Construction and Practical Validation of a Blended Teaching Quality Evaluation Indicator System: A Case Study of Online-Offline Blended Mathematics Courses at Guangdong Technology College

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Abstract: In response to the widespread adoption of blended teaching models in higher education and the lack of a systematic quality evaluation framework, this study develops a comprehensive evaluation indicator system for assessing blended teaching quality, using online-offline blended mathematics courses at Guangdong Technology College as a case study. Guided by three core principles—integration of online and offline components, alignment of process and outcome evaluation, and equal emphasis on teacher and student roles—the framework incorporates two key dimensions: teacher-related factors and student-related factors. Through questionnaire surveys and analysis of platform data (from UOOC and Rain Classroom), an empirical investigation was conducted in the "Economic Mathematics" course across four classes (approximately 200 students) majoring in Accounting and Financial Management during the 2023–2025 academic years. Results demonstrate that the implementation of blended teaching led to significant improvements in student performance (average scores increased by 3–6 points with reduced standard deviation) and more proactive learning behaviors. The study ultimately proposes an evaluation system consisting of 3 first-level indicators (pre-class, in-class, and post-class) and 20 second-level indicators, providing a systematic and practical tool for evaluating blended teaching quality.

Keywords: Teaching Quality Evaluation; Evaluation Indicator System; Blended Teaching; Online-Offline Integration; Higher Education

1. Introduction

The impact of technology on higher education continues to deepen, giving rise to a variety of teaching methods. Models such as micro-lectures, Massive Open Online Courses (MOOCs), Small Private Online Courses (SPOCs), and flipped classrooms [1] each have their own advantages and disadvantages, but it is undeniable that they have introduced new perspectives for educational reform. Through continuous research and exploration by educators, the blended teaching model, which integrates online and offline elements, has emerged. It is not an entirely new educational theory but rather a flexible integration of various teaching methods tailored to current educational needs, hence termed "blended teaching" [2].

Due to the diversity inherent in the online and offline teaching processes of blended instruction, traditional outcome-based teaching evaluations are no longer suitable. In this context, scientific and reasonable evaluation methods are crucial for "improving the quality of higher education" [3]. As the evaluation of blended teaching quality is an indispensable part of the teaching process, establishing an appropriate evaluation system has become an unavoidable issue in educational research [4].

Therefore, this paper develops a blended teaching evaluation system based on the implementation process of blended teaching at our institution. The objectivity and accuracy of the evaluation indicator system are key to reflecting the teaching quality in higher education. Constructing a blended teaching indicator system requires observation and practice of educational activities, i.e.,

summarizing and integrating various components of the blended teaching process to extract content that can serve as evaluation indicators. Only through analysis, processing, and screening can a practical blended teaching quality evaluation indicator system be established.

Compared to traditional classrooms, the diversity of blended teaching increases the complexity of its evaluation indicator system. Thus, when developing the corresponding evaluation system, it is essential not only to adhere to the principles of constructing an evaluation indicator system but also to consider relevant influencing factors. Only on this basis can the extracted evaluation indicators be targeted, the developed evaluation indicator system be more accurate and scientific, and the established blended teaching quality evaluation model fulfill its intended role.

2. Three Core Principles for Constructing a Blended Teaching Quality Evaluation Indicator System

Teaching quality evaluation is an indispensable component of the blended teaching model. It not only provides guidance for the specific implementation and improvement of blended teaching but also, in the long term, promotes the development of blended teaching to a certain extent [5-8]. When constructing a blended teaching evaluation indicator system, certain principles must be followed, as this step is a fundamental requirement for evaluation work. To ensure the rationality of the evaluation indicators and the reliability of the evaluation results, the blended teaching quality evaluation indicator system developed in this paper should adhere to the following basic principles:

2.1 Integration of Online and Offline Components

The blended teaching process includes both online self-directed learning and offline face-to-face instruction. When implementing blended teaching for specific courses, schools must ensure that these two components complement each other to achieve the goal of improving teaching quality. In the blended teaching process, teachers need to guide students and help them adapt to the new online teaching methods as quickly as possible. However, it is essential not to neglect either component. While students are adapting to the online part, offline classroom teaching should be conducted appropriately, with teachers supervising and guiding students. Therefore, only by integrating both online and offline aspects can a comprehensive evaluation of blended teaching be achieved.

2.2 Balance between Process and Outcomes

Teaching outcomes are the ultimate reflection of teaching quality, which often leads to the misconception that "student exam scores represent teaching quality" in evaluations. However, factors affecting blended teaching quality are distributed across various stages of the teaching process. Process leads to outcomes, and in blended teaching, the influencing factors are even more numerous and complex [9,10]. Therefore, the evaluation indicators for blended teaching must encompass both the teaching process (such as students' specific learning behaviors and quality in online and offline settings) and the teaching outcomes, thereby balancing process evaluation and outcome evaluation.

2.3 Emphasis on both Teachers and Students

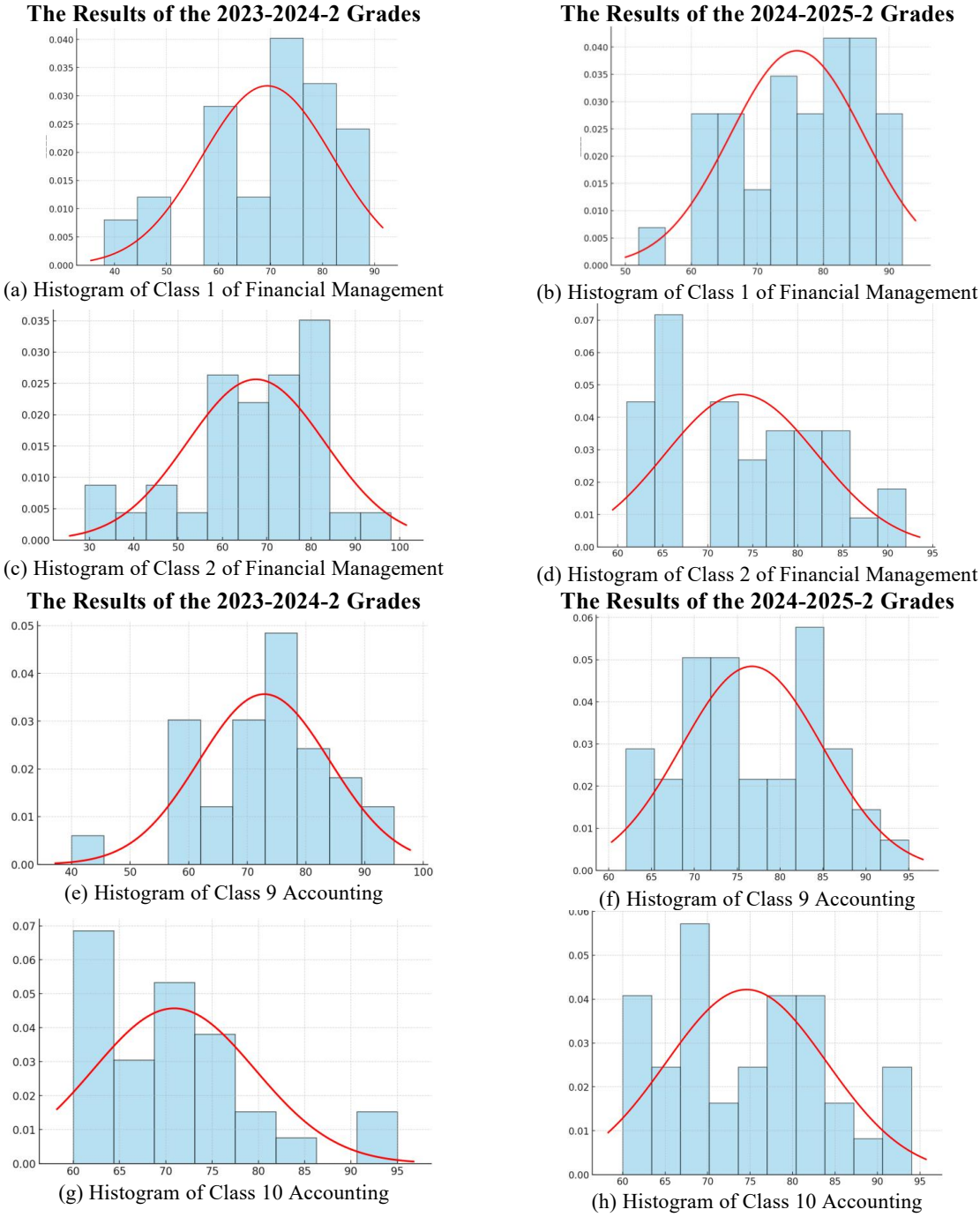
Teaching activities are a process of interaction between teachers and students, a point that is particularly prominent in blended teaching. Unlike traditional teaching, implementing blended teaching requires teachers to familiarize themselves with online platforms, especially integrating platform-based tutoring into the teaching process. On the other hand, as one of the main participants in teaching, whether students adapt to the blended teaching model and whether their initiative and motivation are enhanced will directly impact teaching quality. Therefore, when determining the evaluation indicators for blended teaching quality, the influence of both teachers and students on teaching quality must be considered.

3. Analysis of Blended Teaching Effectiveness

To demonstrate the scientific validity, rationality, and accuracy of the blended teaching evaluation, institutions should establish a corresponding blended teaching quality evaluation indicator system based on the actual implementation of blended teaching, by examining both the process and outcomes of blended instruction. Given the guiding role of evaluation indicators in teaching quality, the selected indicators must not only reflect the essence of blended teaching but also include representative ones. When evaluating the

content of these indicators, an inappropriate number or inaccurate content would undermine the purpose and significance of the teaching evaluation. This study takes the blended teaching of the course "Economic Mathematics (II)" in the Accounting and Financial Management majors at a university in Guangdong during the 2023–2024 and 2024–2025 academic years as an example. By comparing the results between the experimental group (2024–2025 academic year) and the control group (2023–2024 academic year), it provides a reference for developing a blended teaching quality evaluation indicator system.

To more clearly and intuitively reflect the outcomes of blended teaching, a simple statistical analysis was first conducted on the final exam scores of two classes from Accounting and two classes from Financial Management over two semesters. The score distribution is shown in Figure 1:



(a) Histogram of Class 1 of Financial Management

(b) Histogram of Class 1 of Financial Management

(c) Histogram of Class 2 of Financial Management

(d) Histogram of Class 2 of Financial Management

(e) Histogram of Class 9 Accounting

(f) Histogram of Class 9 Accounting

(g) Histogram of Class 10 Accounting

(h) Histogram of Class 10 Accounting

Figure 1. Shows the Distribution of Grades over the Two Semesters

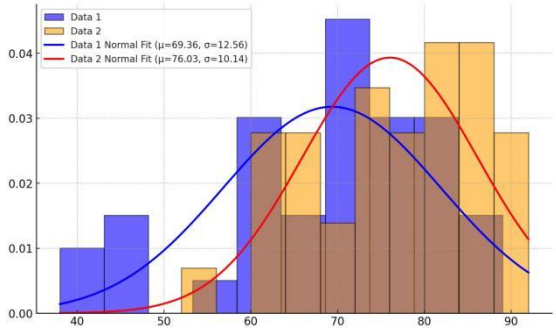
As can be seen from the statistical results in Figure 1, the grade distributions of all four

classes generally follow a normal distribution. Preliminary calculations and analysis yield the key data for each class as shown in Table 1:

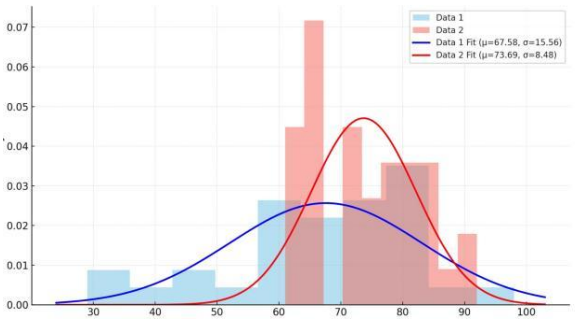
Table 1. Analysis of Grades for Two Semesters

	2023-2024-2				2024-2025-2			
class	Class 1 of Financial Management	Class 2 of Financial Management	Class 9 of Accounting	Class 10 of Accounting	Class 1 of Financial Management	Class 2 of Financial Management	Class 9 of Accounting	Class 10 of Accounting
Average value	69.36	67.58	72.90	70.90	76.03	73.69	74.58	76.71
Standard deviation	12.562	15.56	11.19	8.73	10.14	8.48	8.24	9.46
25th percentile	62	59.5	63.5	63.75	67.5	66	70.75	67
50th percentile	72	68	74	70	76.5	73.5	75.5	76
75th percentile	78	79.5	81	76.25	84.75	80	85	81.75

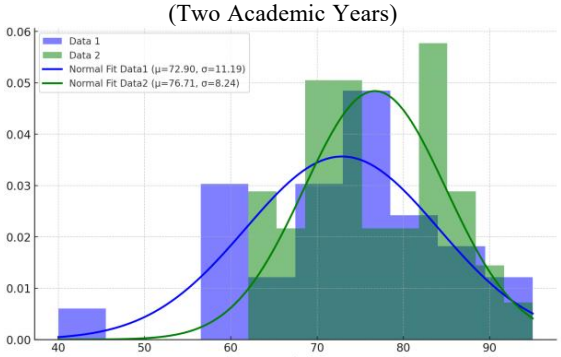
As shown in the data from Table 1, all four classes that implemented blended teaching demonstrated an improvement in academic performance. This reflects the effectiveness of the teaching reform. To provide a more intuitive comparative analysis of the scores between the experimental group and the control group, the grade distributions of the two majors are now separately visualized, as shown in Figure 2:



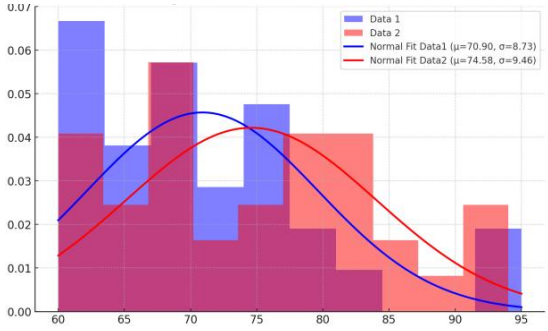
(a) Grade Comparison for Financial Management Class 1 (Two Academic Years)



(b) Grade Comparison for Financial Management Class 1 (Two Academic Years)



(c) Grade Comparison for Accounting Class 9 (Two Academic Years)



(d) Grade Comparison for Accounting Class 10 (Two Academic Years)

Figure 2. Grade Analysis of Experimental and Control Groups in the Two Majors

Note: Data 1 represents non-blended teaching; Data 2 represents blended teaching.

Analysis of the full academic year's results shows that the scores of the experimental class in Financial Management are relatively concentrated in the 70-80 point range, with a smaller number of failing students compared to the control classes. A similar pattern is observed in the Accounting major. Furthermore, the scores of Financial Management Classes 1 and 2 and Accounting Class 9, which did not undergo blended teaching, are more dispersed, with fewer high-scoring students. In conclusion, the statistical analysis of blended teaching outcomes indicates that the implementation of blended teaching is effective in improving teaching quality.

4. Establishing a Blended Teaching Quality Evaluation Indicator System

When constructing a blended teaching evaluation system, the first step is to determine appropriate content for setting evaluation indicators, as these elements are crucial to the evaluation framework. Adhering to the three core principles and considering factors related to both teachers and students, a statistical analysis was initially conducted on data generated from the UOOC Alliance platform during the implementation of blended teaching. The results

of this data analysis are presented in Figure 3.

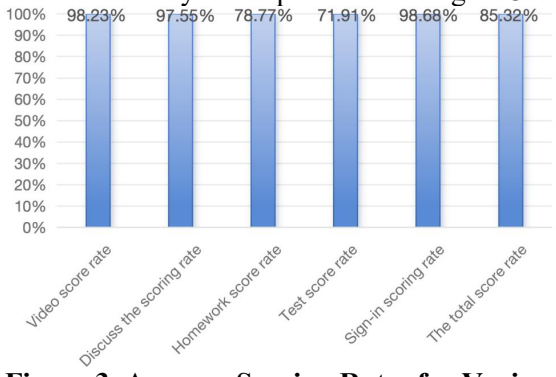


Figure 3. Average Scoring Rates for Various Components in the Online Teaching Process

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From the perspective of student participation in the teaching process, students find it easiest to complete check-ins, discussions, and video views. The completion rates of these three tasks can directly reflect student engagement in online teaching. The gradual decline in quiz and assignment scores, to some extent, indicates the learning outcomes and challenges encountered by students. Therefore, the evaluation indicators for the online component of blended teaching can include the number of student check-ins, video views, interaction frequency, online quizzes, online assignments, quiz scores, and online discussion participation.

For the offline classroom indicators, a literature review was conducted, and a questionnaire was designed based on the offline teaching process. The survey results were analyzed to identify the most critical indicators, which include: clear task objectives, classroom discipline (e.g., attendance), group collaboration, classroom performance (e.g., discussion and interaction), engaging and dedicated teaching, rigorous and meticulous attitude, patient tutoring and Q&A, emphasis on guidance and inspiration, focus on key and difficult points, concentration, integration of theory and practice, and mastery of fundamental knowledge.

In summary, this study, grounded in the blended teaching activities of a university in Guangdong and based on data analysis of student performance in actual teaching scenarios, designs the evaluation indicators into three first-level indicators, summarized into 20 second-level indicators. These indicators reflect the specific implementation process of blended teaching. The developed blended evaluation indicator table is shown in Figure 4.

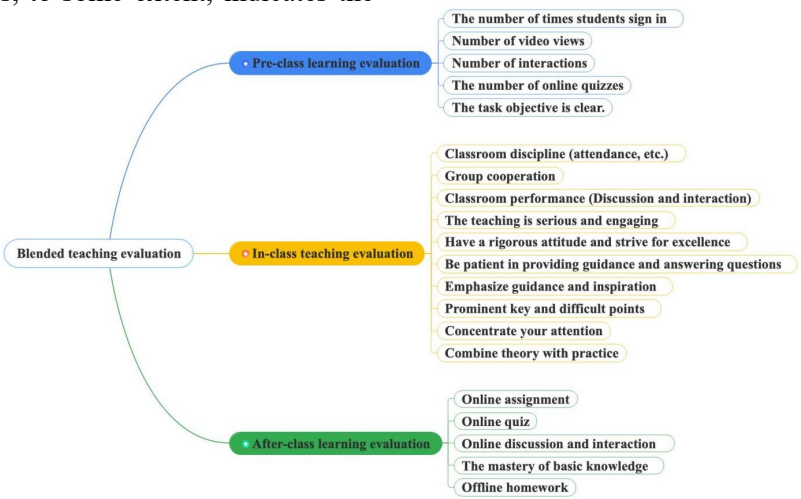

Figure 4. Blended Teaching Evaluation Indicators

Based on the analysis and synthesis of influencing factors and outcomes in blended teaching quality evaluation, and grounded in the three core principles for establishing a blended teaching evaluation system, the blended evaluation indicator system developed in this study is presented in Table 2.

When establishing a blended evaluation system, it is essential to comprehensively and objectively examine all indicators to lay a solid foundation for model development. Only in this way can a blended teaching evaluation model be successfully constructed and fulfill its intended role.

Table 2. Blended Teaching Evaluation Indicators

First-level indicator	Symbol	Secondary indicators
Pre-class learning evaluation	I1	The number of times students sign in
	I2	Number of video views
	I3	Number of interactions
	I4	The number of online quizzes
	I5	The task objective is clear.
In-class teaching evaluation	I6	Classroom discipline (attendance, etc.)
	I7	Group cooperation
	I8	Classroom performance (Discussion and interaction)
	I9	The teaching is serious and engaging
	I10	Have a rigorous attitude and strive for excellence
	I11	Be patient in providing guidance and answering questions
	I12	Emphasize guidance and inspiration
	I13	Prominent key and difficult points
	I14	Concentrate your attention
	I15	Combine theory with practice
After-class learning evaluation	I16	Online assignment
	I17	Online quiz
	I18	Online discussion and interaction
	I19	The mastery of basic knowledge
	I20	Offline homework

5. Conclusion

This study systematically elaborates on the three core principles required for constructing a blended teaching quality evaluation system: the integration of online and offline components, the unification of process and outcomes, and the equal emphasis on both teachers and students as key participants. It also analyzes the critical influencing factors of blended teaching evaluation from the perspectives of these two main stakeholders. Building on this foundation, the study further refines and finalizes the evaluation indicators through a systematic review of the blended teaching implementation process and offline questionnaire surveys, preliminarily establishing a structured blended teaching evaluation indicator table. Ultimately, by integrating the analysis of influencing factors and teaching outcomes, a comprehensive and well-defined blended teaching evaluation indicator system is constructed, laying a solid foundation for the subsequent development of a scientific quality evaluation model.

Acknowledgments

This paper was supported by the following projects:

Research Project of the 2024 Annual Project by the Professional Committee on Teaching Quality Management of Private Universities under the Guangdong Higher Education Teaching Management Association: Blended Teaching Quality Evaluation for Mathematics Courses Based on Neural Networks (No. GDZLGL2423);

Guangdong Technology College 2024 “Quality Engineering” Project: Blended Teaching Quality Evaluation for Mathematics Courses Based on Neural Networks (Project No. JXGG2024150)

Guangdong Province Higher Education Association “14th Five-Year Plan” Research Project for 2024 on the Evaluation of Mathematical Modeling Capabilities of Undergraduates in New Era Applied Universities (No. 24GQN35);

Guangdong Technology College 2025 first-class course construction project Economic Mathematics (II) (No.YLKC202521);

Guangdong Technology College 2025 Annual Smart Course Construction Project: Economic Mathematics (II) (ZHKC202575).

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