

Knowledge Graph Visual Analysis on the “Stickiness of Learning” Based on the VOSviewer Software

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Abstract: In order to focus on the research status of “stickiness of learning”, the bibliometrics method is applied to make the statistical analysis on the number of publications, the source of journals, and the content of keywords. According to the line chart of publications and the pie chart of journal sources, it is discovered that “stickiness of learning” plays an important role both in the epidemic period and post-epidemic period, and the research on this topic from scholars at home and abroad is on the rise. On the basis of the network visualization, density visualization, and overlay visualization in the VOSviewer software, it is summarized that research perspectives of influencing factors of “stickiness of learning” are mainly divided into two categories: Expectation Confirmation Model of Information Systems Continuance (ECM-ISC) and Unified Theory of Acceptance and Use of Technology (UTAUT). However, as a social cognitive activity of learners, learning is actually an interactive process among learners, learning behaviors and external society. Social cognitive theory ignored in previous publications is supposed to play an indispensable role in the future study on influencing factors of “stickiness of learning”.

1. Introduction

Under the new ecological background of educational informatization, Moore pointed out that online learning has become an essential learning method [1]. The key of online learning lies in the effective interaction between learners and the information flow of the online learning platform. To be specific, the effective interaction can be illustrated as the effective stickiness between learners and learning resources due to their affinity under the mutual internal drive, so as to achieve the goal of “deep learning”. However, the shortage of motivation and persistence of learners in the online learning process also adversely affects the effectiveness of online learning behaviors. How should online learning platform stick learners together and attract them to continue learning online?

The word “stickiness” was originally employed to describe the characteristics of commercial websites, referring to the relationship between websites and users. A website with the high “stickiness” will often attract users to visit it repeatedly, to browse web pages for a long time, and to make the decision to purchase its products and services [2]. At present, the research on “stickiness” at home and abroad has gradually extended from the traditional business field to the online learning

scope. Online learning and website access have many things in common, such as users' time commitment, energy consumption, application frequency and addiction degree. "Stickiness of learning" can be used to reflect the learning willingness and learning behaviors between learners and online learning platforms. Therefore, mining the main influencing factors of "stickiness of learning" will not only greatly improve the completion rate of online courses, but also dramatically enhance the effectiveness of online learning. This has become an overwhelming research perspective of online education in the epidemic period and post-epidemic period.

2. Research Design

In this study, the bibliometrics method was applied to make the statistical analysis on the number of publications, the source of journals, and the content of keywords, with the purpose of exploring the research status of "stickiness of learning". China National Knowledge Infrastructure (CNKI) was employed as the data source. "Stickiness of learning" AND "online learning platforms + online learning + mobile learning + blended learning" were considered as retrieval fields. By excluding the repeated publications, a total of 20 papers from journals, conferences, and universities were retrieved, focusing on the study of "stickiness of learning" under the new ecological background of educational informatization.

As shown in Figure 1, the research on "stickiness of learning" in recent nine years has been gradually increasing, and the number of related literatures has also been significantly enhanced. The first stage is from 2014 to 2016 when the number of published articles shows a horizontal trend. The second stage is from 2016 to 2019 when the number of published articles generally keeps a slow rise. However, due to the outbreak of COVID-19, the number of published articles dramatically increased, which can be seen that "stickiness of learning" plays an important role in the epidemic period and post-epidemic period. In other words, scholars' research on this topic is on the rise and its prevalence is just around the corner.

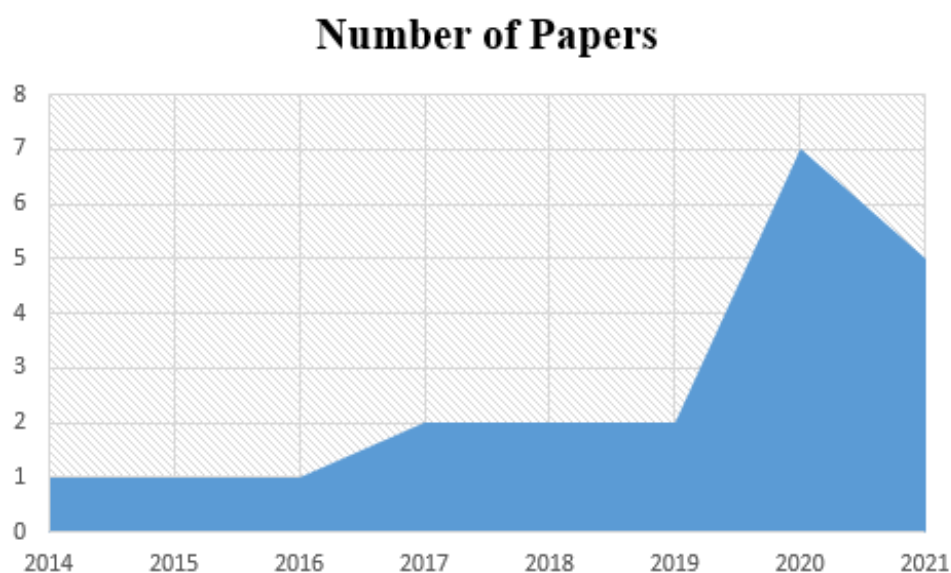


Figure 1: Line Chart of Publications Related to "Stickiness of Learning" from 2014 to 2021

According to statistics, a total of 19 sources of journals, conferences and universities has the closed relationship with "stickiness of learning". The specific sources of journals, conferences and universities are shown in the pie chart of Figure 2.

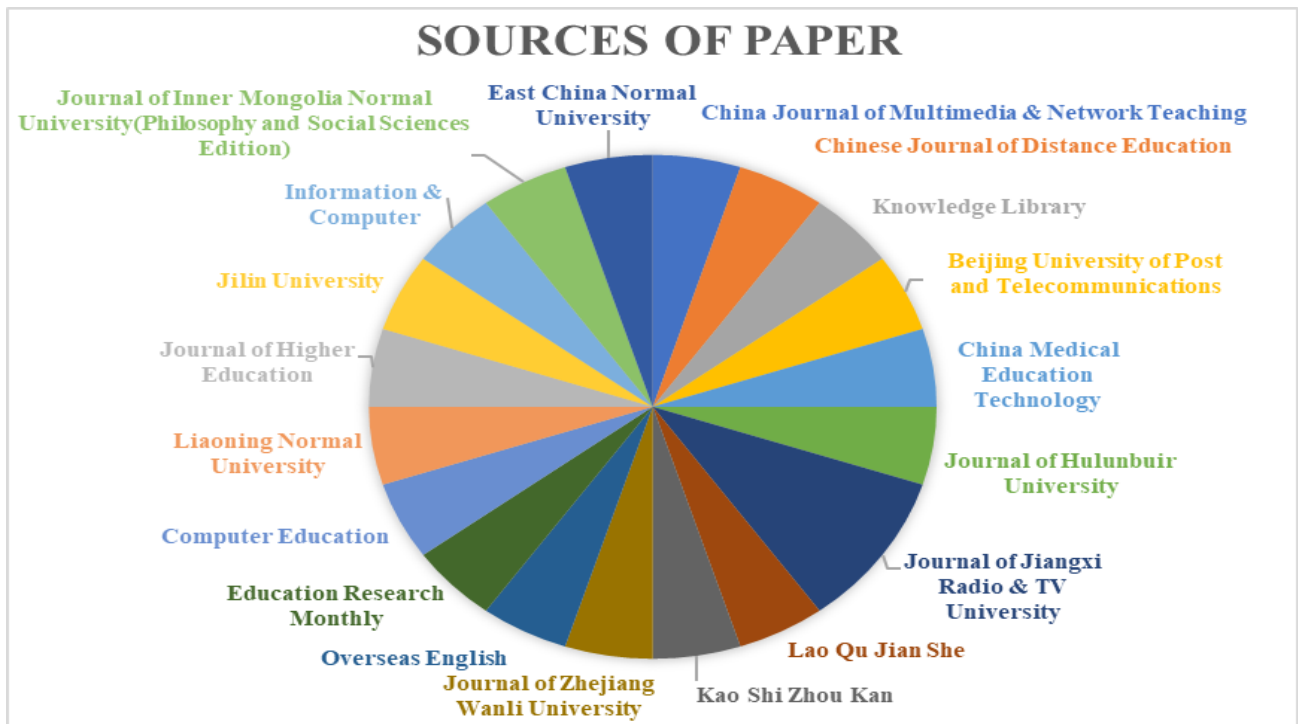


Figure 2: Pie Chart of Sources of Publications Related to “Stickiness of Learning” from 2014 to 2021

VOSviewer is a software tool for constructing and visualizing the bibliometrics network [3]. For instance, these networks may be correlated with journals, researchers and publications, which can be realized based on the citation, bibliographic coupling, co-citation or co-author relationship. VOSviewer software can also be applied to construct and visualize the co-occurrence network via the texts-mining function and terms-extracting mechanism. The massive amount of information, the clear and distinct diagrams, and multiple perspectives and dimensions are regarded as the main characteristics of VOSviewer software.

The specific operation procedures of VOSviewer software are as follows:

STEP 1: The retrieved publications should be exported and saved in Endnote format, and then be imported into VOSviewer software for bibliometric analysis. The type of data should be set as “Create a map based on bibliographic data” and the source of data should be set as “Read data from reference manager files”, which has been shown in Figure 3.

STEP 2: The minimum number of occurrences of a keyword can be set 1 so as to obtain the network visualization of keyword co-occurrence (as shown in Figure 4), a density visualization of keyword co-occurrence (as shown in Figure 5) and an overlay visualization of keyword co-occurrence (as shown in Figure 6), which contain 52 keywords with a total frequency of 80 and a total link strength of 260.

The network visualization of keyword co-occurrence related to “stickiness of learning” is displayed in Figure 4. In this figure, the size of nodes and font sizes depend on the frequency of keywords. The larger the nodes are, the more times they appear, which indicates that there is the greater contribution in the related studies. A range of colors represent different clusters and the thickness of connecting lines symbolizes the relevance degree among keywords. To be specific, the more times two keywords appear, the stronger the relevance degree between them is, and then the thicker the connecting line will be.

As shown in Figure 4, keywords related to “stickiness of learning” are mainly divided into six

categories. Cluster 1 displayed by the color of blue mainly focuses on learners' stickiness, with MOOC, information technology acceptance model, whole life cycle and medical students as the auxiliary research. Cluster 2 displayed by the color of green mainly puts the stress on the information technology acceptance model, with the digital education and online learning platforms as the auxiliary research. Cluster 3 displayed by the color of red takes influencing factors of "stickiness of learning" as the focal point, involving keywords such as online learning and information systems continuance model. Cluster 4 displayed by the color of yellow mainly emphasizes ECM-ISC model, which involves the collaborative learning. On the basis of the thickness of connecting lines, it can be summarized that cluster 1 is related to cluster 2, cluster 3 and cluster 4; cluster 3 is related to cluster 1, cluster 3 and cluster 4; but cluster 2 is not related to cluster 4.

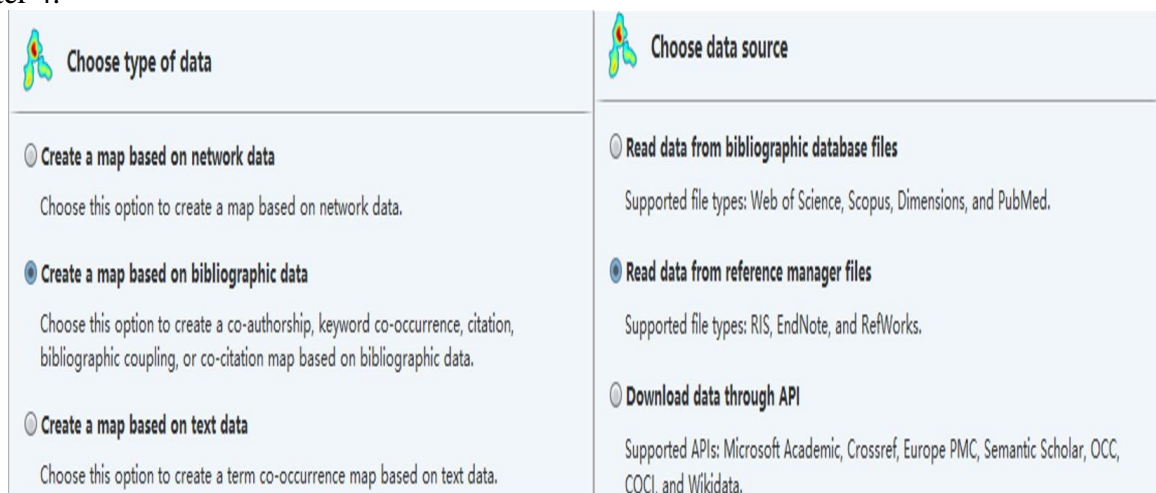


Figure 3: Settings of Data Type and Data Source in VOSviewer Software

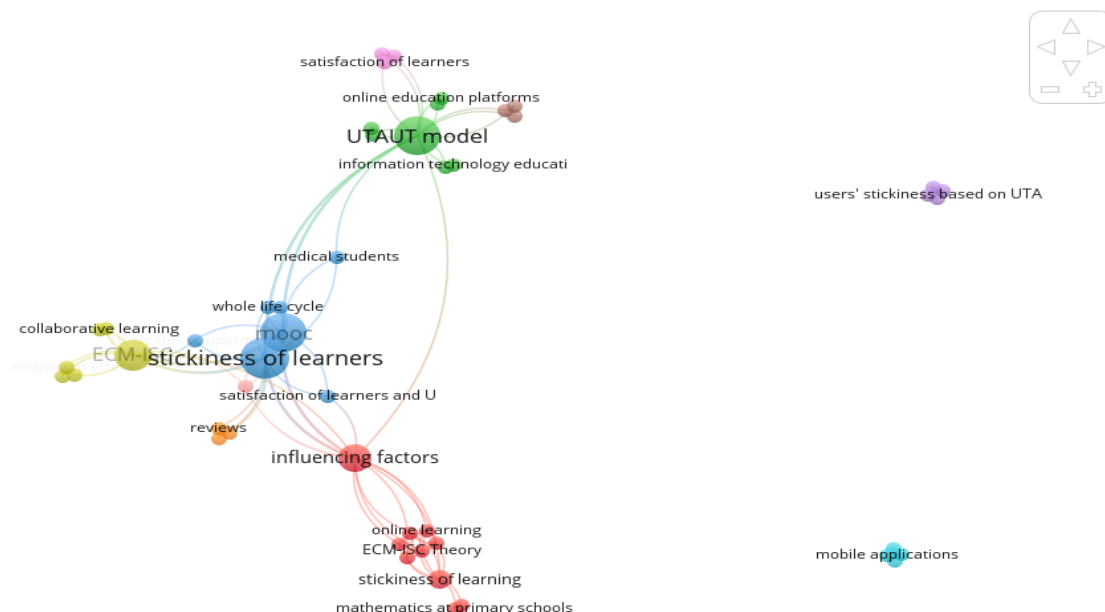


Figure 4: Network Visualization of Keyword Co-occurrence Related to “Stickiness of Learning”

According to Figure 5, the color changes from the cool color system (green) to the warm color system (yellow). The higher the frequency of keyword co-occurrence is, the higher the prevalence of related studies is. “Learners’ stickiness” appears for 9 times in total, and the link strength is as

high as 26, which indicates that “learners’ stickiness” has gradually become a hot spot in recent years. Additionally, the UTAUT model appears for 8 times with the link strength of 20, and the ECM-ISC model appears for 7 times with the link strength of 17, which implies that the UTAUT model and the ECM-ISC model have been considered as the foundational models for studying on “stickiness of learning”. Based on the above frequency representing the high conciseness in a certain field, the development route and research tendency of “stickiness of learning” can be explicitly and logically analyzed.

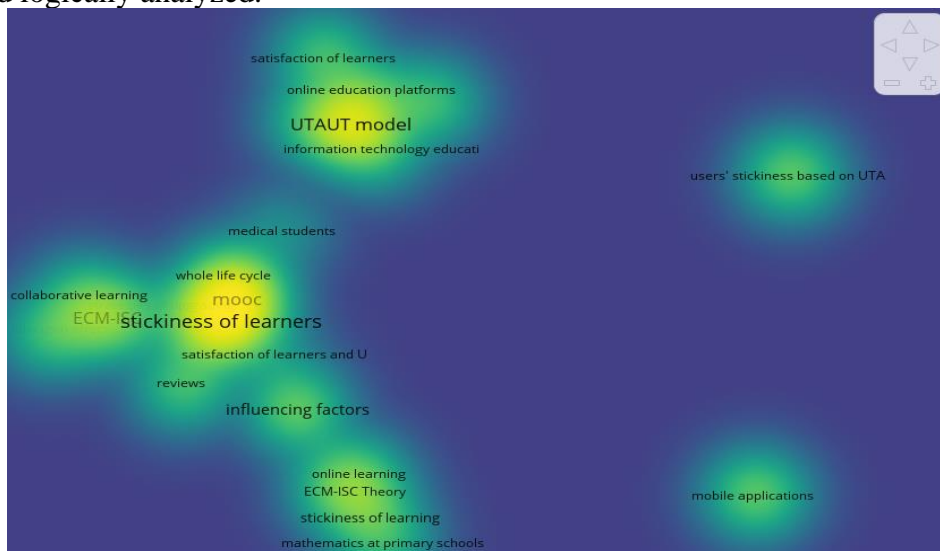


Figure 5: Density Visualization of Keyword Co-occurrence Related to “Stickiness of Learning”

The overlay visualization in Figure 6 shows that the change of keywords with time reveals the prevalent keywords in different stages. To be specific, 2017-2018 is the initial stage of “stickiness of learning” research. Essential keywords such as teaching via information technology, collaborative learning, and the model of ECM-ISC have emerged, which has laid a solid foundation for the development of “stickiness of learning” research. 2018-2020 is the development stage of “stickiness of learning” research. The number of keywords shows a significant increase trend, such as MOOC, learners’ stickiness, influencing factors, and the model of UTAUT. From 2020 to 2021, keywords mainly consist of online learning, online platforms, stickiness of learning, learners’ satisfaction, medical students and so on.

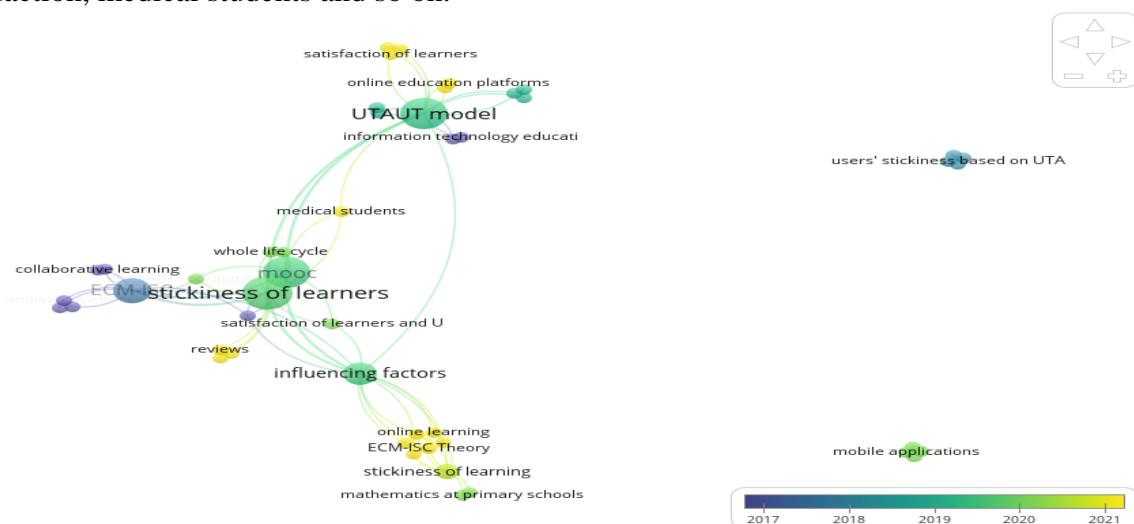


Figure 6: Overlay Visualization of Keyword Co-occurrence Related to “Stickiness of Learning”

3. Discussions

With the aid of VOSviewer software, the knowledge graph visual analysis of 20 papers was accomplished. It was summarized that scholars' perspectives on "stickiness of learning" research can be mainly divided into two categories: ECM-ISC model and UTAUT model.

Based on ECM-ISC model, Hsu and Liao found that when learners can establish a sticky relationship with the online course platform, they usually participate in the learning activities and practices supported by the online learning platform more frequently and profoundly [4]. Yanjun CHEN made use of ECM-ISC model and combined it with characteristics of MOOC platform including the massive scale, openness and time-space separation, in order to set up a research model on the influencing factors of learners' willingness to continue the application of MOOC. It is discovered that the quality of MOOC platform, perceived interest and social interaction can have a positive impact on learners' willingness to continue the application of MOOC [5]. What's more, Ziming ZENG also put forward suggestions to improve learners' stickiness of learning from perspectives of instructing design, learning community, functions of MOOC, activities on MOOC, and evaluation mechanism [6]. On the basis of six influencing factors proposed by Yanjun CHEN, Le YANG supplemented other two factors which are functions of teaching platforms and interactive behaviors [7]. By constructing a model of influencing factors on the stickiness between learners and online learning platforms, it was summarized that the flow experience from learners was the main factor that positively affected their stickiness of learning.

Halilovic and Cicic pointed out that the investigation on the "stickiness of learning" based on the ECM-ISC model only put the stress on learners, but factors of non-learners were largely ignored [8]. As a result, they introduced UTAUT model, and designed non-learners related variables including learning resources, peers, instructors, equipment, learning environments, etc. to explore the influencing factors of stickiness between learners and online learning platforms. Xiaotian YAN applied the concept of stickiness to conduct the research on mobile learning APP for the first time, and constructed a model of influencing factors of users' stickiness for mobile learning APP based on the classical behavior theory and UTAUT model [9]. Yue YIN designed influencing factors with 6 dimensions and 25 items to focus on "stickiness of learning" and tested its hypothesis through the empirical research [10]. In her study, UTAUT model was also the foundation.

All the above scholars put the emphasis on the application of information system continuance and information technology acceptance into influencing factors of "stickiness of learning". However, learning is known as a social cognitive activity of learners, and it is an interactive process among learners, learning behaviors and external society. Therefore, social cognitive theory should play an indispensable role in the research of influencing factors of stickiness between learners and online learning platforms.

On the basis of the existing researches, social cognitive theory might be employed to systematically analyze the main factors affecting learners' stickiness, to scientifically construct the structural equation model of influencing factors, to profoundly explore the interaction mechanism among a range of factors, to discover channels and ways of improving the "stickiness of learning", and ultimately to accomplish the research report which can be the reference for the online education.

In the dimension of learning behaviors displayed in Figure 7, the academic integration is the focal point. According to Choi and Park, the academic integration consists of the curriculum quality, instructors' guidance, organization of learning resources and other learning-related factors [2]. This structure has always been regarded as the most basic requirement for learners to apply the online learning platform, and it highlights if online learning can meet learners' academic needs, improve learners' academic performance and enhance learners' learning efficiency.

In the dimension of learners shown in Figure 7, expectation confirmation and technical factors

are the focal point. Alshurideh et al. demonstrated that expectation confirmation is also an essential factor to evaluate the extent to which online learning can satisfy learners' expectations [11]. When learners have high expectations for online learning, they will hold the positive attitude toward learning contents, decide to browse for a long time and actively participate in interactions online. In other words, expectation confirmation plays a core role in learners' stickiness in the learning processes. In addition, technical factors will also affect the realization of learners' learning expectations, which may be the influencing factor for their final decision to persist in the online learning behavior.

In the dimension of external society presented in Figure 7, social integration is the focal point. According to Vygotsky, social integration means the interaction between learners and their social environment [12]. Social integration has been widely considered as the critical promoting factor of cognitive development. For foreign language learners, social integration is usually to integrate social interaction into learning behaviors with the purpose of creating the supportive environment including peers, instructors and the external world.

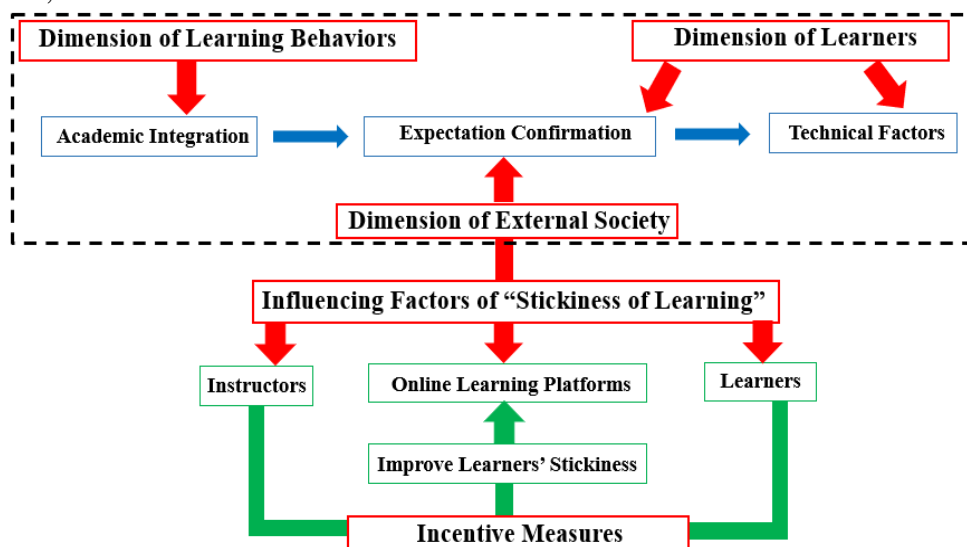


Figure 7: Research on “Stickiness of Learning” Based on Social Cognitive Theory

4. Conclusions

The research on stickiness both at home and abroad has been gradually extended from the traditional commercial field to e-commerce, online community, online education and so on. The research in the field of online education has just started and publications are relatively few. Inspired by the social cognitive theory, if researchers in the future can construct a model that covers three dimensions of learners, learning behaviors and external society and four focal points of academic integration, social integration, expectation confirmation and technical factors, the main influencing factors of “stickiness of learning” might be systematically summarized, the interaction mechanism among a range of factors might be scientifically explored, and effective strategies to enhance learners' stickiness for online learning platforms might be ultimately put forward.

However, it is the focus in the future study to analyze the potential influencing factors of “stickiness of learning”. Since various potential influencing factors have the strong interdisciplinary feature, a large number of publications should be mined and analyzed. Additionally, it is also the difficulty in the future study to set up an effective influencing factor model for “stickiness of learning”. The construction of the model directly determines the scientificity and effectiveness of the future research, which definitely will provide the practical and empirical data support for the

subsequent researchers.

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