. Analysis of high-frequency keywords

4.2.1. High frequency keyword extraction. High-frequency keywords can reflect research hot-spots in a certain field. The Bibliographic Items Co-occurrence Matrix Builder 2.0 (bicomb2.0) is used to extract high frequency keywords from the mobile learning related literature. In order to ensure accuracy, the keywords with similar meanings are merged. For example, learning system and learning platform merged into learning platform, smartphone, tablet and mobile phone are merged into mobile terminal. The standard is generally that the cumulative frequency of intercepted high-frequency words reaches about 40% of the total frequency [2]. In the CNKI, the search for high-cited articles of mobile learning finds that the highest frequency of citations is published by Ye Chenglin, Review of Mobile Learning Research, which is cited 631 times. It is substituted into the Price calculation formula and yielded an M value of 18.8. Therefore, keywords with a word frequency greater than or equal to 19 are selected as high frequency keywords, and a total of 55 high frequency keywords are obtained. As shown in Table 1, the cumulative percentage of 55 keywords accounts for 43% of the total frequency, which is also in line with the standard of “high-frequency words cumulatively reach about 40% of the total frequency”.

| Keywords                      | Frequency | Percentage | Accumulated percentage |
|-------------------------------|-----------|------------|------------------------|
| Mobile Learning               | 2174      | 18.72      | 18.72                  |
| PDA                           | 308       | 2.65       | 21.37                  |
| Learning platform             | 200       | 1.72       | 23.09                  |
| ELT                           | 161       | 1.39       | 24.48                  |
| learning model                | 128       | 1.10       | 25.58                  |
| Android                       | 112       | 0.96       | 26.55                  |
| WeChat                        | 109       | 0.94       | 27.49                  |
| self-directed learning        | 94        | 0.81       | 28.30                  |
| Mobile Learning               | 89        | 0.77       | 29.06                  |
| distance learning             | 74        | 0.64       | 29.70                  |

4.2.2. Social network analysis of high-frequency keywords. In order to further analyze the research hot-spots of mobile learning, this paper uses the social network analysis software UCINET to draw the social network relationship diagram of high frequency keywords, as shown in Figure 2. Through the spectrum analysis, the following conclusions are drawn:

In the relationship diagram shown in Figure 2, the larger the node, the greater the role of the node in the relational network, and the greater the control over other nodes. In addition to the search terms, the three keywords of "mobile terminal", "self-learning" and "learning platform" have larger nodes and are located at the center of the entire relational network, which plays a controlling role for the entire relational network. Besides, if the solid line between the two nodes is shorter and thicker, the closer the relationship between the two nodes, the more times the two keywords appear in the same document. The solid line between “mobile learning” and “mobile terminal” is the thickest, and the solid line distance between “mobile learning” and “learning platform” is the shortest; the solid line between “mobile terminal” and “self-learning” is thicker and the distance is the shortest. Therefore, it
can be considered that the three core keywords of “learning platform”, “mobile terminal” and “self-learning” construct the “mobile learning” ecological chain. It supports the mobile learning system, where mobile learning carries learning resources based on the learning platform, records learning behaviors, builds bridges between learning platforms and learners based on mobile terminals, and realizes information transmission; learners conduct independent learning based on mobile terminals.

What’s more, there are mobile terminals, applications, learning resources, learning platforms, WeChat, English teaching, self-learning, learning mode, information technology, and distance education that are closer to the solid line of the search word "mobile learning." These keywords represent the focus of research in mobile learning. The keywords such as Android, learning process and learning activities are relatively high, but the solid line distance from the search term is relatively far, and the relationship is relatively loose. The keyword "English teaching" appears more frequently and is at the center of the spectrum. Combined with relevant literature, it can be considered that mobile learning is widely used in the teaching and learning practice of English courses such as College English.

In the social network relationship diagram of high frequency keywords, keywords including learning activities, learning processes, instructional design, mobile learning environments, learning effects, and resources, are located at the edge of the map and are more distant from other nodes, where there is still a lack of in-depth research. However, from the perspective of in-depth study, these keywords are just a few links that are very important in the design of traditional learning activities. It can be seen that there are still differences between traditional learning activities and mobile learning in the process links.

4.2.3. Analysis of keyword hybrid network clustering. In order to further study the research theme of "mobile learning", through the analysis software Citespace to map keywords to the co-occurrence network map, the mobile learning research field is classified and analyzed. As shown in Figure 3, mobile learning research centers on "smart phones" and forms a number of stable research areas.

Figure 2 High frequency keyword relationship diagram
4.3. Research conclusions

Combining the above high-frequency keyword co-occurrence map and related literature content, the research theme of domestic mobile learning mainly involves the following five aspects:

4.3.1. Basic theoretical research on mobile learning. The core keywords are system design, model, lifelong learning, adult education, and open education. The main contents include mobile learning theory foundation, definition and change, mobile learning meaning and development interpretation; mobile learning teaching design research; mobile learning model research; mobile learning in lifelong learning, adult education and open education application value analysis and relevant theoretical research on mobile internet, representative of the environmental road-map of mobile learning system proposed by Fang Haiguang [3]; the discussion of mobile learning theory and current situation, put forward by Huang Ronghuai [4] in Mobile Learning - Theory, Current Situation, Trend.

4.3.2. Mobile learning application research. The core keywords are English teaching, digital learning, independent learning, distance education, mobile education, teaching mode, flipping classroom, lifelong learning, distance learning, application, and learning effects. There are 723 practical application research literatures, accounting for 28% of all literature, such as 161 studies on mobile learning in the "College English" course, an empirical study of mixed mobile learning conducted by Lin Xiaofan et al [5], mobile learning activities design and empirical analysis supported by WeChat by Yan Yingqi [6]. Almost all practical application research is supported by mobile terminals, learning platforms (systems), and autonomous learning activities.

4.3.3. Research on mobile learning technology. The core keywords are mobile learning platform, Android technology, 3G technology, WeChat, cloud computing, information technology, J2ME, HTML5, mobile platform, WeChat public platform, APP, learning system, Weibo. The technical means is the bridge between learning platforms and learning activities. For example, Miao Ning [7] uses WeChat to construct a college English mobile learning application model, the research by Ma Yuhui et al [8] bases on the development model of mobile APP. Mobile learning technology is no longer limited to smart-phones, tablets, and even bar code technology and QR code technology are gradually applied to mobile learning research and practice.
4.3.4. Research on mobile learning resources and environment. The core keywords are resource design, resource design, mobile learning resources, development, and mobile internet. Mobile learning emphasizes the high degree of autonomy and the attraction of resources and the environment. Zhao Hui et al [9] divide the mobile learning resources into five parts: design, development, application, management and evaluation in Review of Domestic Mobile Learning Resources and proposes the trend of mobile learning in technology research, applied research, standard construction and cloud environment. Li Huiqing [10] further review the research on mobile learning resources in China from 2013 to 2015, and conducts an in-depth analysis of the design, development and application models of learning resources.

4.3.5. Research on the status quo, countermeasures and influencing factors of mobile learning. The core keywords are current status, measures, questionnaires, and influencing factors. Through the survey and measurement analysis, the current situation, problems, learners’ attitudes and needs of mobile learning are analyzed. For example, Chen Yiqin [11] investigates the current situation and needs of adult learners’ mobile learning, Chen Jingyuan [12] studies the influencing factors of mobile learning acceptance from the aspects of users, information, system and sociality, Liu Minna [13] analyze the influencing factors of mobile learning from the perspectives of learning process, students, teachers and users and social technology, and Ji Xiaomin [14] reviews the status quo of mobile learning in China from the aspects of theory, technology, platform, learning system and applied research design.

4.4. Multidimensional scale analysis to see the trend of mobile learning

In order to further clarify the research topic and the network relationship position of each high-frequency keyword so as to determine the trend of mobile learning, this paper uses the Multidimensional Scaling (ALSCAL) of SPSS software to draw the two-dimensional scale knowledge map of mobile learning field, as shown in the figure 4. The research field of mobile learning is clearly marked in the figure, which is basically consistent with the current research hot-spots. Keywords such as mobile terminals, learning models, learning effects, learning platforms, J2ME, classroom teaching, strategy and application models will lead the research trend in the next few years. The “learning mode” is closest to the origin of the coordinates, so the learning model based on mobile learning will become the most important research hot-spot in the next few years.
5. Research Conclusions and Prospects

Based on the above research, the research status of mobile learning in China is analyzed systematically and intuitively. Not only stable research teams and core research institutions are formed with steadily increased number of research papers, but also multiple disciplines and research levels are involved. They receive funding from provincial and above, resulting in some highly cited papers with high research value, forming a stable research theme and clear research direction. Mobile learning carries out extensive research in various aspects such as technical support, learning design, learning mode and practice. Combined with the above-mentioned map analysis and related research citations, this paper believes that further research should be carried out in the following aspects.

5.1. In-depth study of mobile learning theory

The current literature has been used to study the theory of mobile learning instructional design. Although the existing theories of constructivism, activity theory and situational learning have certain guiding effects on mobile learning, from the perspective of mobile learning flexibility, immediacy and fragmentation, mobile learning and traditional learning have significant differences. Research that only pursues technological breakthroughs and ignores learning theory will not improve the learning effect of mobile learning.

5.2. Changing the concept of teachers

In the Internet Plus environment, mobile learning will promote the transformation of educational teaching mode, and the transformation of teachers’ concept is the key. The history of education development and change shows that whenever new technologies and concepts are brought into the field of education, they will experience a period of turbulence in the transformation of teachers’ concepts. Therefore, in order to promote mobile learning, it is necessary to speed up the transformation of teachers’ concepts, jump out of the guiding ideology and mode of traditional learning, and quickly adapt to the concepts related to mobile learning, especially in the implementation of learning activities combining mobile learning with traditional teaching organizations.

5.3. Implementing a combination of mobile and traditional classroom learning

Mobile learning is highly autonomous, and learners obtain learning content through mobile terminals based on individual needs. From this perspective, mobile learning lacks systematicity. Learners can construct a knowledge point, but cannot construct the knowledge structure or system in which the knowledge point is located. The results of the study show that the application of mobile learning in higher education shows a shift towards a student-driven mixed learning format. Learners use mobile technology to conduct online learning in the classroom, reconstructing traditional face-to-face classes and forming a hybrid learning model [15].

5.4. Strengthening the depth and breadth of integration of mobile learning and curriculum teaching

The integration of mobile learning and traditional curriculum teaching is mainly concentrated in the English teaching of colleges and vocational colleges, which forms the practical results of collaborative self-learning mode and teacher-led emotional supply teaching mode between teachers and students. However, mobile learning lacks integration with other general and professional courses. Therefore, it is necessary to strengthen the practical research on the depth and breadth of curriculum integration and promote the construction of the gold class.

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