



# Blended Learning for Teachers in the Era of "Internet+": From Meta-analysis to Multidimensional Scale Constructs

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**Abstract.** The Internet+ era has brought changes to teachers' learning styles. Objective: To study teachers' blended learning not only at the theoretical and strategic levels, but also at the practical level. Methods: Using meta-analysis, we explored the characteristics of teachers' blended learning and used spss26.0 to analyze the current state of the field of teachers' blended learning. Process: A meta-analysis was conducted by searching and screening the literature, using the time of publication, disciplinary orientation, research area, and research method as research variables; the SPSS multidimensional scale was used to construct a model of teachers' blended learning field and design a blended course learning platform. Conclusion: Blended learning in the era of "Internet+" is an effective way to provide teacher training and promote teachers' professional growth, and a high-quality blended learning platform should be established to better serve teachers.

**Keywords:** "Internet+"; blended learning for teachers; meta-analysis; multidimensional scales; Blended Course Learning Platform

## 1 Introduction

The development of the Internet and information technology today has changed the way knowledge is generated, the development process, the means of acquisition and dissemination, and the human learning style and education model have also changed. Blended learning is a new learning environment based on theories such as constructivism, behaviorism, and cognitivism, which combines face-to-face teaching and information-networked teaching to constitute a new learning environment [1], and also includes the integration of technology, place, teaching methods, and other aspects [2]. At present, blended learning research from the students' perspective has been effective, but innovative training and learning models for teachers are still in the exploration stage [3].

"Meta-Analysis" (Meta-Analysis) is also known as meta-analysis, integrative analysis, synthesis, etc. [4]. Since 2002, the National Research Council has been promoting the use of meta-analysis for the accumulation of scientific knowledge in education [5]. As a quantitative and systematic literature review method, meta-analysis provides

methodological guidance for integrating existing research findings, and the number of studies on meta-analysis in education continues to grow. To grasp the development of blended learning research as a whole, the meta-analytic approach was used to explore the current status of teachers' blended learning research, construct a model of teachers' blended learning domain, and design a blended course learning platform.

## 2 Research sample and research method

Using the CNKI and WOS database as a research tool, we searched for "teachers" "blended learning" AND "online training" from January 2010 to March 2023. We searched for the keywords "teachers" "blended learning" and "online training", and obtained 125 data items.

Meta-analysis is the study of existing data, which belongs to non-interventional research methods, and with the help of measurement and statistical analysis, a sample of existing studies on a topic is re-tabulated, analyzed, and synthesized to finally reflect the overall effect of the topic, and then summarize the characteristics, trends, and problems of research on this topic[6]. Meta-analytic methods have been commonly used in the field of educational research and are an effective method for evaluative research. In this paper, SPSS 26.0 and Excel 2019 software were used as tools to analyze and count the research samples.

## 3 Meta-analysis study design

### 3.1 Set meta-analysis variables

The normative coding frame and specific variables were determined according to the research purpose and research needs. Based on the experience of previous researchers on meta-analysis and blended learning research, the following variables were selected for analysis in this paper: (i) publication dynamics: the time when relevant papers were published publicly to analyze the timeline of research changes in blended learning. (ii) Subject distribution: the subject areas involved in teachers' blended learning research. (iii)Research themes: the direction of the thematic clustering of teachers' blended learning research in recent years. (iv)Research methods: The tools and instruments used in research to reveal the inner laws of things.

### 3.2 Meta-analysis coding system

To comprehensively analyze the current situation and problems in the development of blended learning for teachers in China, the indicators were developed by analyzing the samples one by one, screening the different samples, and summarizing the content and types of research to form coded indicators [7]. As shown in Table 1.

**Table 1.** Table of teachers' blended learning coding system

Research Characteristics	Meta-analysis coding element characteristics
Number of articles issued	Year

Academic Direction	Educational Theory-1; Educational Administration-2; Secondary Education-3; Computer Software-4; Computer Applications-5; Elementary Education-6
Research Topics	Web-based training-1; blended training-2; school-based training-3; primary and secondary school teachers-4; teacher professional development-5; blended learning-6
Research Methodology	Literature analysis method-1; Action research method-2; Questionnaire survey method-3; Case study method-4; Experimental research method-5; Qualitative research-6; Interview research-7 Evaluation research method-8

## 4 Analysis of research results

### 4.1 Trends in the number of articles issued

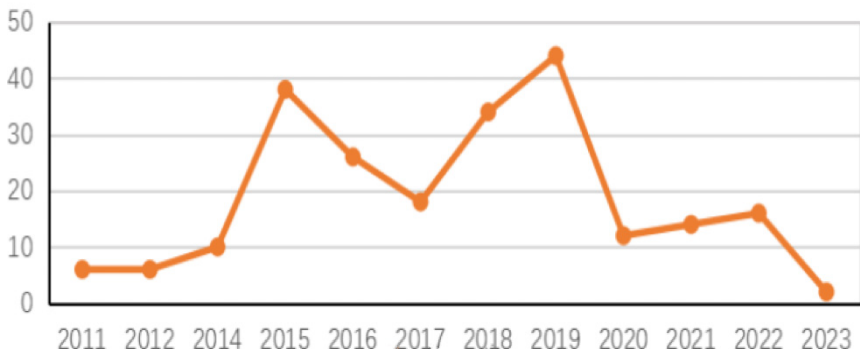


Fig. 1. Trends in the number of blended learning

As can be seen from Figure 1, the research on "blended learning for teachers" showed an increasing trend from 2011 to 2023, and in January 2011, the Department of Education issued the "Opinions of the Ministry of Education on Strengthening Teacher Training in Primary and Secondary Schools", which put teacher online training on the right track, and the academic community began to combine "blended learning" with "teacher training". "In January 2011, the Ministry of Education issued the "Opinions of the Ministry of Education on Enhancing Teacher Training in Primary and Secondary Schools", and the academic community began to combine blended learning with teacher training. From 2014 to 2020, research on blended learning for teachers rose in waves until 2019, when the highest number of 44 articles was published. 2020 to 2022 saw a significant decline due to the global epidemic (2023 data are not indicative). Overall, the attention to research on blended learning for teachers in China continues to increase, and the extent of researchers' research on blended learning for teachers increases year by year.

### 4.2 Academic Direction

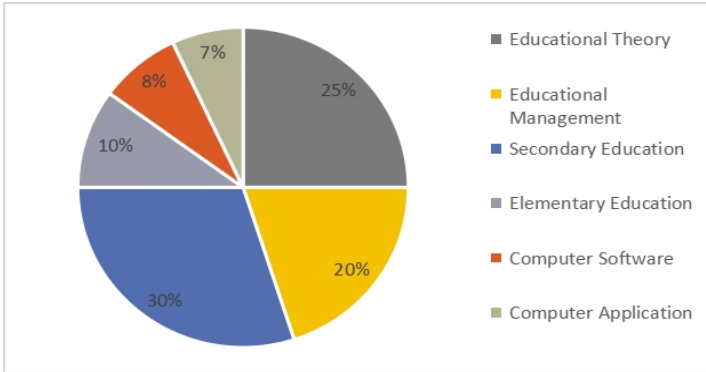


Fig. 2. Faculty Blended Learning Research

The disciplinary directions are more involved, mainly involving educational theory, educational management, secondary education, primary education, computer software, and computer applications. As can be seen from Figure 2, the research direction of secondary education accounts for 30%, and the discipline of secondary education generally focuses on teacher training. Secondary Education, which is in Primary Education includes full-time general secondary schools, specialized secondary schools, vocational secondary schools, and technical schools. Compared with secondary education, primary education accounts for less than 10% of the total, indicating that the research on blended learning for teachers in primary education has yet to be strengthened. The blended learning about higher education teachers did not enter the top six, which is related to the importance of theoretical research for higher education teachers. The disciplines of educational theory and educational management accounted for 25% and 20%, respectively, and most of the theoretical research was conducted by academic researchers in universities. Blended learning for teachers is the research direction of both theory and practice, so the total proportion of computer software and computer application is 15%, which indicates that the relevant research has involved the development of online software and the application of platforms.

### 4.3 Analysis of research themes

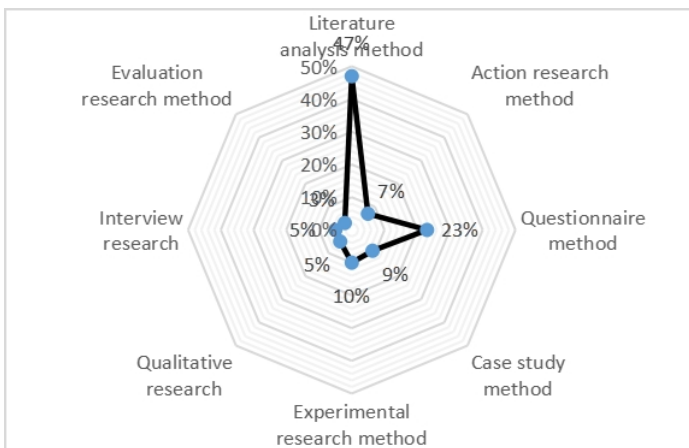
Table 2. Similarity matrix of Ochia coefficients for high-frequency keywords

	Webinars	Blended training	School-based Training	Teacher Professional Development	Blended Training	Blended Learning
Webinars	1.000					
Blended training	0.180	1.000				

<b>School-based Training</b>	0.476	0.278	1.000			
<b>Professional Development</b>	0.367	0.000	0.065	1.000		
<b>Blended Training</b>	0.226	0.000	0.140	0.231	1.000	
<b>Blended Learning</b>	0.355	0.309	0.219	0.161	0.201	1.000

The numbers in the Ochia similarity matrix indicate the similarity between the data, and the size of the numbers indicates the distance between the corresponding two keywords; the closer the value is to 1, the closer the keywords are to each other and the greater the similarity; conversely, the closer the value is to 0, the further the keywords are to each other and the less similar they are [8]. Table 2 shows that the order of relationship with blended learning in descending order is: online training (0.355), blended training (0.309), school-based training (0.219), blended training (0.201), and teacher professional development (0.161). This shows that there are more research results combining blended learning with "online training" and "blended training". The rapid development of modern information technology provides excellent conditions for teachers' professional growth, and blended learning assumes an important role in teachers' professional development, providing the possibility of close communication with high-level experts. In addition, blended learning has the most distant relationship with "teacher professional development", which indicates that the state and society need to pay attention to teachers' professional growth and update the concept of teacher training.

#### 4.4 Analysis of research methods



**Fig. 3.** Percentage of research methods

From Figure 3, it can be seen that the articles studying teachers' blended learning mainly used the literature analysis method, accounting for 47%, the highest percentage, followed by the questionnaire survey method, accounting for 23%. The questionnaire method is a structured survey method, and its survey questions are expressed in a fixed

form, the order of questions, and the way and method of answers. Although it saves time, money, and manpower, the questionnaire responses are sometimes more subjective, and it is difficult to guarantee the quality of the questionnaire. Overall, it seems that teachers' blended learning research lacks data support and empirical research, and it is difficult to strictly screen and control various variables to ensure the reliability and validity of research results.

## 5 Teachers' blended learning multidimensional scale constructs

The multidimensional scale analysis of the dissimilarity matrix of high-frequency keywords using SPSS 26.0 was used to draw a visual map of blended learning research hotspots for teachers in China to further explore the hidden inner meanings between keywords, as detailed in Figure 4. data were created to select group plots, and the standardization method was selected for Z-scores, and the results showed that Stress=0.23625, RSQ= 0.72201, which is a good fit and better reflects the relationship between individual keywords.

In the strategic coordinates, each small circle represents the position of each high-frequency keyword. The closer the distance between the circles, the closer the relationship between them; conversely, the more distant. The closer to the center of the strategic coordinate, the greater the influence. The horizontal axis of the coordinates represents centripetal degree, i.e. the strength of inter-domain influence; the vertical axis represents density, i.e. the strength of inter-domain influence.

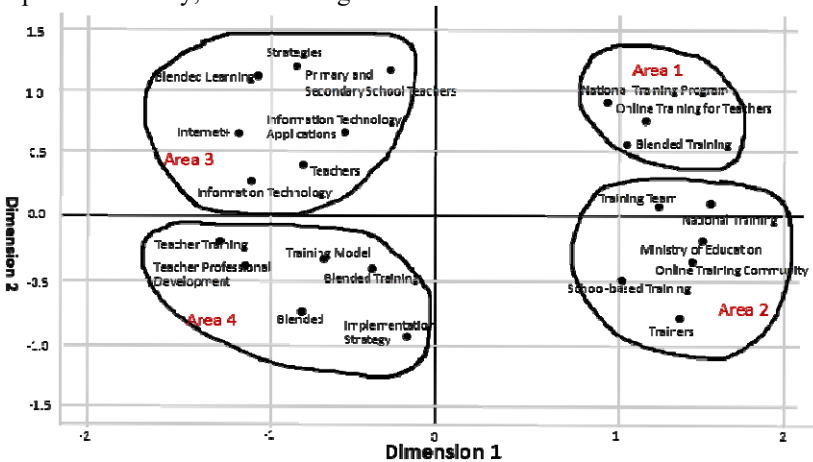


Fig. 4. Multidimensional scale analysis of teachers' blended learning

According to Figure 4, the first quadrant is centered on the "National Training Program" (Area 1), which was fully implemented in 2010 and focuses on improving the quality of primary and secondary school teachers, especially those in rural areas.

teachers. The purpose of the program is to improve the overall quality of primary and secondary school teachers, especially rural teachers, and includes two programs: the "Model Training Program for Primary and Secondary School Teachers" and the "Training Program for Rural Backbone Teachers in Central and Western China". As a result, it became a hot spot for research on "teacher learning" between 2010 and 2015, but has gradually become marginalized in recent years. The second quadrant is "Internet Information Technology" (Area 2), which is a hot spot. With the development of Internet information technology, a huge amount of curriculum and teaching resources have been accumulated for online research, and blended learning approaches have gradually emerged. On the one hand, it provides teachers with high-quality static resources, and on the other hand, teachers use the platform to exchange and learn with experts and scholars across time and space. Teachers use teaching and research resources to improve the quality and efficiency of lesson preparation and to learn advanced teaching concepts and methods. The third quadrant is the research on "blended teacher training" (Area 3). Since 2015, the General Office of the Chinese Ministry of Education has issued several implementation plans for teacher training programs in primary and secondary schools, and a "blended teacher training" model has gradually emerged, driven by policy and Internet information technology. The training integrates high-quality teaching resources in the "Internet+" era and offers a variety of training activities such as online courses on demand, live broadcasts on online platforms, independent training, class discussions led by class instructors, cross-class online and offline exchanges, and the preparation of learning briefs. The combination of learning demand research and reflection feedback provides strong support for the implementation and quality improvement of online and offline training. The fourth quadrant is centered on "school-based training" (Area 4), which was introduced by Vice Minister Yuan Guiren in 2010 and requires training to be school-based, for schools, and to develop school-based training. In the context of comprehensive education reform, school-based training integrates forces from multiple perspectives and aspects to create a good ecological environment for school-based training, to enable teachers to achieve professional development through expert leadership, peer support, and individual reflection and practice. From the multidimensional scale model, it can be seen that domain 2 and domain 3 models are close to the center, indicating active research performance, and each keyword is more loosely related to each other, indicating that there is still room for research; domain 1 and domain 4 are closely aggregated, indicating that there are more research results, but more results have been formed because the relevant policies were proposed earlier, and the research gradually tends to the edge.

As shown in Figure 5, course objectives, course content, course structure and course feedback are four important elements of distance training for primary and secondary school teachers that are complementary, mutually supportive and inseparable[9]. First of all, the course objective is the fundamental embodiment of the concept of distance training for primary and secondary school teachers and is the global overview of the training activities. It determines the course content, the basic direction of the course structure and the expected effect of the course. Only after setting clear and explicit course objectives can we choose suitable course contents and build a complete course structure according to this objective. Secondly, course content is the direct object of

distance learning for primary and secondary school teachers, and is an important influencing factor of distance learning quality. Course content must reflect the course objectives, specify the knowledge and skills that learners will learn, and be a concretization of the course objectives[10]. Only by setting specific course content can learners truly understand and master the knowledge and skills they have learned, and thus achieve the level required by the course objectives. Secondly, the course structure is a structural and specific arrangement of the type, nature and proportion of the course content, reflecting the requirements of the course objectives. When constructing the course structure, the learning needs of learners should be considered and the course content should be reasonably arranged by combining teaching resources and teaching methods. By optimizing the course structure, learners can be better helped to achieve the course objectives. Finally, course feedback is the extent to which course objectives are achieved and an important way for course improvement and quality assurance. Through course feedback, the difficulties and problems encountered by learners in the learning process can be understood, and corresponding adjustments and improvements can be made in response to these situations.

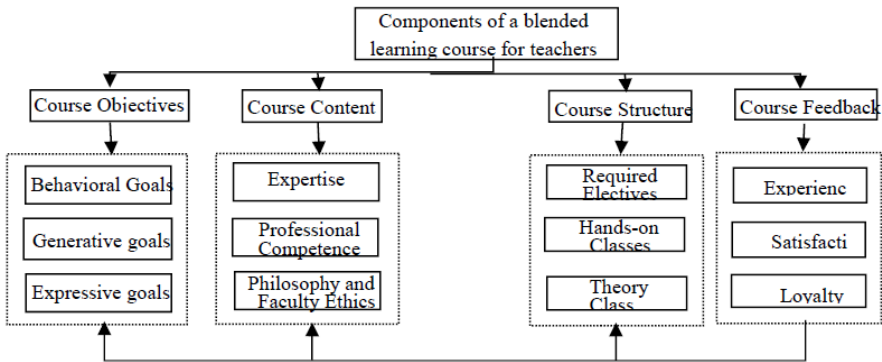


Fig. 5. Components of a blended learning course

## 6 Conclusion

From the meta-analysis of research results, we can see that blended learning for teachers has progressed from theoretical discussions to applied research combined with information technology, and the blended learning approach has been widely recognized in the education field. Entering a new era, curriculum reform and the development of new technologies, especially online technologies, have put forward higher and newer requirements for teachers' concepts and methods. The teaching profession is special and developmental, and "blended learning" meets teachers' pursuit of professional development, improves their learning ability, and provides them with room for continuous growth. At present, there are still many problems with "blended learning for teachers", such as the inconvenient operation of the online platform, the lack of interest, and the low utilization of online resources. With the rapid development of modern information technology and the accumulation of open educational resources, the po-



tential of various blended learning models is increasing. Relevant departments should based on education practice, summarize and conclude the characteristics and rules of blended learning, develop teachers' blended learning activities and course programs, improve the effectiveness of teachers' learning; strengthen the interactive mechanism of the learning platform, meet the communication needs between teachers and peers, courses and platforms in many ways from topic discussions, interactive Q&A, and group collaboration, and create a learning atmosphere to enhance learners' interest. The flexibility of the blended learning model and the diversity of methods will contribute to the creation of a high-level and high-quality teaching force.

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