The Effectiveness of Implementing Deep Learning Activities in a Blended Learning Perspective Based on Big Data Analysis

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Abstract. In order to solve the problem that learners' mastery of knowledge under the blended teaching mode only stays on the surface and lacks deep learning of knowledge. Based on big data application combined with DELC deep learning route, this study proposes an effective deep learning activity model in terms of constructing learning ladder, activating learning motivation, reconstructing migration, and process evaluation. By collecting big data of learners' performance using different learning modes, the analysis compares the data information of learners' average performance, pass rate and merit rate. The statistical analysis showed that the performance of the group using blended deep learning mode is improved.

Keywords: Blended Teaching · Deep Learning Model · Big Data · Statistical Analysis

1 Introduction

Blended teaching combines the advantages of traditional teaching and digital teaching, providing learners with a personalized and differentiated learning experience. It opens up learners' horizons, stimulates their learning initiatives, and is an effective way to adapt to the educational development dynamics during the epidemic period [6]. In the post epidemic era, higher education puts forward distributed needs for teaching due to the different origin of learners. At this time, it highlights the advantages of blended teaching in talent training. The digitalization and networking of education have expanded the breadth of learners' information acquisition, and how to guide learners to use the advantages of information-based teaching to broaden the learning path, strengthen the exploration of the depth of knowledge acquisition, and motivate learners to use the internal drive of learning to actively reflect on the reconstruction and flexible transfer of knowledge application is an urgent problem to be solved. By using big data analysis technology to obtain learner data, it enables the management of students' comprehensive evaluation and effective monitoring of teaching and learning delivery [8].

C. F. Peng et al. (Eds.): EIMT 2022, AHSSEH 3, pp. 29–37, 2023.
https://doi.org/10.2991/978-94-6463-012-1_5

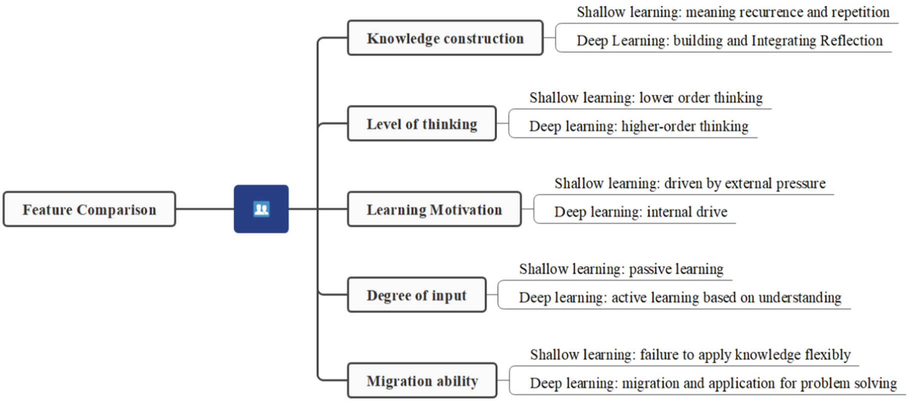

Fig. 1. Deep learning vs. shallow learning feature comparison

2 The Connotation and Theoretical Basis of Deep Learning

2.1 The Connotation of Deep Learning

Deep learning activities generally refer to learning activities that apply higher-order cognitive strategies to solve problems, with the goal of helping learners master core knowledge and effectively transfer applications. There is no uniform definition of deep learning activities. In the 1970s, American scholars Ference Marton and Roger Saljo, who first proposed the impact of deep learning on learning outcomes, argued that deep learning and shallow learning are the main reasons for learning differences. At the same time, deep learning is the active processing and reconstruction of knowledge by learners, which is higher-order cognition, while shallow learning uses immediate memory for low-level cognition of knowledge [7]. Through the multidimensional study comparison of deep learning and shallow learning, the researchers summarized the characteristics of the two as shown in Fig. 1.

From Fig. 1, it can be seen that scholars have two ways of thinking about deep learning research. On the one side, researchers generally agree that deep learning is a change in approach relative to shallow or surface learning. According to the characteristic laws of human cognition, it can be divided into six stages of knowledge, understanding, application, analysis, synthesis, and evaluation according to cognitive abilities [5]. It emphasizes that learners critically learn new ideas and knowledge, incorporate new knowledge into the original cognitive structure and transfer knowledge to new situations to help decision-making and problem-solving [11]. On the other side, researchers believe that learners performing deep learning should have the ability to analyze, evaluate, and reprocess a wide range of retrieved information [1]. It is a learning strategy that learners read extensively, understand and construct, communicate and share, and transfer to apply to solve real-world problems [2]. It can help in the integration of old and new knowledge, deep understanding and transferable application [9].

In summary, deep learning focuses on the comprehension, absorption and transformation of the information or learning materials received by the learner. It focuses on the learner's active understanding of core scientific knowledge. It emphasizes the development of learners' ability to think critically, reconstruct knowledge, and apply transfer to solve new problems.

2.2 Theoretical Basis of Deep Learning

Deep learning is an effective means to adapt to the changing complex learning environment and learners' learning expectations in the blended learning perspective. The knowledge and understanding of deep learning are based on various learning theories such as constructivism, distributed cognition, situated cognition, etc. It needs to be combined with group-driven, communication sharing and scientific evaluation to verify the learning effect.

Constructivism is the process by which learners actively construct their understanding of new knowledge. Deep learning requires learners to use their higher-order thinking skills to deeply process and construct and reorganize the learned knowledge in order to achieve meaningful learning. Deep learning breaks through the learner's original knowledge structure and mindset.

Distributed cognition theory considers cognitive activity as distributed and as a process of interactive cognition between people and people, and between people and technological tools. The process of cognition is a way of acquiring knowledge and applying it in real-life situations such as living environments, social activities, information media and cultural exchanges.

Contextual cognitive theory believes that knowledge is the product of interaction between people and society, and that learners will learn meaningfully in specific contexts with on-site information. In order to achieve the purpose of deep learning, the virtual scenarios are created to visualize the learning scenarios. In a hands-on environment, group members share and deepen their knowledge through interaction and discussion to achieve the goal of solving complex problems in real-life situations. Practice situations

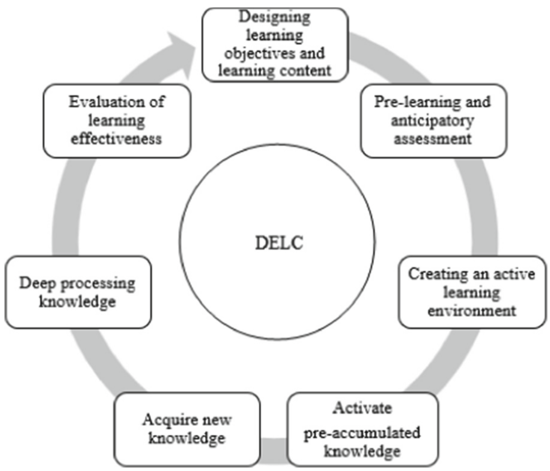

Fig. 2. DELC Deep Learning Route

can be set up with smaller tasks that gradually allow learners to acquire knowledge and skills in the subject area by giving them tasks and thought leadership.

In conclusion, the community theory consisting of constructivism, distributed cognition, and contextual cognitive theory provides strong support for conducting deep learning in a blended learning perspective, and the next step of the study focuses on how to effectively carry out the instructional design of deep learning applicable to blended teaching and learning. This study refers to the DELC (Deep Learning Cycle, DELC) deep learning route proposed by Eric Jensen and LeAnn Nickelsen as shown in Fig. 2 [3], and explores an application model that effectively integrates online learning with offline face-to-face teaching and translates deep learning theory into concrete practice, with a view to achieving the purpose of deep learning.

3 Deep Learning Design and Construction Under the Perspective of Blended Teaching

This study is designed by combining the DELC deep learning route and Mr. Guonong Nan's idea that combining the complementary strengths of traditional learning and digital learning can lead to the best learning results [4]. The design idea is to set the tasks that teachers and learners need to accomplish in each session according to the characteristics of split online and offline teaching. The teacher acts as a guide, assigning good learning tasks to learners, providing screened learning resources and creating a positive learning environment. Learners use online and offline resources to complement each other and actively participate in teaching and learning with internal drive to complete deep learning [10]. Deep learning models in a blended learning perspective, as shown in Fig. 3.

The deep learning model combines an online big data application learning platform for blended teaching, incorporating the advantages of rich online teaching resources not limited by time and space, and offline face-to-face sensory communication, solving the dilemma of lazy learners in online learning. The teacher plays the role of mentor and encourager throughout the activity design, guiding learners through the tasks designed for deep learning such as pre-study tasks, forming groups, group discussions, and validating practice. Learners develop the ability to learn and think independently with an internally driven will, and learn to listen to others' ideas and interpret their own opinions to their peers in group inquiry and communication sharing activities. They learn to collaborate with each other in acceptance and appreciation, master communication skills in mutual assistance and sharing, and continuously reflect, construct and transfer in seminars and debates to complete deep processing of knowledge.

Compared with the traditional teaching mode, the learning space of blended teaching gradually extends from the traditional fixed classroom to the geographically distributed network, the learning effect overflows from shallow learning needs to deep learning, and the scope of learning evaluation expands from result-oriented to process-oriented. It is evident that the blended teaching model puts more demands on the instructional design. In this study, a blended teaching strategy based on pre-class laddering, in-class guidance with emphasis on movement, and after-class transfer integration and evaluation are constructed in conjunction with the DELC deep learning route. The design of deep learning before, during and after the class is as follows.

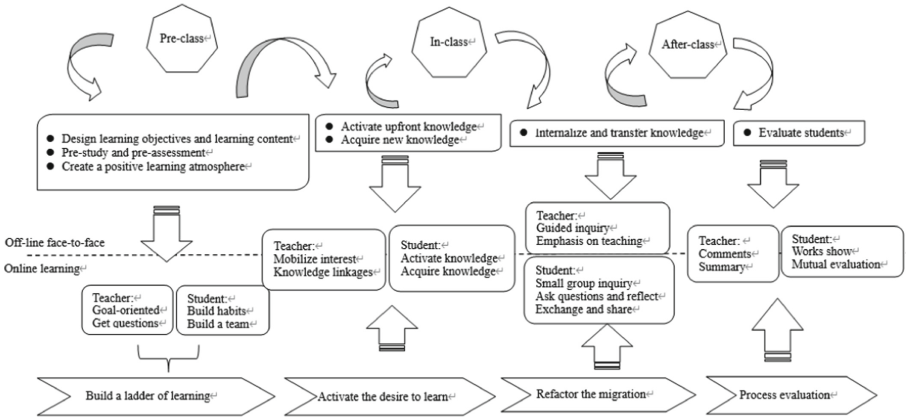

Fig. 3. Deep Learning Models in a Blended Learning Perspective

3.1 Pre-class Design

Pre-learning is a process that allows learners to clarify the learning objectives for the next course and guides them to think and ask questions. The teacher sets the pre-study task in advance, builds a learning ladder, and guides learners to use online resources to complete the pre-study. Learners can form study groups and use the online learning platform to discuss and answer questions within the groups together, so as to cultivate the habit of independent learning and create a positive and harmonious learning atmosphere. The teacher collects learners' questions at this stage and summarizes the key points for answering them. Learners enter the classroom with unanswered questions and a desire for knowledge, and the teacher collects the learners' questions and summarizes the key points for answering them at this stage. This stage mainly prepares two tasks for deep learning, one is to design a clear teaching objective and assign an appropriate amount of pre-reading tasks. Use screened diversified teaching resources to open up learners' horizons and guide them to study independently and think independently, so that they can initially understand the course content and discover blind spots of knowledge in advance. The other is to use appropriate channels to obtain learners' questions and collect the questions that learners cannot solve in the process of independent learning and mutual help in answering questions through questionnaires or interactive discussions.

3.2 In-Class Design

In-class learning is accomplished primarily through physical classrooms, and physical classrooms during the epidemic period often take the form of online classes. Using either approach to classroom instruction requires stimulating learners' interest in learning. New knowledge can be presented through high-quality video resources, animated courseware, and other figurative formats. Teachers should help learners sort out basic concepts and cognition, strengthen the linkage between old and new knowledge, and activate learners' pre-accumulated knowledge memory. Teachers also need to guide learners to use group discussion, questioning and reflection, and exchange of practice to explore the main issues summarized before the lesson, and to complete the content focused on the course in a targeted manner. Teachers should help learners internalize their knowledge in the class, link and reconstruct old and new knowledge, and finally transfer and apply it to solve specific practical problems, so that learners can realize deep processing of knowledge.

3.3 After-Class Design

The time spent in class does not complete the internalization and transfer of knowledge, so teachers still need to continue to guide learners in their thinking and communication after class. Teachers use online resources and learning tools to help learners supplement and expand their course knowledge and deepen their depth of understanding through personalized instruction, group tasks and real-world examples. Teachers provide targeted and personalized instruction to learners through instant messaging software such as WeChat groups and Ding Talk groups, using text, voice, video or even remote control of computers. Learners simulate real-life situations with practical problems through group tasks assigned at the end of the class. The group members divide the work and cooperate to complete the practical case of the extended training. Finally, the learners' performance is comprehensively evaluated through division of labor, documentation, mutual evaluation within the group, and presentation of results, as shown in Table 1.

3.4 Data Analysis and Effectiveness Verification

The data for this study relied on the performance of the Practical Foundations of Computing course for all first-year students in College H. Information on the performance of 5931 learners in the Practical Foundations of Computing course was selected for the years 2019 to 2021. The course was taught in these three years using traditional teaching methods, blended teaching, and deep learning strategies in the context of blended teaching, and a sample of students with different teaching methods was sampled and the teaching effects were analysed comparatively.

Among them, the first group had a sample size of 120 traditional teaching, the second group had a sample size of 113 blended teaching, and the third group had a sample size of 115 blended teaching combined with deep learning strategies. The first group sample had a mean score of 75.07, a pass rate of 96.67%, and an excellent rate of 2.50%; the second group sample had a mean score of 76.50, a pass rate of 99.11%, and an excellent rate of 0.89%; the third group sample had a mean score of 78.83, a pass rate of 100%, and an excellent rate of 13.04%. The mean scores, pass and excellence rates of the three sample groups can be viewed as shown in Table 2.

The data in Table 2 show that although the average score of the second group of samples is slightly higher than that of the first group, the improvement in performance

Table 1. Blended learning course evaluation program

Composition of grades	Evaluation indicators	Score	Evaluation content and scoring methodology
Online part 45%.	Online preview 5%.	5	The completion degree of the pre-study material is more than 85%, and the system automatically scores
	Discussed online 15%.	15	There are 15 questions or discussions in the posting area, and the system automatically scores
	Quiz feedback 25%.	25	Complete 5 times chapter tests, and the system automatically scores
Offline part 55%.	Classroom performance 10%.	10	One point for each attendance, total of 10 points
	Classroom practice 15%.	15	Group discussion, questioning and reflection, exchange and sharing, 5 points each
	Practice 30%.	30	There are 5 points for division of work, documentation and student assessment, 15 points for presentation of results

Table 2. Sample data display

	Average score	Pass Rate	Excellence rate
Sample 1	75.07	96.67%	2.50%
Sample 2	76.50	99.11%	0.89%
Sample 3	78.83	100%	13.04%

is not significant, and the excellent rate of the second group of samples decreased. Compared with the first two groups of samples, the average scores of the third group of samples increased by 3.76 and 2.33 respectively, the passing rate reached 100%, and the excellent rate increased by 10.54% and 12.15% respectively. Especially the number of learners who obtained grades of pass and below decreased significantly, and the excellent rate is improved significantly. The distribution of grades for the three groups of samples presented by the data analysis software is shown in Fig. 4.

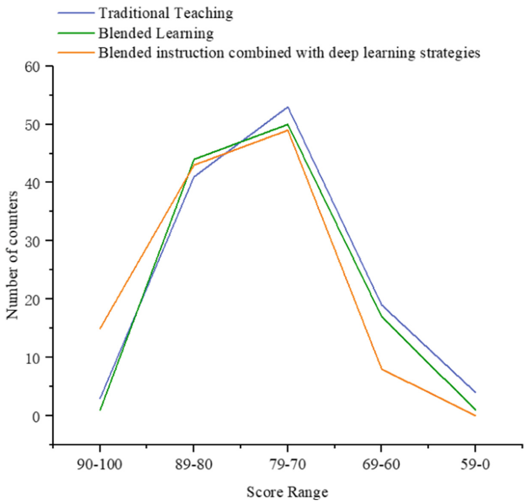

Fig. 4. Results Distribution Chart

4 Conclusion

Analysis of the big data shows that the implementation of deep learning activities effectively enhances learners' key learning competencies in blended learning and promotes the development of learners' thinking structures. Learners are able to overcome difficulties in completing course learning tasks with internal motivation, use critical thinking to analysed problems, and effectively discern truth from the information they acquire. Learners' abilities in collaboration, communication and expression, knowledge transfer, and application were also improved across the board. By comparing the study, the pass and merit rates of learners who participated in deep learning strategies were significantly improved, indicating that the implementation of deep learning strategies on the basis of blended instruction had a positive effect on improving learners' subjective motivation and overall competence.

The change in learning style increases the psychological burden on the learner. The time and effort required to complete deep learning activities with high quality is much greater than that of traditional teaching. Therefore, teachers need to coordinate the difficulty and design complexity of deep learning activities to enhance learners' recognition of deep learning and avoid the problem of unsustainable development of deep learning due to the difficulty of implementation, heavy learning burden, and long time spent.

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