Learning Comparative Analysis of Teaching Models Based on Smart Platforms——Takes ERP Principles and Applications as Example

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Abstract. Based on the background of big data technology and the post-epidemic era, the introduction of online teaching has become an inevitable development trend. Hybrid teaching is a feasible way to improve teaching quality in the teaching reform, and it is important to explore the effect of online and offline hybrid teaching mode. This paper has analyzed the data of an example course—ERP principles and applications, on the EduCoder practice smart platform in a visual form in order to compare learning behaviors and results between hybrid teaching mode and self-learning online mode. Then it has made significance tests and established the teaching quality evaluation model of the course. At last, this paper has given some suggestions on how to improve the online learning ability and results.

Keywords: Online and Offline · Teaching Mode · Blended Learning · Comparative Analysis · Smart Platforms

1 Introduction

At this stage, China's epidemic prevention and control is still on the way. How to balance online teaching and traditional teaching mode has become a major problem in society. How to innovate in education mode has also become a concern of many educators. In this context, it is of great significance to make a comparative study of pure online teaching mode and online and offline mixed teaching mode.

Online learning refers to the mode of online learning or online learning through online learning platform. Online and offline mixed teaching mode means that learners should not only accept learning in the online and offline classroom like the traditional mode, but also carry out operation practice, classroom check-in, discussion, fill in questionnaires and hand in materials on the online platform. The score recorded on the platform is component of the final score of the course.

This paper introduces the conceptual framework, evaluation criteria, verification process and research conclusions of hybrid teaching effectiveness evaluation, realizes the integration of classroom teaching evaluation and online learning evaluation, and establishes the factor composition model of hybrid teaching effectiveness.

This paper aims to compare the differences between pure online teaching mode and online and offline mixed teaching mode in learning behaviors, learning achievement and learning quality, analyze the reasons for the differences, and finally give reasonable suggestions. This study attempts to analyze how the teaching participants in the online and offline integrated teaching build a new network interaction under the complex mode, explore the interactive relationship between the participants in the hybrid teaching construction, and promote the effective transformation of the digitization of higher education in China.

2   Literature Review

Technology-enabled blended learning, combining online and offline, is deconstructing the traditional one-size-fits-all model of teaching and learning. Since the late 1990s, the concept of blended learning, often referred to as 'blended' or 'inverted' learning, has evolved through a focus on information technology and a combination of traditional and online teaching models, teacher-directed and backstage design and transformation, and more 'student-centred' teaching and coaching. From the late 1990s to the present day, the concept of blended learning has evolved through three stages, focusing on information technology and combining traditional and online teaching models, the design and transformation of teacher-directed and backstage classroom organisation, and the blending of "student-centred" teaching and tutorial approaches [1]. In qualitative terms, blended learning must be a deliberate integration of purely face-to-face and online teaching; In quantitative terms, the proportion of online teaching in blended learning should be in the range of 30%–79%, usually around 50%. If the amount of time spent online in a course is greater than or equal to 80% of the total number of hours taught, the course is fully online and not blended.

Modern education has gone through a process of development from offline teaching to distance learning and then to online teaching. Online teaching refers to the process of teaching activities that takes place in an online teaching environment where teachers and students are separated remotely under the guidance of theories such as distance education and online learning. The development of distance learning has been influenced by the work of Borje The early thinking on online teaching, represented by Borje Holmberg, considered online education to be one of the advanced forms of distance learning. The use and spread of Massive Open Online Course (MOOC) technology has led to a transition from distance learning to online teaching and learning. With further research, a more suitable online teaching model for higher education has emerged, namely the SmallPrivate Online Course (SPOC). In contrast to the large-scale and open characteristics of MOOC, SPOC has the characteristics of small scale and privacy.

With the further maturation of technologies such as mobile internet, artificial intelligence and virtual reality, online teaching has been widely used in various fields. Wang Wen and Han Xibin point out that compared to traditional face-to-face teaching, online teaching focuses on "any time, any place" learning and the multiple interactive features of learning, with learners mainly using technology to access learning content, effectively breaking through the limitations of learners in time and space. The purely online mode of teaching also meets the requirements of national strategies to improve the relevance,

adaptability and effectiveness of the training of skilled personnel. It can effectively alleviate the problems of insufficient teachers and teaching resources and student diversity caused by large-scale expansion, and achieve "no lowering of standards, multiple modes and flexible study systems".

Existing research focuses on the following online teaching models: ① MOOC (or SPOC) + domestic online teaching platform model. For example, MOOC + Rain Classroom model, SPOC + Tencent Classroom model, etc. ② MOOC, SPOC or MOOC + SPOC model. ③ Domestic online teaching platform model and its combination. For example, Super Star Learning Pass model, Rain Classroom model or Tencent Classroom + Rain Classroom model, etc. Online learning resources are designed with problems or tasks as the guide, PPT and videos as the carrier, discussions and assignments as the channel, using the immediacy of the online platform to motivate learners and guide students to explore and think and complete their learning tasks. Regarding online teaching modes, Wei Wei and Zhang Xuefeng put forward three common features, ① Live mode. Known as live teaching mode, live mode is a teaching mode that uses online video conferencing and online teaching" platforms such as Tencent Conference, Nail and Super Star Learning Pass to transmit and display images and sounds of teachers and students in real time. ② Recording mode. The recording mode is an online teaching mode in which teachers record the images and voices of the course in advance and students learn anytime and anywhere through the online learning platform. ③ Audio-visual mode. Voice and text mode is an online teaching mode in which the teacher provides real-time teaching information to students by means of continuous voice short messages on voice chat platforms such as WeChat groups and QQ groups, and at the same time assists in sending information such as graphics, and students and teachers complete interactive discussions within the chat groups. Many scholars have actively explored different online teaching models in their own contexts, and have achieved some results.

However, in general, the following shortcomings exist in previous research on online teaching models: ① there are more case studies on a particular online teaching platform, but there is a lack of horizontal comparison studies on different online teaching models or platforms; ② there are more quantitative studies on the influencing factors and teaching effects of existing online teaching, but there is a lack of real-life experience analysis combined with specific teaching situations; ③ the existing studies do not give teachers sufficient suggestions and strategies for teaching.

With regard to blended teaching, some studies have proposed a "two-line integration" type of blended teaching under the concept of co-construction classroom ecology, using technology platforms as support for online and offline interaction [2]. Zhang Qian and Ma Xiupeng propose to create a co-temporal, multi-step blended teaching process [3]. Diao Yajun and Liu Shizhen point out that the change of teaching mode inevitably requires teachers to prepare lessons taking into account the preparation of online resources and their effectiveness, depth and breadth as well as the extent of students' utilization [4]. Fengjuan Jiang use the UTAUT model to conclude that the factors influencing behavioural intentions to learn in a blended learning environment are: mobile self-efficacy > effort expectations > performance expectations > social influence > achievement goals [5]. Chen Xifeng takes the "Psychology of Advertising" course, which is a blended teaching course, as an example, to study the effect of

blended teaching in this course, mechanism and many other problems. Li Minhui and Li Qiong find that the "convergent interactive" blended teaching model can be divided into five categories from the perspective of the field, namely "recorded courses, online learning", "recorded courses, offline learning", "live courses, offline learning" and "live courses, offline learning". ", "live courses, offline learning", "live courses, online and offline dual-teacher teaching", "offline classroom, online and offline learning". Its teaching effectiveness is influenced by the teaching field of the lecturer, the learning field of the students and the supplementary teaching field of other teaching participants. Guan Enjing proposes that the effectiveness of blended teaching can be further explored in three ways: the optimisation of blended teaching evaluation indicators and methods, the validation of the blended teaching effectiveness evaluation system and the expansion of the scope of blended teaching implementation.

3   Course Design and Application of ERP Principles and Applications

The course "ERP Principles and Applications" is characterised by the "principle of application" and the objective of the course is to train students to apply their knowledge in the practical operation of ERP and to master the processes and operations of ERP systems. Through the simulation of various functional positions in the enterprise, familiar with the functions of the ERP system, to clarify the processing of different types of business processes, and the responsibilities, rights and benefits of each position in the enterprise environment. Through the simulation of the enterprise process environment, students are able to systematically combine economic business deepening theory and practice in a comprehensive manner, using the enterprise business process as the connecting thread, to gain a deeper appreciation of the relationship between an enterprise's part and whole, and to understand the enterprise's process-based operation model. Supported by the ERP U8 platform built with UFIDA on the EduCoder Smart platform, students have mastered the principles and methods used in theoretical teaching and then simulated and analysed the business management processes of various departments of an enterprise through demonstration sets of accounts and simulated date. It enables students to practically appreciate the systematic and applied value of ERP.

There were 63 learners in our case study course, including both purely online and mixed learners, with 16 purely online learners and 43 mixed learners. There were 44 online practical exercises, 9 weekly quizzes, a final exam, a group business design and lab report, and a final group defence and submission of materials in the course design (Table 1).

3.1   Online Teaching Design and Application

Online teachers have provided learning resources, formula course delivery and assessment arrangements, set time points and issued learning tasks. Students were mainly self-learning and could access them anytime and anywhere via their computers and mobile phones. The online teaching platform would provide the teacher with the appropriate learning statistics.

Table 1. Comparison between online teaching model and blended teaching model.

Elements		Online Teaching Model	Blended Teaching Model
Teaching objects		Students should master principle and practise skills	Students should master principle and practise skills
Teaching content		Multimedia resources like courseware, cases, tests, etc	Multimedia resources like courseware, cases, tests, etc
Teaching environment		Network teaching platform+Data operational environment	Data operational environment+Physical classroom
Teaching methods		Case teaching method, independent studying	Case teaching method, independent studying, group discussion, presentation
Teaching evaluation		Behaviors of online learning+Achievement of online learning	Behaviors of offline classes+Offline tests+Behaviors of online learning+Achievement of online learning
Teachers and students activities	Before class	Students should complete online preview tasks	Students should complete online preview tasks
	During class	Students learn through network teaching platform autonomously	Teachers give classroom teaching and interact with students
	After class	Complete tasks after class+Group discussion	Complete tasks after class+Group discussion

The online learning resources were modularised according to the knowledge points involved in ERP principles and the rules in application operations, such as basic terminology, system management login, account management, user management and role and authority management. The teachers' main course knowledge points were formed into recorded videos, which were uploaded to the online platform by the teaching assistants. Once the online resources were published, students could access the resources and downloaded the text at any time, even after the course had finished. At the same time, the platform technology allowed online teaching resources to be adapted at any time and their origin or expansion could be visualized.

3.2 Design and Application of Blended Learning

The blended teaching model is completed by a lead teacher and a teaching assistant, using online practical training and quizzes as a bridge between offline courses and

online summaries and practice to complete a two-way teaching flip. The instructor uses the multidisciplinary and comprehensive nature of the ERP course to provide students with certain knowledge of management, computing and finance, such as production operations management, management practices, management information systems and accounting principles.

The teacher offline uses half of the teaching time to narrate learning points and relative ideological and political education. The other half of the time is spent on practical training. Students can analyse specific problems and shift their thinking models from theory to practice through practical training. Feedback sessions are also set up online so that teachers could keep abreast of students' needs and plan their teaching as required. The organic integration of online and offline teaching plays an important role in it.

4   Online Practical Teaching Design

4.1   Instructional Mode

The principle and application of ERP adopted two teaching methods. One of them was online teaching model, students firstly watched teaching video through MOOC platform or EduCoder, and then practised and operated independently on EduCoder. Another method was online and offline blended teaching, students attended offline classes and operated practical training on online platform in the meantime.

4.2   Functions of Teaching Platform

Students can check in and complete unit testing through EduCoder platform, which provides a virtual environment for students to complete practical training, questionnaires. It also supports shared teaching materials, discussions, online video resources uploading, gathering statistics of personal scores and learning time and efficiency analysis. This platform has functions like class ranking and analyse conditions of whole class as well.

5   Analysis of Case Curriculum

5.1   Analysis of Learning Behaviors

In the original approximately 912 data items, 46 practical training completion data, 9 quiz data, and total final grade data were included. We studied more than 100 previous practical training records of the enterprise application platform so as to make comparisons. In the learning behavior analysis process, we filtered the desensitized data and then manually performed secondary calculations. We researched on following targets, average times of measurement, average time of practical training, average ratio of on-time passed/unpassed/late submission, efficiency of passing stages, evaluation efficiency, to analyse learning behaviors.

$$\text{Average times of measurement} = \frac{Sum\ of\ practical\ training\ times}{The\ number\ of\ users} \quad (1)$$
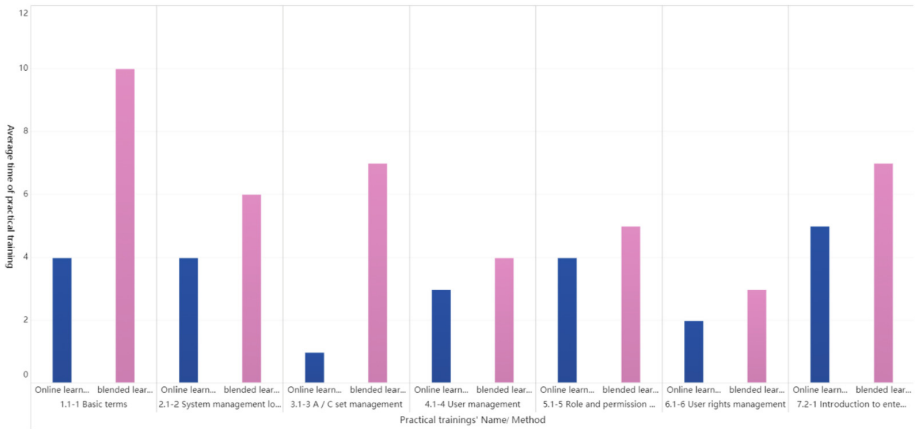
Fig. 1. Average times of measurement

Judged on Fig. 1, average times of measurement of online and offline blended learners were higher than online learners. Online learning mainly depended on students' learning autonomously, which lacked interaction between teachers and students, students' learning initiative and motivation reduced relatively.

Although online curriculum break through limitations of traditional classroom teaching that students have flexible time to learn, and online video resources can be watched repeatedly. However, online learners can't set up links between students and students, students and teachers, students and teaching resources through watching video resources and scanning courseware [6]. Therefore, students couldn't have a good command of knowledge as well as key and difficult points, and then they didn't have enough initiative to complete challenges.
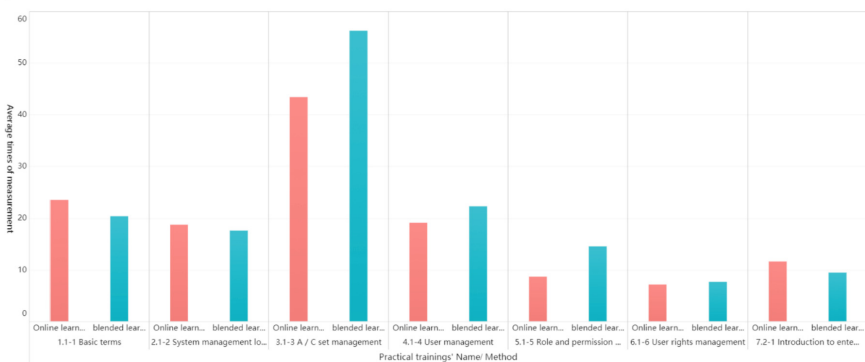

Fig. 2. Average time of practical training

$$\text{Average time of practical trainings} = \frac{Sum\ of\ practical\ training\ time}{The\ number\ of\ users} \quad (2)$$

We can see from Fig. 2 that average offline time of three practical trainings was more than online's, and others were opposite among seven practical trainings. Through calculation, sum of offline time of seven practical trainings was more than 15.66 min, which was sum of online time of seven practical trainings. The most obvious difference between the two modes was account sets management through visualization, while other practical trainings didn't differ much. The practical training which exceeded forty minutes in both modes showed that it's more difficult relatively. We found that students offline were willing to spend more time to study and practise when faced with difficult tasks, while online students were easier to choose to quit.

Online students learned mainly by themselves, so that their mistakes on knowledge understanding couldn't be corrected on time, their questions on teaching content couldn't be answered timely during learning process, and lagging information feedback couldn't satisfy demands of different levels of students.

In comparison, the platform presents testing results after offline learners complete practical trainings. Students' questions can be solved on time through the process and teachers can effectively supervise students' study conditions. Teachers can also adjust teaching plans timely according to visualization data feedback, letting students absorb knowledge easier, increasing classroom efficiency and making teaching process have more individualization and precision [7].

Online learners' ratio of passing stages on time was lower than fifty percent basically, while ratio of not passing stages on time was more than fifty percent on the whole, and ratio of delay of passing stages was tiny, which could be ignored.

In contrast, blended learners' ratio of passing stages on time was ninety percent or so while ratio of not passing stages and delay of passing stages was pretty tiny. Based on the results, we can draw a conclusion that blended learners complete practical trainings better in quality and quantity, while online learners' number of passing stages gradually decline.
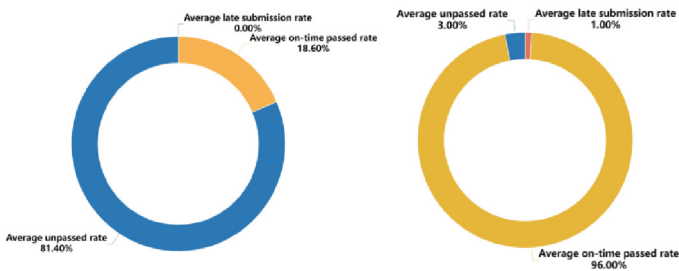

Fig. 3. The average ratio of on-time passed/unpassed/late submission

After calculation, Fig. 3 shows online learners had 81.4% not passing stages and 18.6% passing on time in every practical training, while blended learners had 3% not passing stages and 96% passing on time in every practical training.
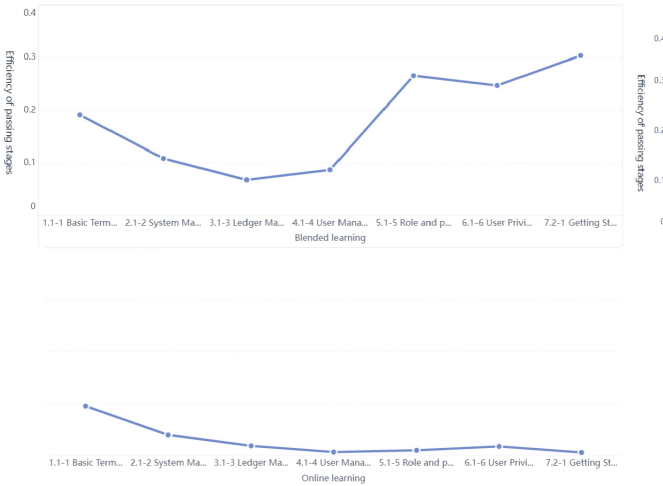

Fig. 4. Efficiency of passing stages

$$\text{Efficiency of passing stages} = \frac{\text{Number of finished stages}}{\text{Used time}} \tag{3}$$

Based on Fig. 4, online learners completed a maximum number of 0.1 levels per unit of time, and their efficiency gradually declined. The completion efficiency of offline learners' level exceeded 0.3, which fluctuated slightly in the early stage. With the growth of training experience, the efficiency increased substantially after about four training, and basically remained above 0.25. At the same time, the number of assessments (evaluation efficiency) per unit time was calculated, and the overall evaluation efficiency of online learners was not as good as that of offline learners.

$$\text{Evaluation efficiency} = \frac{\text{Average times of measurement}}{\text{Average number of levels completed}} \tag{4}$$

Finally, we calculated the evaluation efficiency. It's found that online learners have basically exceeded 10 from the fourth level, that is, it took ten times to pass a level on average, while offline learners were basically less than five times. At the beginning of the course, there's no big efficiency difference between online students and offline students, there's no big difference in learning ability. The problem was that the tracking and feedback in the later stage of the course were not in place, resulting in a decline in learning enthusiasm and a sharp decline in efficiency. This suggested that online learning couldn't produce a resulting chain of positive feedback. In the ERP principle and application courses, verification experiments accounted for a large proportion, and

students needed to test the theoretical knowledge learning results through practical training. EduCoder platform calculated the star students, got positive feedback, stimulated students' learning motivation [8], offline learners group collaborated to complete the homework, exercised diversified thinking mode through discussion, improved knowledge transfer and innovation ability, created a strong learning atmosphere, and formed a virtuous circle. However, online learners couldn't get positive feedback in the overall environment, and then the results couldn't promote and guide the behavior.

5.2 Analysis of Results

The results of pure online teaching and blended online and offline teaching were compared and analyzed by the significance test.

1) Test of achievement significance

① Analysis Of Results

Let the single factor A have r levels, recorded as A_1, A_2, ... A_r, under different levels (i), each m repeated test sample is Y_{ij}(i = 1, 2,…, r; j = 1, 2,…, m), each level can be regarded as a population, that is, the m observed sample set corresponding to level A $\{Y_{ij}, j = 1, 2,…, m\}$ as a population, a total of r populations. Suppose, here each population is normally distributed N (μi, $\sigma i2$), each population variance ($\sigma i2$) is equal, and all test samples are independent of each other.

② The original and alternative assumptions are based on the overall distribution of the two teaching modes.

Original hypothesis H0: There is no significant difference between the performance of pure online learning and those of mixed online and offline learning.

Hypothesis H1: There is a significant difference between the scores of pure online learning students and those of mixed online and offline learning students.

At the significance level = 0.05, the minimum significance level p-value for rejecting the null hypothesis was 1.36267E−9, and $p < 0.05$, so we reject the original hypothesis.

③ Get significant differences in the results of these two learning modes.

5.3 Teaching Quality Evaluation Model

This course follows the principle of "combining process evaluation with result evaluation, and combining online activity evaluation with offline activity evaluation" [9]. According to the requirements of the relevant documents of the school curriculum examination and the actual situation of the course, the quality evaluation model is established as follows:

$$Z = G + 0.5Q + 0.3C + 0.2A \tag{5}$$

Z represents the total score of the course and the final score; G represents the attendance, assigned points according to the regulations of the school, Q represents the process assessment score, C represents the quiz score, and A represents the defense score.

In the actual operation process, we quantify each training task; Quiz results were directly quantified, namely unit test scores; Defense scores were directly calculated by the teacher; Attendance was directly deducted from the sum of process assessment results and quiz scores and defense scores. In conclusion, this model is a quantifiable model and is operable.

6 Conclusion and Strategic Suggestions

6.1 Conclusion

After analysis, online and offline mixed learners were far better than pure online learners in learning behavior, academic performance and learning quality. The "fusion and interactive" blended teaching mode combines online and offline teaching through information technology to create a field-based interactive relationship between teachers, students and other teaching participants. Improve the efficiency of students' self-construction of knowledge system, and promote the further transformation of higher education to digitization and modernization. The case presents the advantageous "fusion and interaction" blended teaching mode 10 [10].

6.2 Suggestions

In the post-epidemic era, we will face comprehensive changes in teaching concepts, teaching platforms, teaching methods and teaching relations.

For educators, teachers should have the teaching concept of keeping pace with The Times, abandon the traditional concept of "teaching for learning", and cultivate and stimulate students' independent learning motivation and consciousness [11]; and establish an equal, active and democratic atmosphere of classroom, encourage students to actively participate in classroom activities, reasonably set and arrange classroom teaching content and related knowledge modules, so that students can easily and actively complete the course learning.

In terms of online courses themselves, course content organization requires modular, time fragmentation and diversified knowledge acquisition [12], while independent learning resources should meet the needs of new era learners with fragmented, mobile and interactive characteristics. More importantly, we should highlight the interaction design [13], and use the question answer and theme forum to strengthen the communication and interaction in the learning process, so that the teaching effect will be better.

Finally, colleges and universities should increase the investment of network resources and campus learning culture construction, to provide a learning atmosphere and environment that can guarantee college students' online independent learning. Only by firmly establishing the dialectical development concept that online teaching triggers the profound reform of college teaching, and accurately grasping the problems that need to be solved in different development stages of online teaching, can we achieve better

results [14]. In the era of promoting the development of education formalization, we should create a benign ecological environment for the high-quality development of online teaching.

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