Analysis and Prospects of International E-learning Research Hotspots

Chao Tong[1*]

[1]*School of Teacher Education, Qiqihar University, China.*

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Original Research Article

ABSTRACT

Using the Web of Science database as a literature source and Citespace to analyze the 592 selected literatures, first of all, we find that Spain has become one of the most influential countries in the field of E-learning. Then, by clustering analysis, we find that the main research hotspots in E-learning are Universal Design for Learning, Teacher Training, Technology Acceptance Model and Ubiquitous Learning. We also analyze the representative research themes in the field of E-learning. The future picture of E-learning is envisioned, namely, integration of inclusion and personalization, acceptance of diversity and complexity, reaffirmation of humanity and equity and moving towards AI and ubiquity.

1. INTRODUCTION

Internet technology has brought unprecedented changes to human society. With the proliferation of wireless networks and the rapid development of digital technology, mobile devices have become one of the most commonly used assistive technologies in education [1]. While changing the way of life and thinking of human beings, the internet has also set off an unprecedented revolution in the field of education. Thanks to the popularization of internet technology, the carrying capacity, dissemination capacity and presentation level of information have been qualitatively improved.

---

*Corresponding author: Email: tongchao19921204@163.com, tongchao1204@163.com;

E-learning is the abbreviation of Electronic Learning. In the history of E-learning, there is no single definition and contemporary usages of the term E-learning have different meanings in different literature [2]. E-learning has become a new paradigm in modern education, and its emergence has fundamentally changed the way people learn. In "E-learning: The Education Industry Has Changed Schooling" which is Part II of the 2000 White Paper on Educational Technology from the U.S. Department of Education, E-learning was described as follows: "What is E-learning? It is a new way of being educated and includes new communication mechanisms: Computer networks, multimedia, content portals, e-libraries, distance learning, and online classrooms. E-learning is characterized by rapid, technological transformation and human interaction. E-learning success does not depend on a single entity or link, but rather on the school, parents, child E-learning will not replace schooling, but it will dramatically change the purpose and function of the classroom, and it will give us new ways of thinking about the design and delivery of education, which is no longer confined to the classroom. A certain age, but throughout one's life." It is of great theoretical and practical significance to explore the hotspots and frontiers of E-learning in the world. It is important to systematize the literature on E-learning, to identify the hot spots, and to make an outlook on the future development of E-learning.

2. MATERIALS AND METHODS

2.1 Data Sources and Research Tools

2.1.1 Research data sources

In order to provide a comprehensive and objective description of international e-learning research frontiers, this paper adopts the Web of Science (WoS) database core data collection (including SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH) as the source library. And reviews the international E-learning research in the field. The research literature is searched and analyzed. In order to provide a comprehensive, objective, and accurate description of the frontiers and hotspots of international E-learning research, this study took the Web of Science (WOS) database core data set as the source of literature, and Science Citation Index Expanded (SCI-Expanded) was chosen as the source of citation index. Through screening with the Social Science Citation Index (SSCI), the subject category was limited to Education Educational Research (EER),

retrieval spans the years 2016-2020 and 533 articles were retrieved.

2.1.2 Research tools

Citespace is a Java-based citation visualization and analysis software developed by Prof. Chao-Mei Chen of Drexel University to analyze and visualize literature effectively and accurately.

2.2 Preliminary Analysis of the Literature

Through the statistical compilation of the 533 articles published in five years, the numbers of them were 116 in 2016, 129 in 2017, 91 in 2018, 118 in 2019 and 79 in 2020, and in general, the number of articles published in each year tends to be stable. Using Citespace, this paper presents a statistical analysis of the national and institutional sources of the 533 selected articles.

2.2.1 Quantitative analysis of countries/areas

In this paper, Citespace was used to visualize and analyze the source countries and regions of the 592 documents obtained, and the results are shown in Fig. 1.

The size of the circle in the figure represents the number of publications, i.e. the larger the circle diameter, the more the number of publications, and vice versa. N=45 means that there are 45 nodes in the graph, which means that the 592 articles come from 45 different countries and regions, and the countries and regions are ranked according to the number of articles sent and the size of intermediary centrality.

From the analysis of the literature, we can see that the research in the field of E-learning is no longer limited to the developed countries in Europe and the United States, but widely distributed in various countries and regions. However, compared with previous years, the United States is no longer the absolute center of E-learning research, either in terms of the number of articles published or in terms of centrality. In terms of the number of articles published, both Taiwan and Spain are ahead of the United States. Among them, the number of articles published in Taiwan reached 100, accounting for 16.9% of the total number of articles published, ranking first among all countries and regions. Betweeness Centrality was first proposed by the American sociologist Professor Linden Freeman [3], a concept that simply understands that the higher the
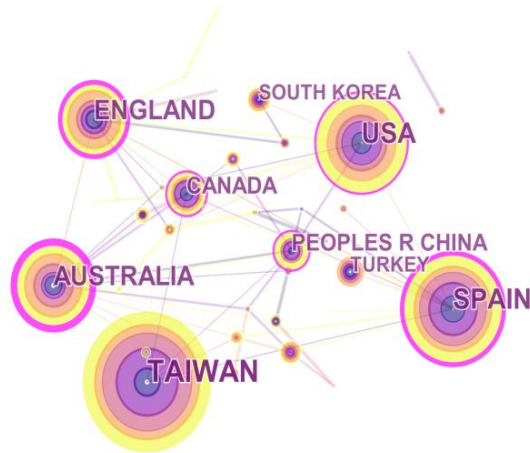
Fig. 1. Quantitative analysis of countries

Table 1. Number of articles issued against different countries

	Number of articles issued	Country/area		Betweeness centrality	Country/area
1	100	China Taiwan	1	0.40	Spain
2	73	Spain	2	0.40	England
3	71	USA	3	0.39	Canada
4	57	Australia	4	0.19	Australia
5	50	England	5	0.14	USA
6	31	Canada	6	0.14	China
7	28	France	7	0.08	Colombia
8	22	Turkey	8	0.08	Qatar
9	21	South Africa	9	0.07	Germany
10	17	Germany	10	0.05	Netherlands

mediocentricity of a point means that it is more in the middle of multiple points, and more closely connected with multiple points, the stronger the intermediary role, the more in the center of the entire network. From the data, although Taiwan is far ahead of other countries and regions in terms of the number of publications, it has only 0.03 of them in terms of centrality, which ranks 12th among all countries and regions together with Greece. This means that although the number of research outputs is higher in Taiwan, the collaboration and linkages with other countries and regions and the influence of research institutes in other countries and regions are less. Spain, on the other hand, ranks high in terms of both number of publications and centrality, and it can be argued from the data that Spain has

become one of the most influential countries in the international E-learning field.

3. RESULTS AND DISCUSSION

3.1 Analysis of Current E-learning Research Hotspots

3.1.1 Universal design for learning: The key concept in the development of E-learning

The concept of Universal Design for Learning (UDL) was originally derived from the concept of "universal design" in the field of architecture. Universal learning Refers to a pragmatic educational framework based on learning

13

science, using technology to guide the development of a flexible learning environment to adapt to the differences in individual learning, and to maximize the learning opportunities for each student [4]. In short, the purpose of UDL is to allow each student to develop to the best of his or her ability, whenever possible. In coincidence with the inherent concept of E-learning, it is clearly and officially stated that every student and learner can be produced with an information-based environment and services for personalized learning and lifelong learning. It is easy to see that UDL, as the current frontier research hotspot in the field of E-learning, fits well with the development direction of education modernization and education informatization in China, which is increasingly noteworthy in policy making and academical research.

3.1.2 Technology Acceptance Model (TAM)

An important model tool for studying the effect of E-learning applications. TAM is a theoretical model proposed by Davis et al. [5] when they applied the Theory of Reasoned Behavior (TRA) to management information systems to explain and predict users' acceptance of information technology based on individual beliefs, subjective attitudes, behavioral intentions and external variables." TAM is a model in information systems theory of how users accept and use a technology, which suggests that when users use a new technology, there are many factors that influence their decisions about how and when to use it, two of the most significant of which are: Perceived usefulness and perceived ease of use. Fred Davis, founder of the Technology Acceptance Model, defines them separately: Based on the Theory of Planned Behavior, it contains six research variables: perceived usefulness, perceived ease of use, user attitudes, intention to use, actual use behavior and external variables, among which, perceived usefulness and perceived ease of use are extracted from previous studies based on the theoretical review [6]. The Technology Acceptance Model, an information systems theory model of how users accept and use a technology, suggests that when users use a new technology, many factors influence their decisions about how and when to use it, two of the most significant of which are: perceived usefulness and perceived ease of use. Fred Davis, founder of the Technology Acceptance Model, defines them separately: Perceived usefulness is the degree to which individuals subjectively believe that using a particular technology system will enhance their work performance, whereas perceived ease of use is the degree of effort individuals subjectively believe they should have to cope with when using a particular technology system. TAM is effective in interpreting and predicting the level of information acceptance by E-learning participants in order to help adopt the necessary methods to influence the learning status of students and the teaching behavior of teachers for the purpose of managing and controlling distance education. Thus, it reinforces the acceptance of E-learning, and helps achieve a more effective teaching effect in E-learning and make better use of the advantages and functions of it.

3.1.3 Ubiquitous learning

The inevitable development direction of E-learning in the future. Mark Weiser, widely regarded as the originator of the concept of ubiquitous computing, envisioned making computers into chips of all sizes that could be installed in everything in life, and then allowing computers to provide services to humans via wireless communication, regardless of time and space, arguing that the ultimate goal of ubiquitous computing was to make computers pervasive yet invisible to life [7]. As soon as the concept of Ubiquitous Learning was put forward, it immediately gained the attention of the education circles in various countries. In a seminal 1991 essay, "The Computer in the 21st Century," he argued: "The most profound technologies are the ones that seem to disappear, that are so integrated into everyday life that they are indistinguishable [7]." To a certain extent, Ubiquitous Learning and E-learning can be taken as a pair of symbiotic concepts. Ubiquitous Learning was originally proposed to compensate for the drawbacks and limitations of E-learning. In the traditional E-learning model, students must acquire knowledge and information at home, at school or in the library through the Internet, while the core concept of Ubiquitous Learning is that learners can learn any content they are interested in at any time, at any place, on any device. The core concept of Ubiquitous Learning is learners can learn from any content of interest at any time, in any place, and on any device. Although there are still debates on whether existing technologies can effectively support Ubiquitous Learning under the current technological conditions, from the general trend point of view, Ubiquitous Learning is undoubtedly the main development direction of E-learning in the future.

3.1.4 Flipped classroom

One of the main forms of E-learning. In short, the flipped classroom is to adopt the method of "learning before teaching" to teach students [8]. It could be a subversion of the traditional teaching process and the main expression of "reverse order innovation" in information education. Flipped classroom can effectively promote the transformation of teacher-student roles, so that the main body of learning gradually transferred from the teacher to the students, which is undoubtedly more in line with the requirements of the new era for education. This is undoubtedly more in line with the requirements of education in the new era. It is easy to see from the literature and research that although there are still many problems that need to be improved and perfected, there is no doubt that flipped classroom has become one of the most important forms of E-learning in the field of education all over the world.

3.1.5 Teacher training

In my opinion, the study of teacher training in E-learning can be viewed from two aspects. The first aspect is that with the increasing popularity of E-learning in the field of education, the role of E-learning in modern education has become more and more important. Compared with traditional classroom teaching, the positioning of E-learning to teachers shows more dynamics and multiplicity, which undoubtedly puts forward higher standards and requirements for teachers' professional quality. In the environment where E-learning is becoming more and more popular, how to provide suitable training for teachers so that they can skillfully use E-learning to teach, and thus adapt to the new role of teachers in E-learning is a very important research topic in the current E-learning research. The second aspect is the application of E-learning as a new form of teacher training. In general, traditional teacher training has many unfavorable factors, such as the lack of interaction between teaching and learning, the inability to meet teachers' individual needs for training, the difficulty in ensuring that all teachers can meet the training requirements, the inflexibility of teacher training evaluation models, the need for large amounts of financial support for teacher training, and the disruption of normal teaching in schools due to long periods of training away from home. Compared with the traditional teacher training, teacher training through E-learning has great advantages in these aspects.

3.2 The Prospect of Future E-learning Development

Although E-learning is an important indicator of the future direction of education, we must admit that there are still many imperfections in E-learning that need to be solved. Specifically, what we need to do is to face the challenge rationally in today's context and make a reasonable outlook on the future development of E-learning.

3.2.1 Combination of inclusion and personalization

In a literal sense, "inclusion" means "total acceptance" and advocating fairness and anti-discrimination is precisely the core of inclusive education. Education is a "human" activity. To receive education is one of the most basic rights of human beings, and inclusion is the best interpretation of "human nature" in education. Throughout the development of education in the world, with the continuous development of human society and the progress of productivity, education is not only the most basic right of human beings, but also a deeper need for education. The theme of inclusion as the core attribute of education has become increasingly prominent. China's education has always advocated fairness and anti-discrimination. "A person, regardless of his or her status, qualification or educational background, as long as he or she has a certain level of professional knowledge or expertise and can contribute to the progress of our society, he or she should be recognized and respected, and everyone should be given the opportunity to excel in life."

The ideal form of education is to let each person get the most suitable development for himself. With the gradual development and perfection of E-learning, personalized education will gradually move from prospect to reality. We can foresee that the organic combination of inclusion and personalization will be an important guiding concept in the development of E-learning for a long time to come.

3.2.2 Acceptance of diversity and complexity

The world today is a world of integration and development. With the accelerating process of globalization and the strengthening trend of world integration, the building of a community of human destiny has gradually become a consensus reached by all countries in the world. Under the background of globalization and integration, the

intermingling of diverse cultures is certainly an important issue that needs to be faced by education nowadays. There is no doubt that the world is a complex organic whole, and this complexity is reflected in all aspects of the world, and the same is true for the field of education. E-learning, as a new educational paradigm derived from the combination of various new technologies and education, should not only focus on the teachers and students in traditional education, but also on the interdisciplinary nature, the technical development, model application, human-computer interaction, and so on, which make it more complex than traditional education. The acceptance of such diversity and complexity is a prerequisite for the future development of E-learning in the face of a complex world.

3.2.3 Reaffirming humanism and fairness

However, unlike traditional classroom teaching, E-learning originated after the information technology revolution and is a teaching mode based on network information technology. The disadvantage of the lack of humanism accompanies the entire E-learning development process. Humanism not only affects the definition of learning contents and educational methods, but also affects the role of teachers and other educators, which is especially important in today's rapid development of digital technology.

The spirit of humanism also calls for the fight against discrimination and for equity in education, and while economic growth and wealth creation have reduced global poverty rates, there is still a huge gap in educational attainment between developed and less developed countries, and even between developed and poor areas within a country, as well as those who are discriminated against in education. Women and girls, indigenous people, people with disabilities, migrants, the elderly, etc. are all constant reminders of the educational equity issues that are still present in every corner of the world today. E-learning has greatly improved the openness, equality and sharing of education, enabling the educated in less developed countries and regions to transcend the limitations of time and space, and to achieve the greatest possible results in terms of education quality. It will undoubtedly be a powerful means to promote equity in education. At the same time, it is also one of the goals that E-learning will pursue in its future development to provide education that meets its own conditions for people with different intellectual development levels, different learning conditions and different receptive abilities.

3.2.4 Towards artificial intelligence and ubiquitousness

With the emergence and maturing of a range of new technologies, such as artificial intelligence (AI), the fourth industrial revolution is sweeping in. Like the Internet in the third technological revolution, AI technology is destined to change once again the way of life in human society. Artificial intelligence education is the product of combining artificial intelligence in the field of education, and artificial intelligence is the inevitable direction for the future development of E-learning. As mentioned above, Ubiquitous Learning is the extension and expansion of E-learning, and is the inevitable direction of its future development. But under the limitation of current technology, the goal that learners can learn any content they are interested in at any time, at any place, on any device is still in the theoretical stage. In the field of E-learning, the use of artificial intelligence not only helps the learner but also helps in deepening the understanding of the learning process [9]. However, the increasing maturity of AI technology gives hope to the ubiquitousness of E-learning, and it can be predicted that with the more mature AI technology and the continuous emergence of more new technologies, the day will come when we can move from E-learning to U-learning.

The relation between AI education and E-learning is not a simple substitution and replacement, but a rather complementary and synergistic one. The application of AI technology in the field of education is also inseparable from the support of internet technology. It is not only the future development direction of E-learning, but also an inevitable trend, to perfectly apply artificial intelligence technology to E-learning, and to make E-learning really go towards Artificial Intelligence and Ubiquitization.

4. CONCLUSION

As a new paradigm in education that has received widespread attention from education scholars around the world, the importance of E-learning for the future of education is evident. The current research hotspots in the field of international E-learning mainly include universal learning design, technology acceptance model, ubiquitous learning, flipped classroom, teacher training and so on. The future picture of E-learning is envisioned, namely, integration of inclusion and personalization, acceptance of diversity and complexity, reaffirmation of

humanity and equity, and moving towards AI and ubiquity.

As we all know, SCI and SSCI journals are very strict in reviewing and selecting papers, and the publication cycle of a paper may take more than one year, which will undoubtedly affect the effectiveness of the source literature. In addition, this study only selects journal articles from 2013-2017 as sources, and only "E-learning", "e-Learning" are selected in the Web of Science database. In the future, we need to select literature with wider sources and longer time span as the research samples, adopt more search terms and analyze them according to the current situation of research to enrich the research content.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Qahmash AIM. The potentials of using mobile technology in teaching individuals with learning disabilities: A review of special education technology literature [J]. Tech Trends. 2018;62(6):647-653.
2. Nicholson PA. History of E-learning: Echoes of the pioneers. In Fernazdez-Manjon B, et al. Eds. Computers and Education: E-learning, from Theory to Practice, Dordrecht: Springer. 2002;1-12.
3. Freeman Linton. A set of measures of centrality based on betweenness [J]. Sociometry. 1977;40(1):35-41.
4. Rose DH, Meyer A. Teaching every student in the digital age: Universal design for learning. Alexandria, VA: ASCD. 2002;1-10.
5. Davis Jr. FD. A technology acceptance model for empirically testing new end-user information systems: Theory and results [D]. Massachusetts: Massachusetts Institute of Technology; 1986.
6. Davis FD. Perceived usefulness perceived ease of use and acceptance of information technology [J]. Mis Quarterly. 1989;13(3):340-391.
7. Weiser M, Gold R, Brown JS. The origins of ubiquitous computing research at PAPC in the late 1980s [J]. IBM Systems Journal. 1999;38(4):693-696.
8. Robert Talbert. Inverting the linear algebra classroom [J]. Problems, Resources and Issues in Mathematics Undergraduate Studies. 2014;24(5):361-374.
9. Neil Rubens, Dain Kaplan, Toshio Okamoto. E-Learning 3.0: Anyone, anywhere, anytime and AI [C]. International Conference on Web-based Learning; 2014.