

Visualization Analysis of Online Learning Resource Recommendation based on CiteSpace

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Abstract

In order to understand the research hotspots and trends of online learning resource recommendation in China, this study uses software such as CiteSpace to make quantitative statistics on 305 literatures related to online learning resource recommendation in CNKI database in the past 11 years. This paper analyzes the research status, hotspot and foreword of online learning resource recommendation by means of keyword visualization map, keyword clustering map and time zone view. It is found that the research on online learning resource recommendation mainly focuses on technology research and personalized learning guidance research for learners, and it may be combined with Wechat mini program to further facilitate learners in the future.

Keywords

CiteSpace; Online learning; Resource recommendation; Personalized recommendation.

1. Introduction

With the development of information technology and the progress of The Times, online learning has become more and more popular and indispensable, and the number of learning resources has been "explosive" growth. Learners have been submerged in the "ocean of resources", so the relevant research on online learning resource recommendation has come into being. In September 2020, China Internet Network Information Center (CNNIC) released the 46th Statistical Report on Internet Development in China [1]. It shows that by June 2020, the scale of China's Internet users was 940 million, and from June 2017 to June 2020, the number of online education in China has been showing a growing trend. By June 2020, the number of online education users reached 381 million, accounting for 40.5 percent of the total Internet users. In July, the National Development and Reform Commission, the central net letter office, the Ministry of Industry and Information Technology such as 13 departments jointly issued by the on the healthy development of the new model to support the new formats and activate the consumer market to drive's opinions on expanding employment, made it clear to develop the integration of online education, build online education normalized integration development mechanism, form the benign interaction pattern [2]. Thus, it can be seen that finding the resources needed by learners from the massive information is the current focus, so what are the current status, hot spots and trends of online learning resource recommendation research? This paper will discuss and analyze from these three aspects.

2. Data Sources and Research Methods

2.1. The Data Source

In this paper, CNKI was used as the retrieval database, and the advanced search type was selected. The search conditions were (topic = online resource recommendation or topic = online resource push or topic = online learning resource recommendation or topic = Network resource

recommendation or topic = mobile resource recommendation). The retrieval literature was published from 2010 to July 2021. Literatures without keywords and irrelevant to online learning resource recommendation were excluded, and 305 valid literatures were obtained, which were used as the analysis basis for online learning resource recommendation.

2.2. Research Methods

In this study, CiteSpace software developed by Professor Chen Chaomei was used for bibliometric analysis. This software can draw a series of knowledge maps, and provide a basis for researchers to carry out knowledge management or make scientific decisions by analyzing the map information to interpret the research status and explore the frontiers of disciplines [3]. Firstly, the relevant literature data in CNKI was exported as TXT document, and the keywords of the selected literature were extracted by citespace5.0.R1 software, and the co-occurrence network was built. Secondly, using the methods of word frequency analysis and cluster analysis to construct and interpret the knowledge graph, the research status of online learning resource recommendation in China is analyzed and summarized. Thirdly, by drawing the time zone view, the keywords of different time nodes are analyzed to reflect the evolution trend of research topics and explore the relationship between different topics. Finally, the future of online learning resource recommendation is prospected based on the knowledge graph.

3. Visual Analysis of Online Learning Resource Recommendation Research

3.1. Keyword Co-occurrence Analysis

Keywords are the core words that can reflect the topic and content of literature research. By extracting keywords from a large number of literature, the occurrence times of different keywords and their correlation are statistically analyzed to reflect the research status in this field [4]. Among them, word frequency refers to the number of words appearing in the analyzed literature, and word frequency analysis is to extract the frequency distribution of key words or theme words that can express the core content of the literature from the literature to study the research hotspot in this field. In this paper, based on the subject words and keywords in the sample data, the visualization map of keywords and high-frequency keywords are drawn, so as to determine the research hotspot of online learning resource recommendation.

Using CiteSpace analysis tool, set the parameter as node threshold, select TopN=50 policy, the time period is 2010-2021, the time slice is 1 year, and the node type is "Keyword". A total of 347 high-frequency keywords are obtained by statistics, and the total frequency is 901. To merge similar keywords (such as "collaborative filtering algorithm" "collaborative filtering recommendation algorithm" "collaborative filtering recommendation" "collaborative filtering technology" into "collaborative filtering", the "education resource" "teaching resources" into "learning resources"), to remove has nothing to do with this research keywords, and according to the price law, determine the keywords for high frequency words of ≥ 6 , In the end, the high-frequency keywords shown in Table 1 are retained. From the table, we can have a preliminary understanding of the research hotspots of online learning resource recommendation in China, especially the keywords that appear frequently, such as collaborative filtering, learning resources, personalized recommendation, personalized learning, online learning, resource recommendation, etc.

Table 1. High frequency keyword statistics table

Keyword	Freq	Centrality	Year	Keyword	Freq	Centrality	Year
Collaborative filtering	68	0.47	2010	Recommendation algorithm	16	0.1	2012
Learning resources	67	0.32	2010	Learning platform	14	0.05	2010
Personalized recommendation	63	0.54	2010	Deep learning	10	0.01	2019
Personalized learning	53	0.31	2010	Knowledge map	9	0.12	2015
Online learning	38	0.2	2010	Hybrid recommendation	8	0.05	2014
Resources to recommend	36	0.38	2010	online education	8	0.07	2019
Learning Resources	33	0.23	2016	Learning path	7	0.08	2016
Recommendation system	28	0.44	2011	Study analysis	7	0.02	2016
Mobile learning	17	0.12	2015	Cold start	6	0.09	2014

The visualized map of keywords obtained through CiteSpace analysis is shown in Figure 1. The number of network nodes N=38, where nodes represent keywords, and font size represents the occurrence frequency of keywords. The line between nodes represents the co-occurrence of keywords. As long as keywords have appeared in the same literature, there will be a line between them. The thicker the line, the greater the co-occurrence intensity. The circle size represents the frequency of keywords, and the higher the frequency, the larger the circle.

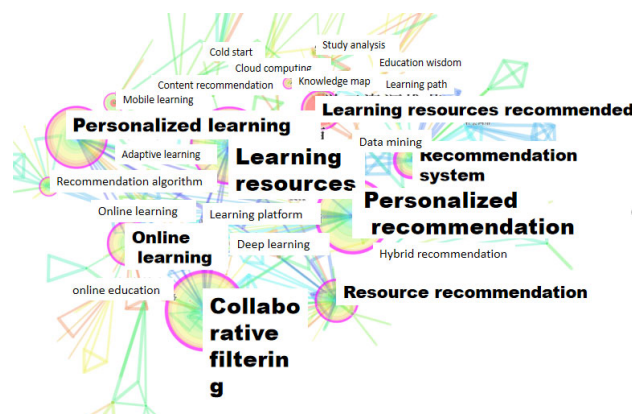


Figure 1. Keywords Visualization map

3.2. Keyword Cluster Analysis

In order to analyze the knowledge structure recommended by domestic online learning resources in a more concise and clear way, and to further understand the internal relationship between the above keywords, this paper uses Log Linkelihood Rate (LLR) algorithm to cluster the keyword co-occurrence network and divide the keywords into different knowledge subgroups. The clustering results are shown in Figure. 2. Generally speaking, the smaller the number of keywords in the figure, the more keywords are contained in the cluster [5]. The first nine clusters were selected from Figure 2: cluster #0 resource recommendation, cluster #1 personalization, cluster #2 personalization recommendation, cluster #3 deep learning, cluster #4 mobile learning, cluster #5 recommendation system, cluster #6 recommendation service, cluster #7 collaborative filtering, and cluster #8 learning resource recommendation.

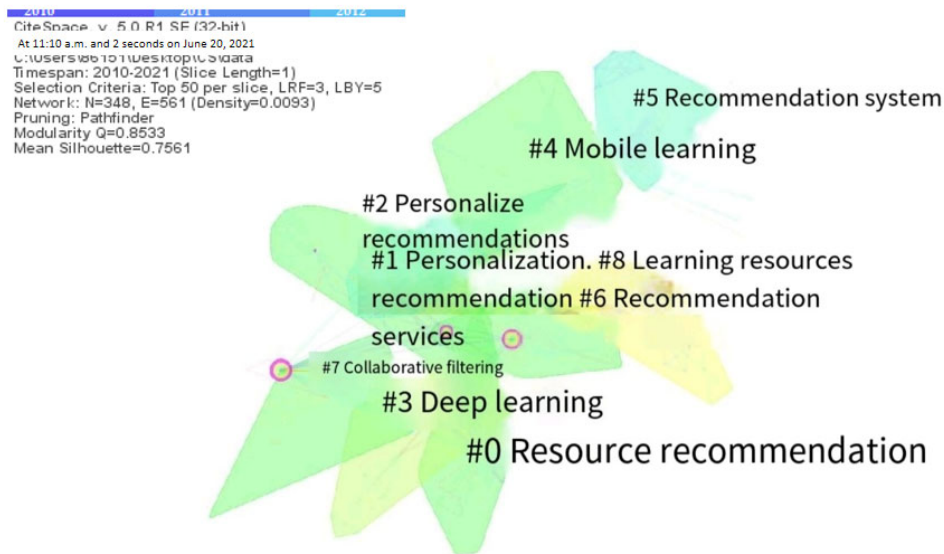


Figure 2. Keywords Cluster atlas

CiteSpace evaluated the clustering effect based on two indicators, Q (Modularity) and S (Silhouette), where Q corresponds to the network structure and S represents the definition of clustering. It is generally believed that when $Q > 0.3$, it means that the cluster structure is significant; When $S > 0.5$, clustering is reasonable, and $S > 0.7$ means that clustering is convincing [6]. As can be seen from Figure 2, $Q = 0.8533$ (> 0.3) and $S = 0.7561$ (> 0.7) of the keyword clustering graph, indicating that the research topics of online learning resource recommendation are relatively concentrated, and the clustering results are significant and convincing. Therefore, the research on online learning resource recommendation can be divided into three major topics: The first is the application research around resource recommendation, including recommendation system, recommendation service and learning resource recommendation; The second is the research on technology. The technical research on online learning resource recommendation through clustering mainly focuses on collaborative filtering algorithm and deep learning. The third is the study of personalized learning, from two aspects of personalized and personalized recommendation. These three themes complement each other, with both applied research for resource recommendation as the purpose to provide personalized services to students, and technical research as an important support.

3.3. Analysis of Timezone Map

In order to more comprehensively and intuitively reflect the introduction evolution of online learning resource recommendations, the "Time zone view" will be used to show the evolution of keywords. CiteSpace's "Time Zone View" presents the main research content in the coordinate system with time as the horizontal axis. According to the time when the keyword first appears, the corresponding nodes are set in different time zones, and the node positions are upward along the time axis [7]. The recommended domain keyword "Time Zone View" of online learning resources is shown in Figure 3:

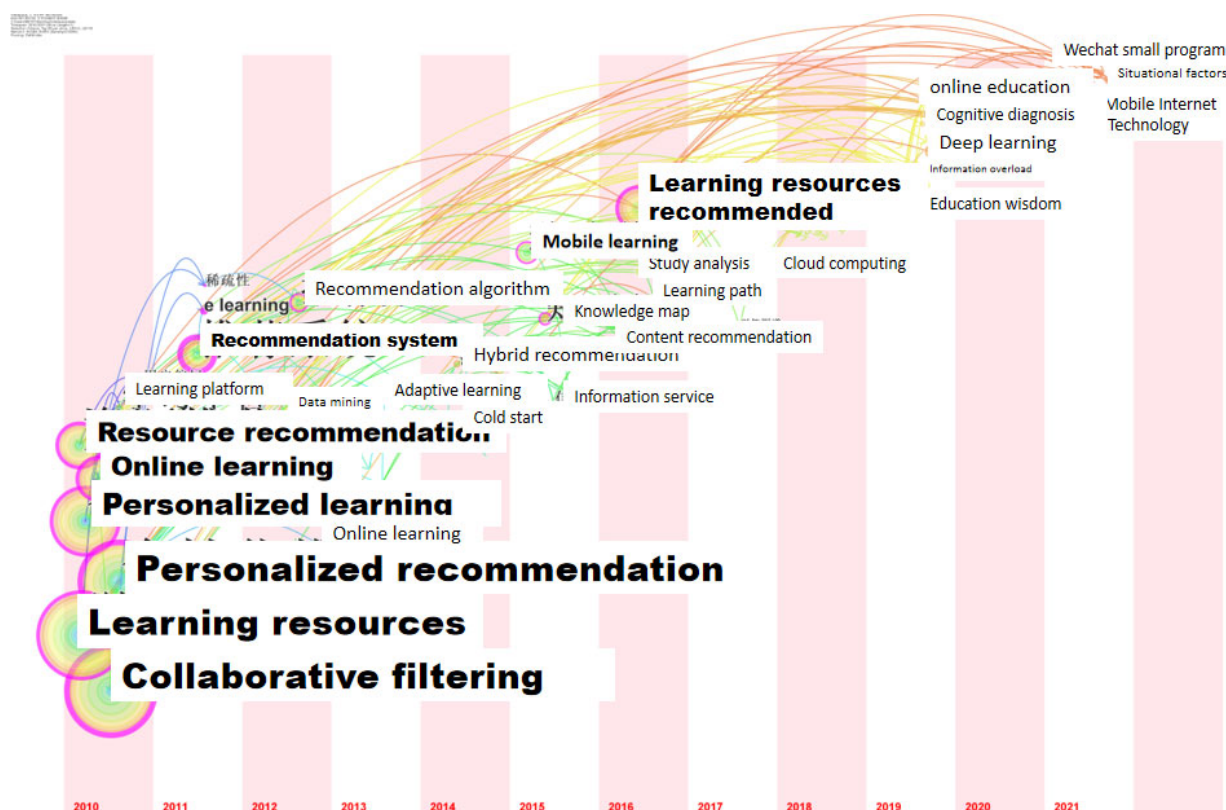


Figure 3. Keywords Timezone view

From the evolution of keywords, there were many time zone view nodes in 2010-2011, and most high-frequency keywords appeared in this stage. Observing the connection, these high-frequency keywords not only appeared early, but also ran through the whole time line of online learning resource recommendation research. The number of nodes in 2012-2013 is small, indicating that the research on online learning resource recommendation in this stage is still on the basis of previous years, and the research on innovation is few. Hybrid recommendation appeared in 2014, indicating that the research on recommendation technology has made a further step. Most of the previous researches were based on collaborative filtering algorithm. As people demand change and the progress of technology, starting from 2015, the "mobile learning", "intelligence education", "cloud computing", "online education", "WeChat applet" new keywords, such as online learning resources recommended research more combined with the characteristics of era, outstanding online learning resources recommended by the applied research more widely.

4. Hotspot and Trend Analysis of Online Learning Resource Recommendation

In combination with the keyword visualization map in Figure 1 and the keyword time zone map in Figure 3, I will analyze online learning resource recommendation and research hotspots and trends from the following three aspects.

4.1. Technical Research on Online Learning Resource Recommendation

Technical support is the main guarantee for online learning resource recommendation. Domestic research on online learning resource recommendation started late. Ding Lin et al. first applied personalized recommendation technology into online teaching platform in 2002, and proposed to use data mining technology to establish personalized service model in distance education [8]. In 2010, personalized learning and recommendations were introduced. From the

overall research, the main technologies include "collaborative filtering", "recommendation algorithm", "learning analysis", "knowledge graph", "data mining", etc., among which the research on collaborative filtering algorithm is the most applied. Collaborative filtering recommendation algorithm is one of the most widely applied algorithms. In the field of online learning resource recommendation, Altered Vista System[9], as an early System with resource recommendation service, adopts collaborative filtering algorithm to recommend appropriate online learning resources for different learner groups according to learners' goals and interests. According to learners' activities and behaviors, Liu et al. [10] designed a course recommendation method by taking advantage of collaborative filtering and provided keyword resource search function. Chen et al. [11] refer to the collaborative filtering algorithm of e-commerce and online music, and recommend the resources most similar to the learning resources that learners are interested in to learners by calculating the similarity of learning resources. Ding Yonggang et al. [12] combined the learner's social network with the traditional collaborative filtering algorithm to alleviate the problem of data sparsity and improve the recommendation accuracy. Wang Gensheng et al. [13] proposed a personalized recommendation algorithm for network learning resources based on improved collaborative filtering. This algorithm first converts users' learning behavior on resources into users' rating on resources, so as to alleviate the sparse scoring array problem. Secondly, the user initialization label is introduced to improve user similarity calculation and solve the cold start problem of new users. Finally, root-mean-square error is used to measure the prediction accuracy of the recommendation algorithm to achieve the effect of improving the resource recommendation algorithm.

4.2. The Main Purpose of Online Learning Resource Recommendation Is to Provide Personalized Learning

The main purpose of the research on online learning resource recommendation is to provide personalized guidance and services for learners. It can be seen from the above figure that there are many keywords "personalized learning" and "personalized recommendation". However, any field can not be separated from the support of theoretical research, at present, the connotation of personalized learning theoretical research mainly includes the concept of personalized learning, characteristics, influencing factors. As for the concept of personalized learning, scholars have given different definitions from different perspectives. Some emphasize the transformation of the way, while others emphasize the use of technology. For example, personalized learning is a manifestation of the deep integration of education and technology in the advanced stage [14]. Scholars also have different opinions on the analysis of characteristics. For example, from the perspective of learning theory, it can be divided into mental analysis, service difference and goal-oriented [14]. With the development of national policies and social needs, the connotation of individualized learning will be paid more and more attention.

4.3. Online Learning Resource Recommendation Combined with Wechat Applet

With the convenience of people's life, the combination of online learning resource recommendation and Wechat applet will be a trend in the future, and "Wechat applet" will appear in 2021 in Figure 3. In 2016, Zhang Xiaolong, the father of Wechat, announced the birth of Wechat mini program in Wechat open class. On January 9, 2017, Wechat officially launched its lightweight app, Wechat Mini Program, and Zhang xiaolong described the portrait of Mini Program. Wechat applet is born by relying on Wechat App. A set of API provided by it realizes the dream of "easy to reach" application, and also embodies the concept of "ready to use and ready to go" [15]. Wechat provides access to small programs, users do not need to download and install when using small programs, through the scan or search function provided by Wechat, users can experience small programs. With the continuous development of small programs,

small programs have been involved in many fields, including social, entertainment, government and public transportation and other aspects. In many application fields, users use frequency is not high, short stay time of the application is especially suitable for the use of Wechat small program development, users do not have to use a function and specially to download an App, without downloading, installation and follow-up management and other work. Based on the above description, if the content recommended by online learning resources can be put into Wechat applet, learners will be able to browse anytime and anywhere.

5. Conclusion

With the deepening and development of information technology, education gradually from the informationization to the wisdom, but at the same time, with the rapid increase in the number of learning resources, users find really need teaching resources more and more difficult, the amount of time more and more, the learning resources "overload", "information trek" problem. This paper, by using the literature measurement analysis of CNKI nearly 11 years of literature, around the "online learning resources recommended" as the theme, through keyword visual map, key word clustering map view online learning resources are analyzed, and time zone recommended research present situation, hotspots and preface, give the rationalization suggestion at the same time, for the study of the related resources recommended by the late provide certain reference value.

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