Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

https://doi.org/10.57239/PJLSS-2024-22.2.0032

RESEARCH ARTICLE

Construction of Formative Evaluation Model in Blended Teaching

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ARTICLE INFO

Received: Apr 24, 2024

Accepted: Jul 30, 2024

Keywords

Formative evaluation

Blended teaching

Delphi method

Evaluation index

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ABSTRACT

This study aims to construct a formative evaluation model for blended learning. First, starting from empirical investigation and literature analysis, the current research status is summarized, and then the rich connotation of formative evaluation in the context of blended learning is explored through a combination of literature research and empirical research. Second, the Delphi method is used to form a measurable evaluation index structure based on the practice of blended learning, and the weight of each index item is reasonably and scientifically assigned using the analytic hierarchy process to construct a reasonable and scientific formative evaluation system for blended learning. In this study, the formative evaluation index system of blended teaching was proposed, which supplemented the current formative evaluation research for blended teaching, and a formative evaluation model was constructed to creatively strengthen formative evaluation by using data mining technology, promote the evaluation of teaching and the evaluation of learning, so that the true meaning of formative evaluation could be revealed. It lays a theoretical and practical foundation for formative evaluation to break the dominant situation of results-based evaluation and promote the sustainable development of educational evaluation

INTRODUCTION

With the rapid development of science and technology in the information age, blended teaching has become an important research direction and mainstream teaching mode in the field of education, so it is urgent to explore scientific, reasonable and effective blended teaching evaluation. Judging from the research trend in recent years, the main research direction focuses on the concept discrimination and teaching mode exploration of blended teaching, but the research on blended teaching evaluation is relatively scarce. According to existing studies, although blended teaching achieves the integration of online courses and offline courses, it is still in a separate state in the evaluation of teaching effect, that is, the evaluation of online course teaching is only for online courses, and the evaluation of offline course teaching is only for offline courses, failing to achieve the integration and mutual benefit of the two evaluations. Based on the characteristics of blended teaching and formative evaluation, the application of formative evaluation in blended teaching will help to scientifically, comprehensively and effectively evaluate the learning process and comprehensive quality of students in blended teaching, enrich the current research path of blended teaching evaluation, and meet the development direction of educational informatization in the new era and the needs of educational evaluation reform.

LITERATURE REVIEW AND CONCEPT

At present, the research on formative assessment is mainly distributed in the following aspects: First, formative assessment based on advanced information technology can promote students' learning process. For example, Jinnie et al. introduced a deep learning framework to predict and optimize the number of exam executions, and used clustering methods to support decision making, so as to improve the effectiveness of formative assessment in promoting student learning [1]. Weronika proposed that Moodle tests support continuous student engagement in learning and provide multi-level tutor feedback to facilitate formative assessment [2]. Zamzami et al. proposed an interactive gamification solution for a formative assessment system and verified the effect of gamification electronic tests on student learning and participation [3]. Istvan proposes to apply the motivational formative assessment tools used for massively multiplayer online role-playing games (MMORPGs) to connectionist massive open online courses (CMOOCs) so that CMOOCs can benefit from the motivational potential of MMORPGs [4]. Stavros proposed a mobile-assisted formative assessment framework to promote students' self-determination ability, which has made practical contributions to the mobile learning and assessment practice of students' motivation [5]. Secondly, it is verified that formative assessment can improve learning effect. For example, Mukhtiar et al. found that formative assessment on blackboard newspaper can improve the final score of medical students in the mixed learning environment, and verified medical students' cognition on the influence and effect of formative assessment on blackboard newspaper [6]. Chinese scholar Chen Huai et al. found that formative assessment based on interactive whiteboard used by teachers for a long time has a gender difference on students' math achievement [7]. Clare found that students answering questions in the formative exam question bank could benefit from answering, writing, and peer discussion, thereby improving summary exam scores [8]. Patrick found that student achievement in core academic teachers' practice of computer Formative assessment (CBFA) in a one-to-one computing environment may be related to teachers' increased use of this teaching practice [9].

David et al. verified through experiments that the Linear Assessment tool (OFAT) can improve the motivation and achievement of college science education students [10]. Harizah found that interactive demonstration teaching of Web-based formative assessment in a static fluid environment can improve students' critical thinking ability [11]. Finally, we try to use formative assessment based on advanced information technology to solve some problems in current education assessment. For example, Kevin et al. transformed the text-based analysis rules (TR) into "Video enhanced analysis rules (VERS)", promoted the training and formative assessment of complex skills, and made up for the shortcomings of text-based analysis rules in mastering skills [12]. Timothy summarized the previous research on linear nature assessment and provided practical examples to extract the best practices of online learning [13]. Erica et al. explored ways for educators to integrate technology in process assessment and discussed the implications of different uses of assessment technology [14]. Petra provides information on formative assessment of vocabulary knowledge through mobile vocabulary learning applications [15]. Enilda et al. have used formative assessment to solve the difficult problem of evaluating the effectiveness, efficiency and usability of web-based experiential role-playing aging simulation [16].

Through literature study, we can find that the research on process evaluation in China is mainly concentrated in four directions: (1) Theoretical discussion on the connotation and definition of process evaluation; (2) The study of the function and value of process evaluation, which is mainly related to curriculum reform and personnel training; (3) Research on the methods, techniques and tools of process evaluation, including electronic archives, gauges, recording cards, logs, etc.; (4) Research on the specific application of process assessment in teaching and learning. The research designed in this part includes the status quo and strategies of the application of process assessment in specific disciplines of different student segments, covering all stages from early childhood education to higher education and basically involving all existing disciplines. Among them, the most

researches are on the application of process evaluation in information technology curriculum. Taking the study on process evaluation of information technology curriculum as an example, Guo Wen studied the implementation effect of process evaluation of information technology curriculum and found that process evaluation can promote the transformation of cooperative learning, thinking mode and behavior attitude in information literacy [17]. However, Sun Yue combined the MOODLE platform with high school information technology classes to explore its process evaluation function. By providing a virtual space, students can conduct self-evaluation and other evaluation, and teachers can also conduct phased evaluation of students [18]. Liu Ximing and Tian Xuelin [19] made a detailed study on the key points, precautions and implementation strategies and schemes of the application of process evaluation in information technology curriculum from the perspectives of students' learning behavior, value orientation of evaluation and content of evaluation.

To sum up, most domestic and foreign researches on process evaluation explore the implementation strategies and programs of process evaluation in traditional curriculum from the perspective of curriculum theory, and there are few researches on the application of process evaluation in the area of blended teaching evaluation.

Research Content

Based on the teaching data, this study will fully consider the influence of various elements in the learning process of students under the blended teaching mode, adopt the Delphi method and based on the mixed teaching practice, design the evaluation process and tools of formative evaluation, form a measurable evaluation index structure according to the evaluation elements, and use the analytic hierarchy process to assign reasonable and scientific weights to each index item. Establish a reasonable and scientific formative evaluation system. The specific research includes: ① design of formative evaluation indicators, ② mining and establishment of key indicators, ③ quantification and weight setting of indicators.

RESEARCH METHOD

Literature research method

Utilizing the resources of the school library, relevant foreign databases and domestic databases such as China Knowledge Network, the author systematically reviewed the relevant literature on "blended learning" and "formative assessment," further understanding the current status, trends, and problems of research on blended learning and formative assessment both at home and abroad.

Delphi Method

Seeking as many expert opinions as possible on the theme of "Design of Formative Assessment Tools in Blended Teaching Model," then organizing, statistically analyzing, summarizing, anonymizing, and feeding back the suggestions collected to all the participating experts, and soliciting feedback on the suggestions, repeating this process until all the experts reach a consensus.

Analytic Hierarchy Process

In this study, the formative evaluation index structure for blended teaching was formed by Delphi method. The index structure contains 4 first-level indicators and 15 second-level indicators, which is hierarchical. Therefore, the analytic hierarchy process is used to determine the weight of each first-level indicator and second-level indicator.

Theoretical Basis

Humanistic theory

Humanistic learning theory advocates that teaching and teaching evaluation should promote students' development to be people-oriented, student-oriented, and promote students' growth and change. In the process of constructing the process evaluation index system, this study adheres to the student-oriented education concept, records various learning behaviors and outcomes in the learning process, makes scientific judgments on the whole learning process, and timely feedback the detailed evaluation results to students, urging them to improve themselves in time, finding loopholes in the learning process, and improving learning methods in time. Improve the learning effect.

Theory of multiple intelligence

In education, every student also has a certain kind or several kinds of intelligence, with the development potential of these abilities, so schools and teachers need to provide appropriate education or training for these students, so that each student's outstanding intelligence can be timely and effective guidance and development.

For these students with different development potential, a more scientific and comprehensive evaluation system should be provided. Adhering to the concept of multiple intelligence education, this study makes a comprehensive evaluation of students learning in blended learning environment. It not only evaluates students' learning process and results, but also comprehensively examines students' learning attitudes such as classroom attendance, involvement and participation, as well as students' higher-order skills such as creativity, problem solving ability and critical thinking. Through the three-dimensional evaluation of knowledge, skills and quality, students are guided to pay attention to the overall cultivation of comprehensive quality, so as to promote the all-round development of students.

Research Process

Determination of the evaluation index structure

This study selects the Cross-cultural Communication course of blended teaching practice in a university as the experimental subject for formative evaluation research. This course adopts a mixed teaching mode that combines online and offline. Students' learning is primarily reflected through indicators such as learning attitude, learning process, communication and cooperation, learning effect, and others. Through the implementation of blended teaching and literature reading, it is comprehended that the evaluation dimensions of blended teaching evaluation and formative evaluation mainly encompass that the formative evaluation of blended teaching attaches equal significance to the goal and process, integrates with the entire learning process of students, and aims to facilitate the all-round development of students. In conjunction with the current thinking of new engineering, this study also took into account the investigation of students' higher-order skills when designing the primary index structure, considering it as one of the evaluation dimensions, and initially formed five first-level indicators, namely, learning attitude, learning process, communication and cooperation, learning effect, and higher-order skills. According to the corresponding learning activities of students, it is decomposed into the corresponding operable secondary index items and observation points, thereby forming the primary index structure.

In order to guarantee the objectivity and comprehensiveness of the evaluation system, the Delphi method is employed to determine the evaluation index structure. After the formation of the primary index structure, based on the primary index structure, the expert consultation questionnaire with the theme of "Research on Scale Design of Process Evaluation under Blended Teaching Mode" was compiled and sent to the experts via email and retrieved. The expert consultation questionnaire consists of four parts: research purpose and content, filling instructions, preliminary indicators of

blended teaching process evaluation, and other opinions. The expert opinions were sorted out through the collected questionnaires, which mainly included: (1) The secondary indicators of communication and cooperation were repetitive with each other; (2) The boundary between learning effect and advanced skills was indistinct, and the expression was ambiguous; (3) The examination method of advanced skills was singular, which could not be evaluated fully and comprehensively.

Based on the expert opinions, the structure of the primary indicators was modified and adjusted. The investigation of communication and collaboration was incorporated into the learning process, and the secondary indicators and evaluation observation points of the learning process were modified accordingly. The evaluation method of advanced skills was enhanced from scoring to structured interviews with the assessed participants first. Then, in accordance with the students' interview materials and time performance, diverse evaluation methods such as self-evaluation, mutual evaluation, and teacher evaluation are adopted. The adjusted evaluation index structure was resent to the experts again and was unanimously approved by the experts. Finally, the formative evaluation index structure of blended teaching was formed, consisting of 4 first-level indicators of learning degree, learning process, learning outcome, and advanced skills, and 15 second-level indicators.See Table 1.1 for specific details.

Table 1. Formative evaluation index of blended teaching

Level 1 indicators	**Secondary indicators**	**observation point**
Learning attitude	attendance	1. Number of attendances
	Learning input	1. Landing times of online learning platform 2. landing time of online learning platform 3. Number of assignments on online learning platform
	Learning participation	1. Length of attention in class 2. times of asking questions or answering questions 3. Number of positive interaction with teachers
learning process	classroom performance	1. accuracy of understanding and expression of classroom questions, 2. Degree of connection between answer and other content, 3. Description of answer language, 4. Overall preparation
	Experimental performance	1. The number of times to complete experiments within the specified time, 2. the number of times to complete the experiment report within the specified time, 3.The number of detailed experiment report and accurate data, 4. the number of innovative experimental methods
	Communication and collaboration	1) The time of active participation in group activities; 2) the number of times that individual tasks of the group are completed on time as required; 3. The number of times the group's task objectives were coordinated with the individual task objectives, 4. The number of times the group's team members volunteered to help each other, 5. The number of times resources and information are actively shared

	online learning	1. The number of learning resources uploaded to the online learning platform; 2. The number of learning resources uploaded to the learning platform that were downloaded; 3. The number of learning resources on the learning platform, 4. The progress of browsing learning resources on the learning platform, 5. The completion rate of learning tasks on the learning platform
Learning results	Unit assessment	1. Results of unit test, 2. score of unit comprehensive experiment, 3. Completion of comprehensive tasks
	Homework submission	1. The number of times the assignment is completed within the specified time; 2. The degree to which the assignment adheres to the topic and has its own thinking; 3. Assignment correct answer rate
	works show	1. Grade level of the displayed works, 2. Production and design level of the results, 3. Proper organization and distinct theme, 4. Overall presentation of the display process
	classroom testing	1. Correct answer rate of objective questions; 2. Correct answer of subjective questions
Advanced skills	Innovation and creation	1. Be acutely aware of where and how innovation affects outcomes; 2. Propose innovative or creative solutions to problems; 3. Turn innovative or creative ideas into practice and generate impact
	trouble shooting	1. Actively use various ways and methods to effectively solve problems, 2. creatively put forward new methods and new ways to solve problems, 3. Accurately and appropriate knowledge transfer and decision-making
	Digital literacy	1. Know the functions and use methods of various information and communication technologies and multimedia tools; 2 use various information and communication technologies and multimedia tools to solve problems; 3. Accurately and creatively use appropriate multimedia tools to solve problems
	Critical thinking	1. Accurately understand and interpret the course knowledge and inquiry process; 2. Comprehensively analyze and evaluate the advantages and disadvantages of the course learning and inquiry process; 3. reflect on the deficiencies of the course learning and inquiry process and put forward methods for improvement

Index quantification and weight setting

The formative evaluation index structure of blended teaching has the characteristics of stratification and interleaving, and some indicators are difficult to quantify. Therefore, the analytic hierarchy process is used in this study to determine the corresponding weight of each indicator in the index structure. The main steps are divided into three steps: (1) construct the judgment matrix, (2) carry out the consistency test, (3) calculate the index weight.

Construct the judgment matrix

The first step of constructing the judgment matrix is to select the evaluation scale. This study selects the 9 evaluation scale, which is shown in Table 3.2. According to the evaluation index structure constructed above, the first level index matrix is set as A = (aij) 4 * 4, including learning attitude, learning process, learning results and higher order skills. The corresponding judgment matrix is set as B1 = (b 1 ij) 3 * 3, B2 = (b 2 ij) 4 * 4, B3 = (b 3 ij) 4 * 4, B4 = (b 4 ij) 4 * 4. After the expert judgment, the corresponding importance degree judgment matrix was established respectively.

Table 2. The Evaluation Scale of the Judgment Matrix

scale	meaning
1	Two factors have the same importance
3	Of the two factors, the former is slightly more important than the latter
5	Of the two factors, the former is significantly more important than the latter
7	Of the two factors, the former is strongly more important than the latter
9	Of the two factors, the former is more important than the latter
2，4，6，8	Indicates the median value of the above-mentioned adjacent judgments
reciprocal	If a ij is the ratio of the importance of factor i to j, then a ij = 1 / aij is the ratio of the importance of factor j to i

consistency test

In this study, the judgment matrix consistency test method proposed by Saaly (1977). When the judgment matrix is consistent, the maximum feature root (λ max) of the judgment matrix should be slightly larger than the matrix factorial n, and the random consistency proportion (CR) of the hierarchical ranking should be less than 0.1 and cannot be negative. The consistency test process is divided into two steps: hierarchical single rank consistency test and hierarchical total rank consistency test. When both are satisfied, it can show that the constructed judgment matrix has passed the consistency test.

1. Hierarchical single ranking consistency test, that is, the judgment matrix A and B1～B4 respectively, and the calculation formula is as follows. Where, RI is obtained by query hierarchical ranking of random consistency test index table.

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(Aw)i}{wi} \quad (3.1)$$

$$CI = (\lambda max - n)/(n - 1) \quad (3.2)$$

$$CR = CI / RI \quad (3.3)$$

The test results are shown in Table 3, including the judgment matrix A, B 1 to B 4(λmax) is slightly larger than the matrix factorial n, and the random consistency proportion of hierarchical

ranking is less than 0.1, that is, all hierarchical single ranking judgment matrices have passed the consistency test.

Table 3. Results of the consistency test of the judgment matrix for the hierarchical single ranking

metric	A	B1	B2	B3	B4
λ max	4.1171	3.0536	4.0708	4.1191	4.0604
CR	0.0437	0.0516	0.0265	0.0444	0.0226

2. The total hierarchy ranking consistency test, that is, the total consistency test according to the results of the hierarchy single ranking, the calculation processes such as (3.4), (3.5), (3.6), the result is CR total = 0.04338 <0.1, that is, the total hierarchy ranking also meets the consistency test.

$$CI_{总} = \sum_{j=1}^{m} w_j CI_j = 0.1381 \times 0.2681 + 0.2761 \times 0.2362 + 0.1953 \times 0.0564$$

$$+ 0.3905 \times 0.0391 = 0.0365 \quad (3.4)$$

$$RI_{\text{overall}} = W\sum_{j=1}^{m} RI_j = 0.1381 \times 0.5194 + 0.2761 \times 0.8931 + 0.1953 \times 0.8931$$

$$+ 0.3905 \times 0.8931 + 0.3905 \times 0.8931 = 0.8415 \quad (3.5)$$

$$CR_{\text{overall}} = CI_{\text{overall}} / RI_{\text{overall}} = 0.0434 < 0.1 \quad (3.6)$$

Calculation of index weight

In this study, Yaahp software was used to calculate the index weight W, which is a common auxiliary software for hierarchical analysis calculation. The calculation method is W = Wi * Wij, where Wi is the weight of each indicator of the judgment matrix A, and Wi j is the weight of each indicator of the judgment matrix B1~B4. The calculation process in this study is as follows:

1. Enter the result of judgment matrix A into Yaahp software to obtain the weight of each indicator. WAi = (0.1471,0.3030,0.3872,0. 1628) T.

2. Enter the results of the judgment matrix B 1 to B 4 into the Yaahp software respectively, Get the weight of each secondary index: WB 1 = (0.4934, 0.3108, 0. 1958)T, WB4 = (0.4203, 0.1213, 0.2685, 0. 1899) T, WB3 = (0.3870, 0.3036, 0.1466, 0. 1627) T, WB4 = (0.3562, 0.3219, 0.1609, 0. 1609) T.

3. The weight Wi of each index of judgment matrix A is multiplied by the weight Wij of judgment matrix B 1~B4 in order to obtain the weight of each index in the mixed teaching process evaluation system.

In order to simplify the calculation of the final evaluation results and make the evaluation process more operable, the weight of each index is fine-tuned according to the rounding rules, and the mixed teaching process evaluation index system as shown in Table 4 is finally obtained.

Table 4. Formative evaluation index system of blended teaching

	Primary indicators	Secondary indicators	weight coefficient	Integer weight
		Class attendance	0.068	0.07

Formative evaluation index and weight in blended teaching	Learning Attitude (0.14)	Learning input	0.043	0.04
		Learning participation	0.027	0.03
	Learning process (0.30)	classroom performance	0. 127	0. 12
		Experimental performance	0.081	0.08
		Communication and collaboration	0.058	0.06
		online learning	0.036	0.04
	Learning outcomes (0.39)	Unit assessment	0. 151	0. 15
		Homework submission	0. 118	0. 12
		works show	0.063	0.06
		classroom testing	0.057	0.06
	Advanced skills (0.17)	Innovation and creation	0.058	0.06
		trouble shooting	0.052	0.05
		Digital literacy	0.026	0.03
		Critical thinking	0.026	0.03

Credit and validity test

Reliability and validity test

In this study, the constructive evaluation system of blended teaching was applied to blended teaching in a university, and SPSS 23.0 was used to test the reliability and validity of the data.

Reliability analysis

The reliability of the second-level index item of the index system is measured by using the Cronbach's alpha coefficient, and the results are shown in Table 5.

Table 5. Summary of reliability measurement results of secondary indicators

Secondary indicators	Total correlation of correction items	The α coefficient of term deletion	Cronbachα coefficient
Class attendance	0. 159	0.724	0.719
Learning input	0. 100	0.739	
Learning participation	0. 104	0.721	
classroom performance	0.386	0.642	
Experimental performance	0.497	0.622	
Communication and collaboration	0.523	0.642	
online learning	0. 184	0.637	
Unit assessment	0.323	0.723	
Homework submission	0.043	0.669	
works show	0.590	0.715	
classroom testing	0.270	0.636	

Innovation and creation	0.222	0.695	
trouble shooting	0.200	0.720	
Digital literacy	0. 110	0.716	
Critical thinking	0.279	0.718	

In the results, the total correlation values of the correction items of the analysis items were all above 0.0, indicating that the correlation among each item was favorable, and the reliability coefficient value did not undergo a significant improvement after the deletion of the analysis items. Hence, each item should be retained. The value of the data reliability coefficient is 0.719, which is higher than 0.6, meaning that the quality of data reliability is high. To summarize, the quality of data reliability in this study is high.

Validity analysis

During the design process of the index system in this study, the Delphi method was employed to repeatedly modify the index items, optimize the content validity to determine the index structure, and the analytic hierarchy process was utilized to determine the weight of each index item and passed the internal consistency test. Additionally, the scale validity was examined through factor analysis. Among them, the KMO statistic value was 0.827, and the Bartlett spherical test result was less than 0.05, indicating that all indicators of the model achieved ideal values and were well fitted, that is, the scale structure effect was ideal and the design structure relationship effect was good, which was suitable for exploratory factor analysis. The results are presented in Table 6.

Table 6. Test of KMO and Bartlett

Sample a sufficient Kaiser-Meyer-Olkin metric.		0.827
The sphericity test of the Bartlett	Approximate chi square	297.047
	df	105
	Sig .	.000

DISCUSSION AND RECOMMENDATION

In the era of big data, teachers, students, teaching process and teaching resources in blended teaching mode will generate a large amount of data information along with the development of teaching activities and learning activities, which provides a basis for the scientific nature of formative evaluation. Therefore, based on the learning data of students and the influence of various elements in the classroom teaching process, this study adopts the Delphi method to design the formative evaluation scale and scheme for hybrid teaching based on students' learning behaviors from the dimensions of student self-evaluation, mutual evaluation and teacher evaluation, and constructs a reasonable and scientific formative evaluation system as shown in Table7.

Table 7 The Formative Evaluation index System of Blended Teaching

Primary indicators	Secondary indicators	weight coefficient
Learning Attitude (0.14)	Class attendance	0.07
	Learning engagement	0.04
	Learning participation	0.03
Learning process (0.30)	classroom performance	0. 12
	Experimental performance	0.08
	Communication and collaboration	0.06
Learning outcomes (0.39)	online learning	0.04

	Unit assessment	0. 15
	Homework submission	0. 12
	works show	0.06
	classroom testing	0.06
Advanced skills (0.17)	Innovation and creation	0.06
	Problem solving	0.05
	Digital literacy	0.03
	Critical thinking	0.03

Rational Analysis of Index Structure Design

The learning activities engendered in the blended teaching environment occur on the online learning platform and in the offline actual courses. The formative evaluation of blended teaching emphasizes the assessment of the entire learning process in the blended teaching environment and appraises all online and offline learning activities in which students participate. The evaluation content of online learning activities mainly encompasses browsing platform resources, completing online homework, and participating in communication and discussion. The evaluation content of offline learning includes classroom participation, experimental performance, homework completion, work design, communication and collaboration, etc. Both online and offline learning evaluation contents incorporate students' learning participation, learning engagement, innovation and creation, problem-solving, digital literacy, and critical thinking.

The index structure devised in this study conducts an integrated evaluation of online and offline teaching activities from four dimensions: learning attitude, learning process, learning outcomes, and higher-order skills, thereby resolving the issue of segregating online and offline teaching evaluation in the current research on blended teaching evaluation and demonstrating systematic characteristics. Additionally, the evaluation of advanced skills conforms to the requirements of the current evaluation system, which focuses on the three-dimensional objective investigation of knowledge, ability, and quality and reflects the scientific and comprehensive nature of the formative evaluation of blended teaching.

Rationality Analysis of Index Weight Allocation

The weight distribution of the first-level indicators in the formative evaluation of blended teaching is the learning process (0.39), learning outcome (0.30), learning attitude (0.14), and advanced skills (0.17), as presented in Table 4. Learning process ranks first and constitutes the largest proportion in the formative evaluation of blended teaching, indicating that the learning process is the most crucial basis for determining the final evaluation score, which aligns with the notion that formative evaluation focuses on assessing students' learning process. The weight of the learning outcome is 0.30, signifying that the learning outcome is an important factor in evaluating the final score. This is because one of the concepts of formative evaluation is to promote students' learning to enhance learning outcomes. Considering the learning outcome as one of the significant factors in the formative evaluation of blended teaching is to verify this idea. The weight of advanced skills is 0.17, suggesting that advanced skills are another essential factor in evaluating the final score.

Currently, all countries worldwide, including the OECD (Organization for Economic Cooperation and Development), attach significance to the cultivation of higher-level thinking, which has become the key ability requisite for talents in the 21st century. The evaluation index of the blended teaching process regards it as one of the important factors, reflecting the cultivation and emphasis on higher-order thinking and skills. The weight of the learning attitude is 0.14, and the learning attitude is a fundamental factor for blended learning. Only with a favorable learning attitude can one engage in learning, devote oneself to it, and achieve results. To sum up, the evaluation content in this study centers on learning attitude, learning process, learning outcomes, and higher-order skills, and

comprehensively assesses students' learning behaviors and results throughout the entire process of students' learning from the beginning to the end, reflecting the unity and interconnection of the indicator system.

CONCLUSION

In the era of Education Informationization 2.0, the call for an in-depth reform of educational evaluation is growing louder. How to enhance process evaluation has emerged as one of the issues that require resolution in academic research. Given the scarcity of research on process evaluation within the current academic sphere, this study incorporates formative evaluation into the mixed teaching model and presents a scientifically sound and reasonable formative evaluation system for blended teaching.

The main efforts of this study encompass the following aspects: Firstly, the notion of establishing the formative evaluation index system for blended teaching is proposed from the five perspectives of evaluation goal, scope, subject, method, and content. Secondly, based on the Delphi method and the analytic hierarchy process, the evaluation index system is constructed from four dimensions: learning attitude, learning process, learning achievement, and advanced skills. Thirdly, the index structure and index weight of the constructed index system are analyzed and verified in terms of reliability and validity to confirm its scientific rationality. Additionally, the evaluation scale designed based on the hybrid teaching formative evaluation index system can be utilized to collect data on the entire learning process of students, addressing problems such as the operational difficulty and weak universality of formative evaluation, and laying a theoretical and practical foundation for promoting the reform of teaching evaluation and innovation of formative evaluation.

Limitations

The evaluation index system constructed in this study is applicable to experimental courses and mixed courses with equal emphasis on theory and experiment. The index items are set to evaluate students' theoretical course learning and experimental operation process, which can comprehensively examine students' theoretical learning and practical operation. However, educational evaluation is a complex system, and no evaluation system can be fully applicable to all types of courses. The mixed teaching process evaluation index system constructed in this study will achieve better results if it is adjusted according to different types of courses. If it is a pure theoretical course without the link of "experiment", the index system can be adjusted according to the corresponding teaching principle, for example, the index of "experimental performance" can be changed to "knowledge transfer".

Outlook

In the follow-up research, we will continue to deeply explore and analyze the procedural evaluation, design a procedural evaluation index system covering different disciplines and different course types, increase the application scenarios of the evaluation system, expand the sample size and collection scope of data, further refine the data dispersion, and compare and analyze similar data analysis algorithms. The most suitable algorithm is used to improve the performance of the whole process evaluation and analysis model, so as to draw more detailed and accurate conclusions.

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