

Research on Hybrid Teaching Model Based on Human-Machine Collaboration

Jing Chi

School of Information and Science Technology, Yunnan Normal University, Kunming, 650506, China

2311467540@qq.com

Abstract. The information technology in education promotes the innovation of blended teaching mode with technical support. This paper constructs an online and offline hybrid teaching model based on the concept of human-computer collaboration. In addition, the experimental research method was used to investigate the effect of the hybrid teaching mode on the teaching effectiveness of the course "University Computer Fundamentals" as an example. The study found that learners who participated in the blended learning classroom performed better than traditional multimedia instruction, and that the different learning behaviors of learners correlated with their final grades. This shows that the online and offline hybrid teaching based on human-computer collaboration can improve the learning effectiveness of learners.

Keywords: Hybrid Learning; Human-Machine Collaboration; BOPPPS Teaching Method.

1. Introduction

With the development of information technology in university education, the National Medium and Long-term Education Reform and Development Plan (2010-2020) suggests that teachers should focus on the combination of learning and thinking of learners, and practice the teaching methods of inspiration, inquiry, discussion and participation to help students improve their learning.

As a result, blended learning has gradually become the normal teaching in universities' courses, and has become a hot topic of common concern for educational researchers and educational practitioners. Hybrid learning is a new type of learning method driven by the era of education information technology, which is a combination of face-to-face teaching and online learning [1].

In general, although blended learning has been used in college classrooms, blended teaching is still in the exploration stage, for example, there are still many practical confusions in teaching environment, teaching design, learning input, learning personalization and flexibility, among others [2]. There are also studies that show that students' learning engagement is low, persistence is poor, and interaction is negative in blended instruction [3]. Blended learning directly shows learners more unstructured knowledge, especially the lack of obvious connections between knowledge, which easily leads to learning "stopping at superficial knowledge acquisition", so learners lack active thinking about the systematic cognition of knowledge [4]. Knowledge construction is the process by which valuable ideas, thoughts, and understandings are generated and continuously improved [5].

Due to the insufficient ability to mobilize and integrate the elements of blended learning, this tends to cause teachers and students to lack deep inquiry into knowledge and to have insufficient grasp of the essence of knowledge [6]. In addition, the process monitoring of learning is insufficient, and teachers are unable to grasp information and data in the learning process in a timely manner, so they are unable to conduct scientific and quantitative analysis of learners' learning attitudes, learning behaviors and learning outcomes, which tends to lead to one-sided evaluation, thus affecting the success of subsequent teaching and learning. Thus, how to improve the information literacy of teachers and students, and use online information technology to effectively improve the attractiveness of the classroom, student participation, and maximize the learning efficiency of the professional classroom offline, is an urgent issue to effectively promote the development of hybrid teaching.

Based on the above, in order to improve the effect of hybrid teaching and cultivate learners' cognition and ability, this study introduces the human-computer collaborative teaching model, builds a hybrid online and offline teaching model based on human-computer collaboration, and starts the

teaching practice in the course of " University Computer Fundamentals", hoping to provide reference for the widespread use of the teaching model and the teaching reform of university courses.

2. The construction and application of a hybrid teaching model based on human-computer collaboration

2.1 Construction of teaching model

2.1.1 Theoretical analyses

The human-machine collaboration is the combination of human and machine each to accomplish something together. In 1994, Yongxiang Lu and Ying Chen first introduced the concept of "human-machine system", which emphasizes the mutual cooperation between human and machine, each playing to their strengths to accomplish tasks efficiently. Moreover, their research also compared and discussed human-machine at three levels: thinking, perception and execution [7]. American scholars D. B. Lena and E. A. Feigenbaum suggest that computers and people can be colleagues, with people and machines doing their own jobs [8]. The knowledge construction is the process by which valuable ideas, thoughts, and understandings are generated and continuously improved. Human-machine collaboration is also being used in the field of education. Some scholars analyzed the research on the application of human-computer co-teaching at home and abroad in the past ten years and found that human-computer co-teaching is currently divided into three categories: invisible human-computer co-teaching, tangible human-computer co-teaching and hybrid human-computer co-teaching.

2.1.2 Model Construction

The study takes a hybrid online and offline teaching model, which combines traditional teaching with online teaching mode, and integrates face-to-face offline learning with learning pass and rain classroom. As a result, a hybrid online and offline teaching model with human-machine collaboration was established (Figure 1).

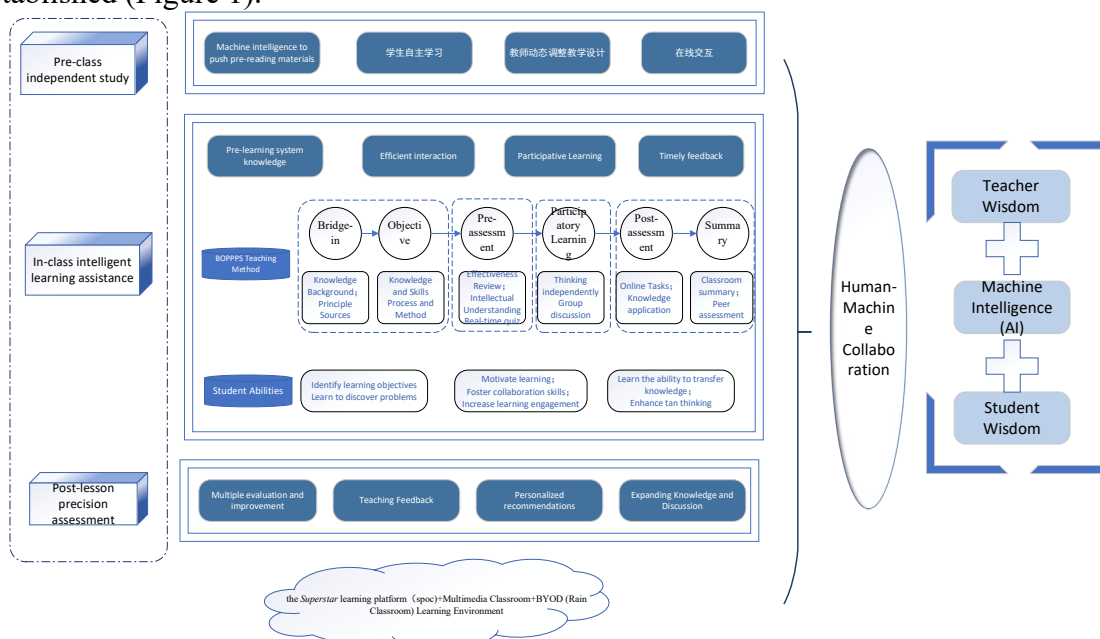


Fig. 1 Hybrid teaching model based on human-machine collaboration online and offline

(1) Pre-class independent study

The pre-class is based on online learning. Through Rain Classroom, teachers push the basic knowledge of video courses and extended knowledge to learners and guide them to learn independently, giving full play to the advantages of students' wisdom, and the learning data will be synchronized to the teacher's end in real time. In addition, teachers use pre-class interaction to

understand learners' cognition of the knowledge taught, and use teachers' wisdom to dynamically adjust the teaching design.

(2) Intelligent learning assistance in class

The BOPPPS teaching model is a teaching model and monitoring system that emphasizes learner-centeredness, focuses the attention of learners, and helps teachers analyze the teaching process and improve the quality of teaching. Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment and Summary.

(3) After-class personalized push

One of the advantages of blended learning is that learners can target their learning after class. Teachers can provide supplementary resources, assign homework, and release topics through Learning Connect online, and conduct comprehensive application and thinking training after class, and set up personalized learning contents according to the characteristics of learners with good learning foundation and ideas to expand the depth and breadth and further cultivate learners' innovation and higher order.

(4) Accurate assessment of learning, multi-dimensional improvement of the evaluation system

The hybrid teaching evaluation integrates diagnostic evaluation, process evaluation and summative evaluation. In besides, the multidimensional evaluation reflects the human-machine collaborative evaluation, the teacher's intelligent evaluation, the machine's intelligent evaluation and the learner's interactive feedback evaluation, which completes the single offline course evaluation

2.2 Empirical analysis of the hybrid teaching model based on human-computer collaboration.

2.2.1 Analysis of the existing situation

A university in Yunnan started to implement online learning for the course "University Computer Fundamentals" in 2019. This study selected the first-year university students in the class of 2019 as the research object, relying on the course "*University Computer Fundamentals*", and analyzed the effect of the online learning application based on the *Super Star* Learning Platform.

In this paper, all information was collected from five data sources of the "College Computer Fundamentals" course: video viewing time, number of chapters studied, number of tasks completed, online tests and final exam scores. A total of 40 learners' online learning records were collected, and the data efficiency rate was 90%. Exploring the complex relationship between the four dimensions of online learning behavior on the Web and the final exam scores, we aimed to verify the effectiveness of their online learning (Table 1).

Table 1 Correlation Analysis

	The final exam score	Video viewing time	The number of Chapter learning	The number of tasks complete-d	Online test
The final exam score	1.000				
	0.000				
Video viewing time(min)	0.182	1.000			
	0.260	0.000			
The number of Chapter learning	-0.09	0.731**	1.000		
	0.954	0.000	0.00		
The number of tasks complete-d	-0.195	0.290	0.261	1.000	
	0.228	0.070	0.104	0.000	
Online test	0.141	-0.011	0.046	0.011	1.000
	0.387	0.946	0.779	0.945	0.000

*. Correlation is significant at the 0.05 level (2-tailed)

**.. Correlation is significant at the 0.01 level(2-tailed)

The analysis showed that there was no significant correlation between video viewing time and final grades. ($R_s=0.182$, $p=0.260>0.01$). Similarly, the number of chapters studied, number of tasks completed, and online tests were not significantly related to the final exam grade. However, there was a significant correlation between the number of videos watched and the number of chapters studied with a correlation coefficient of 0.731 ($p=0.00<0.01$), thus they were highly correlated. This suggests that viewing videos has a positive effect on the number of chapters learned. However, there are still some problems with the online learning process. There was no significant correlation between the number of Chapter learning, the number of learning tasks completed and the length of watching videos and the final exam grade in the learners' learning process. The results of the data analysis and the instructor's feedback reveal some problems: Online learning does not yet support the entire course well, and online learning is not ideal for learners due to a lack of self-directed learning awareness.

2.2.2 Implementation of hybrid teaching model

In the academic year of 2021-2022, the course "*University Computer Fundamentals*" adopts a student-centered human-computer collaborative hybrid teaching model, which organically integrates the MOOC national teaching platform, BOPPPS teaching design, and SPOC small-scale online classroom teaching model. This school uses the national high-quality online open course "*University Computer Fundamentals*" taught by Professor Li Fengxia of Beijing Institute of Technology on the platform of "*China University MOOC*" as the main supplementary learning resources. The MOOC is rich in resources and has a high consistency with the original syllabus of the study case.

This study collected blended learning data from 55 students, including online grades, online self-study data and classroom performance for data analysis and statistics. The online grades include project experiments and post-class assignments submitted by learners online; offline grades include class discussions, post-class assignments, midterm grades, and final grades; where online self-study data are not involved in the final grade evaluation.

3. Analysis of the application effect of the hybrid teaching mode based on human-computer collaboration

3.1 Learning behavior correlation analysis

The correlation analysis was conducted between the process data and the final exam results to test whether the process data effectively supported the final exam results. From the analysis results (Table 2), it can be seen that independent pre-study of MOOC quality boutique courses before class can help improve learners' learning effectiveness, enabling learners to construct knowledge before class and be able to absorb knowledge faster in offline courses; attendance, project experiments, and discussions all have a strong correlation with post-class assignments, which indicates that learners' participation is high, comprehensive experiments cultivate learners' higher-order thinking The class discussion enables learners to improve their interaction and collaboration skills, and enables learners to complete the post-class assignments with higher quality. In the online self-study section, learners were able to discuss and complete the tests independently, with 83% of the students doing self-study and 58% of the students doing well in self-study, which indicates that the online and offline hybrid teaching based on human-computer collaboration is conducive to the improvement of learners' learning efficiency.

Table 2 Learning behavior correlation analysis

	Attendance rate	Video viewing times (min)	Comprehensive Projects	Class Discussion	After-class assignments	Midterm grades	The final exam score
Attendance rate	1.000						
Video viewing	0.208	1.000					

times (min)							
Comprehensive Projects	0.744**	0.120	1.000				
Class Discussion	0.218	-0.028	0.316*	1.000			
After-class assignments	0.732**	0.138	0.289*	0.273*	1.000		
Midterm grades	-0.110	0.237	-0.012	-0.046	-0.212	1.000	
The final exam score	0.176	0.288*	0.210	-0.117	0.086	0.209	1.000

3.2 Analysis of summative results

The final grades in the online learning mode were compared and analyzed with the final grades of teaching in the human-computer collaboration mode, and after converting the grades into standard scores, the SPSS independent sample t-test was used, and the results showed that when the significance of the variance equivalence test is greater than 0.05, it means that the variance is flush when the variance is flush, then when the significance (two-tailed) is less than 0.05, it means that whether teaching in human-computer collaboration is adopted or not has an effect on final grade is influential and there is a significant difference between the two, thus indicating that multiple integrated teaching modes enhance learners' learning (Table 3).

Table 3 Independent samples t-test

	Equivalence of variances test		Mean Equivalence t-test				
	F	Sig.	t	Degree for freedom	Sig.	Difference of mean	Standard Deviation
Assuming equal variance	2.182	0.142	-2.052	110.000	0.043	-0.383	0.186
Equal variance is not assumed			-2.031	97.723	0.045	-0.383	0.188

3.3 Research conclusions

(1) Strengthening multi-dimensional synergy and interaction

Interaction in both offline and online teaching reflects learners' emotions, cognition, and so on; the interaction in either form is a direct factor that can directly affect learners' engagement, and is closely related to teachers' teaching methods, teaching attitudes, feedback, and evaluation; therefore, to improve the efficiency of interaction, all dimensions need to be optimized.

(2) Changing the inherent thinking of teaching and innovate integrated teaching inside and outside the classroom

In the context of the new Internet technology and educational innovation, teachers will adopt different teaching strategies in the face of learners of different majors, and different measures in the face of learners' different stages of learning. The knowledge and ability of teachers in the context of human-computer collaboration do not require teachers to become AI experts, but rather to understand what problems AI can solve, master the methods of using human-computer systems to carry out education and teaching, and innovate integrated teaching inside and outside the classroom.

4. Summary

With the changing times, Internet mobile has become a trend, and the channels to obtain information have been diversified. Traditional teaching can only follow the development of the times

and meet the learning needs of learners by integrating with online platforms and mobile, and through mobile Internet, learners can use fragmented time for learning, which is convenient, efficient and easy to operate. In MOOC, a large number of high-quality courses can be watched repeatedly by learners, and they can exchange and discuss through multiple platforms such as Rain Classroom and Learning Pass, which can stimulate learners' interest in learning. Based on BOPPPS, SPOC, and the case study of undergraduate Computer Fundamentals course, this study constructs and revises the hybrid teaching model with human-computer collaboration, and conducts a case study to conclude that the hybrid teaching method with human-computer collaboration proves in practice to be able to improve learners' learning efficiency, cultivate learners' autonomy, inquiry, and critical thinking ability, and is in line with the requirements of the new curriculum reform. There are still some shortcomings in this study, and we need to further explore the empirical evidence and theoretical improvement around human-computer co-teaching in the future.

References

- [1] BERNARD R M, BOROKHOVSKI E, SCHMID R F, et al. A meta -analysis of blended learning and technology use in higher education: From the general to the applied[J]. *Journal of computing in higher education*,2014,26(1):87-122.
- [2] Guoshuai Lan, Jiakai Wei, Yi Zhang, et al. Future higher Education Teaching: macro Trends, key Technology practices and Future Development scenarios-- key points and thoughts on the Horizon report 2021 (Teaching Edition) [J]. *Open Education Research*, 2021 (3).
- [3] FISHER R, PERÉNYI Á, BIRDTHISTLE N. The positive relationship between flipped and blended learning and student engagement, performance and satisfaction[J]. *Active Learning in Higher Education*, 2021, 22(2): 97-113.
- [4] Mengjiao Jiang, Xia Zou. Research on deep learning based on MOOCs environment[J]. *Software Guide (Educational Technology)*,2014, (7):37-39
- [5] Shaodong Peng. A study on the three-loop model of knowledge construction in blended collaborative learning[J]. *China e-learning*,2015, (9):39-47.
- [6] Feixia Peng, Wen Yang. How blended learning can deepen the depth of learning - and how big data in education can support learning analytics[J]. *Modern Distance Education*,2017, (2):31-39.
- [7] Yongxiang Lu, Ying Chen. Human-machine integration system and technology--an important development direction of mechanical science in the 21st century[J]. *Journal of Mechanical Engineering*, 1994(5): 1-7.
- [8] Lena D B,Feigenbaum E A. On the Thresholds of Knowledge[J].*Artificial Intelligence*,1991,47(1):185-230