

## PAPER

# Influencing Factors of the Blended Teaching Effect of SPOCs: A Comprehensive Evaluation Technology Based on the Kirkpatrick Model and Interpretive Structural Modeling

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## ABSTRACT

Based on the comprehensive evaluation technology of the Kirkpatrick model and interpretive structural modeling (ISM), first, a survey was conducted in four colleges and universities in China, including the Yellow River Conservancy Technical Institute. Second, an influencing factor system for the small private online course (SPOC) blended teaching effect, in 17 aspects, was constructed from four levels: the reaction level, learning level, behavioral level, and results level. Third, the deep-seated factors influencing the SPOC blended teaching effect were analyzed via ISM. Research results showed that the influencing factor system for the SPOC blended teaching effect constructed in this research was scientific, reasonable, and highly operational, with a Cronbach's alpha of 0.887. In addition, teachers' sense of responsibility (A-4) and knowledge internalization (C-2) were the two most important factors influencing the SPOC blended teaching effect. The curriculum setting (A-1) and thinking ability (B-2) were two relatively direct factors. The research results have important reference value for enriching the current SPOC blended teaching method in institutions of higher learning and exploring its suitability for higher education teaching.

## KEYWORDS

SPOC blended teaching, teaching effect, influencing factors, Kirkpatrick model, ISM, comprehensive assessment

## 1 INTRODUCTION

Networked, digitized, intelligent, and personalized education has promoted the formation of a new type of "network + education." In the era of mobile internet, the coverage of high-quality higher education resources is expanding day by day.

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With the globalization of teaching resources and increasing informatization of teaching methods, the high-level education goals of thinking guidance, practice education, and value shaping have become increasingly prominent, accompanied by the transformation of the teacher-centered educational concept into a student-centered one. The learning habits, attitudes, and techniques of course learners in colleges and universities show fragmentation in knowledge acquisition, diversification in value orientation, and enrichment in information sources. The development model of China's higher education is undergoing a fundamental change, from scale and space expansion-centered extension to quality improvement and structural optimization. We are currently in the era of mobile internet, free from scarcity of high-quality educational resources, in which educational informatization promotes the modernization of teaching as a whole. Teaching models are being optimized and reformed continuously to cater to the development of modern education, and the product of integrative development between offline teaching and online teaching—namely, blended teaching—has emerged. Blended learning plays an irreplaceable role in improving education and teaching quality and cultivating high-level practice-oriented talents, thereby becoming the new normal in future education. Driven by the information age and educational reform, the popularity of the online education teaching mode has increased rapidly. Based on the relevant education policies implemented by the state and the COVID-19 pandemic, Chinese and foreign educators have paid increasing attention to research on the online teaching mode.

As a new educational form of online learning, small private online courses (SPOCs) emphasize communication openness between learning resources and students during the learning process. SPOCs have become a teaching improvement trend in colleges and universities by virtue of their small scale, less restriction, and resource-screening management. In the simplest terms, SPOC blended teaching refers to the strategy of combining online network teaching with offline classroom discussions. Compared with traditional teaching modes, blended teaching has more advantages, such as inspiring students' thinking, emphasizing their autonomous learning, training their learning ability, and improving their knowledge application ability. The combined application of SPOCs and blended teaching includes many of the above advantages. Restricting the number of students can help teachers effectively understand the learning situations of individual students and realize targeted teaching. Moreover, the combination of SPOCs and blended teaching fully embodies the student-based teaching mode and concept and plays a decisive role in strengthening students' self-learning ability and broadening their thinking. Although SPOC blended teaching has excellent teaching advantages, to develop and promote teaching quality improvement, colleges and universities should pay attention to scale development instead of quality improvement, emphasize online teaching effectiveness evaluation in talent training, and combine the internal and external evaluation of training units. Based on Kirkpatrick's evaluation model, an evaluation system for the influencing factors of the SPOC blended teaching effect is constructed in this study, and the internal relations between the influencing factors of SPOC blended teaching are explored using interpretive structural modeling (ISM) to provide a reference to education departments and universities for conducting online teaching management and effectively ensure online teaching quality in universities.

## 2 LITERATURE REVIEW

SPOCs are a teaching model that emerged and developed on the basis of massive open online courses, which are implemented through several basic steps. First, professional teaching is aided by existing teaching resources or those developed autonomously by teachers, with relevant network tools and with the help of online teaching or the evaluation functions of related network platforms. Second, the teaching process is replanned. The combination of SPOCs and blended teaching has become one of the most popular teaching modes among teachers, as it attaches importance to online teaching while not ignoring offline teaching and gives full play to the advantages of the SPOC blended teaching and traditional teaching modes. In addition, it has become one of the most popular teaching modes of the Internet era. In terms of research on the effect of SPOC blended teaching and its influencing factors, Wang et al. [1] believed that SPOCs are characterized by the improvement of the teaching effect. Combined with the analysis of SPOC open education, the author demonstrated that four designs—that is, the teaching content system design, personalized learning strategy design, teaching activity design, and teaching evaluation system design—are helpful to effectively improve education quality based on the mixed mode of the flipped classroom and SPOC teaching. Han et al. [2] investigated the learning effect of SPOCs and found differences in their learning effect. Face-to-face courses can effectively improve students' learning ability by increasing their learning interest. Kang et al. [3] indicated that the SPOC teaching mode has a wider range of teaching content, promotes stronger learning, stimulates students' interests more, and facilitates better teacher–student interaction than traditional teaching modes. Zhang et al. [4] showed that in the school year 2017–2018, the final exam scores of students under the SPOC flipped-classroom teaching mode were 11.11 points higher than those of other students. In addition, the cognition, participation, and satisfaction of the students in the flipped classroom were higher than those of the students in the traditional classroom. Sun [5] combined a “rain classroom,” based on WeChat and multimedia intelligent teaching tools, with SPOC blended teaching and designed a SPOC teaching mode based on the rain classroom. The results showed that the SPOC teaching mode based on the rain classroom has a certain effect on the teaching reform of the English translation course in colleges. The results of Wang et al. [6] showed that the improved Bridge-in, Objective, Pre-assessment, Participatory learning, Post-assessment, Summary, combined with SPOCs and flipped classrooms, can improve teaching satisfaction. Through a quasi-experimental design, Jong [7] discussed the influence of model-based collaborative learning on the chemometrics performance of 10th grade students in an SPOC environment. The results revealed that in an SPOC environment, through appropriate design, promotion, and face-to-face interactive groups, mixed model-based collaborative learning can provide students with opportunities to participate in learning to improve their performance. Jiang [8] constructed a theoretical model of the influencing factors of blended teaching in an SPOC environment and demonstrated that schools' incentive mechanism and satisfaction with curriculum platforms are situational influencing factors. Zhu et al. [9] drew on the advantages of big data and ontology theory to create an automatic curriculum ontology construction technology and showed that the method is more efficient and universal than traditional ontology construction methods. Most important, the method can improve the teaching effect and students' autonomous learning. Wang et al. [10] discussed the effectiveness of an SPOC teaching mode in college physics and found that with an effective SPOC design and teaching mode, students' tendency to participate in online learning increased,

and nearly 94% of students preferred the teaching mode. Jia et al. [11] concluded that students' learning needs should be considered in SPOC teaching, and teachers must consider the difficulty level of the course when designing their online teaching. Xue et al. [12] reported on the application of a teaching mode combining SPOCs with a flipped classroom for English education majors and revealed that it helped improve students' positive cognition and knowledge of correct pronunciation. Jiang, et al. [13] explored the factors influencing English students' willingness to continue learning in an SPOC blended learning environment and showed that pre-influencing factors and external situational factors are key to increasing students' willingness to continue learning in that environment. Freitas et al. [14] found that a new learning environment, innovative teachers, and previous experience are the key factors affecting the creation of new curriculum education in SPOCs. Nejkovic et al. [15] determined that high-quality information and useful learning content, ease of use, and social support are important factors driving the success of SPOC platforms.

To summarize, SPOC blended teaching has many advantages, such as inspiring students' thinking, emphasizing their autonomous learning, training their learning ability, and improving their application-learning ability. The combined application of SPOCs and blended teaching can help teachers to effectively grasp students' learning in their classes, understand them individually, and realize targeted teaching. SPOC blended teaching depends on various factors: learning resources, teaching platforms, selection of teaching methods, the teaching process design, students' completion of curriculum resources, and students' internalization of their acquired knowledge. Kirkpatrick's evaluation model is the most widely used tool in the field of training evaluation. The model can provide a scientific measure for evaluating the training or learning effect and be combined with ISM to determine the quality factors of SPOC blended teaching systematically. The goal is to improve the efficiency of blended teaching and explore new SPOC blended teaching models.

### 3 METHODOLOGY

#### 3.1 Model profile

Kirkpatrick et al. [16] proposed and developed an evaluation model that has become one of the most widely used evaluation tools in the field of training evaluation. The model can provide a scientific measure for evaluating the training or learning effect and is divided into four layers—namely, the reaction layer, learning layer, behavior layer, and result layer—abbreviated as 4R. Among the layers, the reaction layer is used to evaluate the satisfaction of the trainees, the learning layer aims to measure the learning acquisition of the participants, the behavior layer is adopted to evaluate and test the application of learned content by the trainees, and the result layer is employed to test the benefits of the training activities to the organization. Kirkpatrick's evaluation model emphasizes the connection and logical relationship between the four evaluation levels, which are in depth, step by step, and closely linked. Introducing Kirkpatrick's evaluation model into the evaluation system for the influencing factors of the SPOC blended teaching effect is feasible.

Watson [17] proposed ISM in 1978. As a model for the qualitative analysis of relationships among various system factors, this model divides the regions and levels of complex factor relationships by establishing a relationship matrix among the system factors and clearly represents the correlation among the system factors with graphs.

ISM is a research method from modern systems engineering that can construct a structural matrix according to the relationship of constraints among the factors of multilevel systems and models to explain the multilevel structure to realize a clearly structured hierarchical system. The ISM steps are described below.

First, a system factor table is constructed. The factors of the examined system are collected and processed to establish a detailed statement  $S$  of the system factors, as shown in Formula (1).

$$S = \{S_1, S_2, S_3, \dots, S_n\} \quad (1)$$

where  $\{S_1, S_2, S_3, \dots, S_n\}$  represents  $n$  system factors.

Second, adjacency matrix  $A$  is generated, as seen in Formula (2).

$$A = (a_{ij})_{n \times n} \quad (2)$$

In Formula (2), if  $S_i$  has a direct influence on  $S_j$ , then  $a_{ij}$  will be 1. Given the indirect influence of  $S_i$  on  $S_j$ ,  $a_{ij}$  will be 0.

Third, reachability matrix  $M$ , which is iteratively generated by the adjacency matrix, is calculated using the Boolean operation rule, as shown in Formula (3).

$$M = (A + I)^r \quad (3)$$

In Formula (3),  $I$  is the unit matrix with the same order as  $A$ , and  $r$  must be calculated in one step, according to Formula (4).

$$(A + I) \neq (A + I)^2 \neq (A + I)^3 \neq \dots \neq (A + I)^r \neq (A + I)^{r+1} \quad (4)$$

Fourth, the system factors are divided into three different regions; namely, a reachable set, an antecedent set, and a common set. The reachable set  $R(S_i)$  refers to the set of all the system factors affected by factor  $S_i$ . The antecedent set  $A(S_i)$  represents the set of factors affecting factor  $S_i$  in the system. The common set  $C(S_i)$  is the intersection of the reachable set and antecedent set, as shown in Formula (5).

$$C(S_i) = R(S_i) \cap A(S_i) \quad (5)$$

Finally, the system factor levels are divided and determined. First, the factors in the first layer of the set are found. When  $C(S_i) = R(S_i)$ ,  $S_i$  will be a factor in the first layer. Second, the factors in the first layer are excluded, and through parity of reasoning, the levels of the remaining factors are derived, and the level division is completed for all the factors. The factor set in each layer represents  $L_1, L_2, \dots, L_p$  from high to low, where  $L_1$  is the top layer. According to the level division results and influencing relationships of the factors in the adjacency matrix and reachability matrix, the factors are allocated from the upper layer to the lower layer and connected together using arrows, thereby eliminating their level-crossing associations and embodying the binary hierarchical structural relationship between the factors.

### 3.2 Index system construction

The evaluation system for the influencing factors of the SPOC blended teaching effect is the key concept in this research. First, 86 people, including vice presidents of

teaching, directors of academic affairs, and secondary teaching units, from four universities, including the Yellow River Conservancy Technical Institute of China, were invited to be the respondents. Then, the influencing factor evaluation system for the SPOC blended teaching effect was combed and summarized. Second, a total of 18 experts were chosen from the relevant principals and participants from the four universities to choose between the combed evaluation indices. The experts were instructed to use the five-point Likert measurement method to judge the indices, with 1 representing “very unimportant,” 2 representing “unimportant,” 3 representing “ordinary,” 4 representing “important,” and 5 representing “very important.” The experts were organized to complete two rounds of scoring for the above indices, a second round of the scale reliability test, and the reliability test of the index system after passing the test in SPSS 22.0.

## 4 RESULTS ANALYSIS

### 4.1 Index system construction for the Kirkpatrick model

With the continuous development of higher education, people’s focus on education has gradually shifted from “teaching” to “learning,” and the role of students as the focus of education has become increasingly prominent. Therefore, when establishing the indices, students and teachers were included in the evaluation activities for SPOC blended teaching, fully considering their views on SPOC blended teaching and applying them to the Coriolis evaluation model to evaluate the quality from the reaction layer, learning layer, behavior layer, and result layer. The Delphi method was used for the two rounds of expert consultations and reliability analysis to establish relatively consistent expert opinions, and the evaluation system for the influencing factors of the SPOC blended teaching effect was established, as shown in Table 1, which was scientific and objective.

**Table 1.** Evaluation system for influencing factors of the SPOC blended teaching effect

First-Level Index	Second-Level Index	Index Observation Points	Index No.
Reaction layer	Curriculum setting	Setting of specialized courses and nonspecialized courses and practicability of specialized courses	A-1
	Teaching content	Whether the teaching content is substantial and forward looking	A-2
	Teaching-practice combination	Teaching is closely integrated with practice and academic study; the two promote each other	A-3
	Teachers’ sense of responsibility	Teachers’ engagement in teaching, standardized guidance, and provision of forward-looking information	A-4
	Teacher–student interaction	Harmony between teachers’ online teaching and students; time, frequency, and depth of teacher–student communication	A-5
	Guidance mode	Techniques for guiding students’ offline self-study; whether offline study reports are regularly organized	A-6

(Continued)

**Table 1.** Evaluation system for influencing factors of the SPOC blended teaching effect (Continued)

First-Level Index	Second-Level Index	Index Observation Points	Index No.
Learning layer	Course grade	Students' final academic performance in SPOCs	B-1
	Thinking ability	Ability to think independently and solve problems	B-2
	Communication ability	Ability to communicate with others, expressiveness, and comprehension	B-3
	Acquisition of qualification certificates	Acquisition of professional qualification certificates and general qualification certificates	B-4
Behavior layer	Ability to migrate and apply knowledge	Independent disposal ability in solving the same types of problems	C-1
	Knowledge internalization	Whether learned knowledge is used to solve realistic problems	C-2
	Internship	Application of professional knowledge during internship	C-3
	Innovation ability	Creative thinking ability and novel and unique views	C-4
Result layer	Career success rate	Is the career development of graduates successful?	D-1
	Employer evaluation	Whether graduates' skills meet the needs of the position	D-2
	Post competency	Graduates' competency in the job content of the position	D-3

The reliability of the evaluation system for the influencing factors of the SPOC blended teaching effect in Table 1 was tested, and the Cronbach's alpha coefficient of the reliability is listed in Table 2.

**Table 2.** Reliability test results

First-Level Index	Number of Measurement Questions	Cronbach's Alpha	Cronbach's Alpha
Reaction layer	6	0.864	0.887
Learning layer	4	0.892	
Behavior layer	4	0.908	
Result layer	3	0.867	

Table 2 shows that the Cronbach's alpha coefficient was 0.887, indicating that the reliability of the questionnaire used in this research was excellent, and the evaluation system for the influencing factors of the SPOC blended teaching effect obtained through the expert consultation method was scientific and reasonable, which can be used for further ISM analysis.

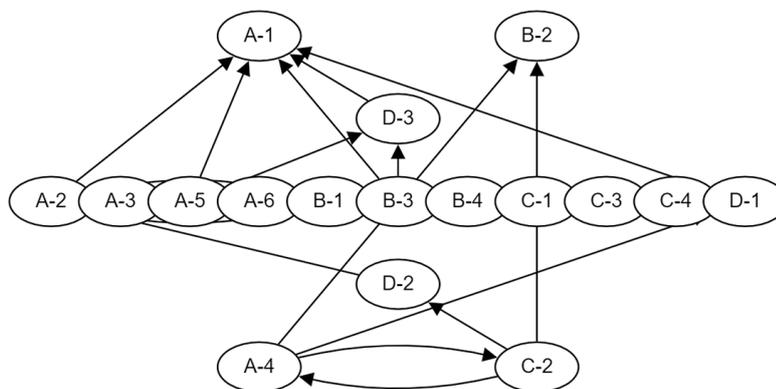
## 4.2 ISM results

The original ISM reachable matrix was programmed and calculated with MATLAB 2017b, and Table 3 and Figure 1 were obtained.

**Table 3.** Reachable set, antecedent set, and their intersection

	Reachable Set R	Antecedent Set Q	Intersection $A = R \cap Q$
A-1	1	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17	1
A-2	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
A-3	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
A-4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	4, 12	4, 12
A-5	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
A-6	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
B-1	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
B-2	8	4, 8, 12	8
B-3	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
B-4	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
C-1	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
C-2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	4, 12	4, 12
C-3	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
C-4	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
D-1	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15
D-2	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 16, 17	4, 12, 16	16
D-3	1, 17	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17	17

Notes: The numbers represent specific factors; for example, 2 represents the second factor.



**Fig. 1.** Schematic diagram of hierarchical relationship

The findings below can be seen in Figure 1.

The bottom layer represents the reason for the initial point of the system, and the upper layers are the result of the lower layer. The figure shows that teachers' sense of responsibility (A-4) and knowledge internalization (C-2) were the two most important factors influencing the effect of SPOC blended teaching. The main conclusion that one might draw is that the stronger the teachers' sense of responsibility (A-4) in the SPOC blended teaching mode, the more the teachers will upload carefully selected and reasonably arranged course content to the SPOC course platform for the students to learn, which can do statistics in the students' learning situation. In class, the stronger the teachers' sense of responsibility, the more the students will learn online by using the SPOC platform, and the more the teachers will use face-to-face learning activities, such as classroom teaching and experimental offline teaching, combining online and offline activities. This will not only give full play to the advantages of SPOCs but also make use of the advantages of traditional teaching methods to provide students with a highly diversified learning environment, which is the most worthwhile blended teaching form in the current "Internet + education" era. Knowledge internalization (C-2) was also a fundamental factor, mainly because fragmented high-quality resources are used to prepare before class or self-study, and those with fast cognitive speed can learn the information in one session. The SPOC platform can provide special functions so that students can learn 1.5–2 times faster than the normal speed. In addition, students with slow cognitive speed can learn repeatedly until they understand the subject. One of its benefits is that the students participating in classroom learning will grasp the content to a considerable extent through pre-class preparation, which can help them effectively understand the important and difficult knowledge in the classroom and drive them to achieve the same or higher teaching effect within a short period of time. Therefore, the ability to internalize knowledge has become a key factor affecting the effect of SPOC blended teaching. This conclusion may inspire university administrators. As students in the same university master knowledge to a similar extent, students with fast cognitive speed can identify problems previously unnoticed through classroom discussions, whereas students with slow cognitive speed can see themselves contributing to the classroom discussions. Therefore, while imparting knowledge online, teachers must consider how to further improve learners' ability to internalize knowledge by using various learning technologies. Only when instructors' teaching problem design is oriented toward the real world and they are provided with corresponding problem-solving suggestions can students learn effectively and improve the efficiency of SPOC blended teaching.

The top layer represents the ultimate goal of the system, and the lower layers represent the reason for the top layer. Curriculum setting (A-1) and thinking ability (B-2) were two direct factors. The main possibility curriculum setting (A-1) was the most direct factor affecting the blended teaching mode. This conclusion can inspire college teachers to combine the actual needs of the course and design it based on the actual needs and curriculum objectives; integrate SPOCs into the classroom on the basis of blended learning; and construct a deep learning mode. The curriculum setting should be systematically planned and designed from internal and external teaching environments to effectively adapt to personalized teaching methods, generate a deep learning experience for students in online courses, and improve students' passing rate and autonomous learning level in the learning process. Teachers should make efficient, active, and reasonable use of teaching resources, teaching platforms, and teaching software to achieve their own characteristic curriculum setting and enhance classroom interest to reduce learners' sense of burnout. Thinking ability (B-2) was easily overlooked in online learning. In many SPOC blended teaching

methods, teachers use the teaching mode considerably, which may fail to effectively improve learners' thinking ability. In online teaching, with the increase in learning time, it will be difficult for students to maintain their concentration in the classroom. Therefore, teachers should pay attention to improving learners' concentration, which will require teachers to arrange their classes scientifically, guide students to work and take breaks regularly, and improve learners' thinking ability. The stronger the learners' thinking ability, the better they can use learning resources to learn, meet their self-learning needs, integrate various resources for learning, and make rational use of various resources to complement their advantages.

## 5 DISCUSSION

SPOCs, as a new blended teaching mode, adopt a combination of online and offline methods. Online teaching mainly uses various online or mobile education platforms for online teaching, task assignment, question answering, taking attendance, and exam assessment. From new knowledge input, pre-class task arrangements, teaching video releases, and teaching resource uploads, students can gain a certain level of understanding of the new information before class. In class, online teaching is performed, and knowledge points are gradually deepened and expanded. Teachers can answer students' questions before class, and students can have discussions with one another. After class, students are allowed to give feedback and summaries and can arrange to complete the targeted task training, according to the effect of the class. Finally, exams are given according to the students' corresponding situation.

With the coming of the information age, online learning has emerged gradually. As a new education model, the SPOC blended teaching mode should be examined further. To a certain extent, traditional teaching modes are restrictive. Meanwhile, as students must improve their logic and autonomous learning ability, teachers should improve students' dominant position and create a relaxed classroom atmosphere. Therefore, the SPOC blended teaching mode can be applied to the teaching of professional courses in higher education to attract students' attention and make up for deficient teaching content by intuitively understanding the problems in students' learning. Teachers can also perform targeted teaching and assign learning tasks according to students' characteristics and cognitive levels at different levels to rationally adjust their teaching methods and improve their teaching efficiency. At the same time, the model can clarify students' shortcomings and enable them to reflect on themselves. Traditional teaching evaluation models attach importance to students' mastery of basic knowledge but ignore their comprehensive qualities and social adaptability. American scholar Kirkpatrick proposed a four-level evaluation model for training evaluation. Against the background of promoting the further integration of higher education and industrial enterprises, this research discusses the influencing factors of SPOC blended teaching quality using ISM, which can help evaluate the teaching quality of higher engineering education from a vertical perspective and higher engineering college graduates to effectively meet the needs of industrial enterprises.

## 6 CONCLUSIONS

The comprehensive application of information technology in the field of education has brought opportunities and created favorable conditions for promoting

educational reform and development. Information technology can be effectively applied to teaching, which can transform students' learning style to enhance their learning ability and optimize the education process, thereby generating a new blended teaching mode. In this research, an influencing factor system for the SPOC blended teaching effect, in 17 aspects, was established from four levels; namely, the reaction layer, learning layer, behavior layer, and result layer, and the deep-seated factors affecting the SPOC blended teaching effect were analyzed using ISM. Three research results were obtained. (1) The Cronbach's alpha of the influencing factor system for the SPOC blended teaching effect constructed in this research was 0.887, which was highly operational. (2) Teachers' sense of responsibility (A-4) and knowledge internalization (C-2) were the two most important factors influencing the effect of SPOC blended teaching. (3) Curriculum setting (A-1) and thinking ability (B-2) were two direct factors affecting the effect of SPOC blended teaching. In the future, SPOC mixed resources should be developed continuously, blended teaching should be promoted to improve the learning effect, and in-depth research should be conducted on the relationship between autonomous learning ability and blended teaching.

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