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PAPER

Evaluation of Project-based Teaching Quality Based on SBM-DEA

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ABSTRACT

Improving the quality of project-based teaching can have several benefits for students, including the development of hands-on skills, expanded thinking abilities, a better understanding of real life situations, building connection between individuals and society, and internalizing knowledge. Therefore, conducting a scientific evaluation of quality of project-based teaching is crucial. In this study, the focus was on the process of project-based teaching, involving 120 computer science and technology students from four universities in Hainan Province. The researchers utilized the slacks-based measure and data envelopment analysis (SBM-DEA) model to measure learning efficiency of these students. Additionally, the study analyzed the insufficient investment in project-based teaching in the four universities and identified the process factors affecting quality of project-based teaching. The results show that out of the 120 students, only 24 students achieved a learning efficiency of 1, accounting for only 20% of the total. This indicates that although project-based teaching is implemented in the surveyed schools, the comprehensive improvement of students' learning efficiency has not been achieved. The two main factors contributing to the low quality of were identified as project-based teaching aids (X-2) and project-based teaching experience (X-3). The findings of this study hold important reference value for optimizing the project-based teaching process, identifying key factors of project-based teaching quality, and promoting the adoption of project-based teaching in higher engineering education to accelerate teaching mode reform.

KEYWORDS

SBM-DEA, project-based teaching, teaching quality, teaching quality evaluation

1 INTRODUCTION

In the era of rapid development of information technology (IT), its widespread adoption is transforming people's life and work practices. The emergence of the big data era is also influencing how people work and the pace at which they learn. The extensive development of modern educational technology has greatly significantly altered the time and space of learners, making learning more flexible and expanding

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the learning environment. College students are increasingly dissatisfied with traditional classroom teaching mode and seek alternative ways to acquire knowledge. The field of new IT applications is undergoing rapid changes. To match increasing demand of IT applications among contemporary students, the speed of updating IT in teaching is also very fast. China has been actively advancing the curriculum reform in higher engineering education, recognizing the need for a transformation in the traditional IT education. It is crucial to adopt a teaching model that is better suited for college students, as it can enhance learners' motivation and improve teaching quality. Among various teaching methods, project-based teaching stands out as a prominent approach based on constructivism theory. Project-based teaching comprehensively improves learners' ability level through theoretical teaching, practical practice, quality improvement and other links, which conforms to the goal of China's higher engineering education reform. In the process of project-based teaching, teachers can design a complete syllabus, convert teaching content into a number of practical projects, and complete teaching task through traditional classroom or online classroom. Under the guidance of teachers, college students can focus on task list of a specific project, moving from theoretical learning to practical practice. This approach allows students to solidify their knowledge and skills through hands-on experience. Project-based teaching places students at the center of the learning process, emphasizing the alignment between students' learning ability and tasks assigned to them. It even provides opportunities for students to engage in real-world scenarios, fully cultivating their problem-solving ability in advanced engineering. This approach enhances students' motivation to learn and improves their autonomy in learning, as well as their ability to think critically and tackle complex problems.

Given the limited duration of teaching, it is challenging for teachers to impart complete knowledge to students within that timeframe. The proposed teaching objectives of the higher engineering education's core quality also necessitate a change in teaching methods. The purpose of project-based teaching is to develop students' core skills and abilities, to closely link knowledge and specific tasks, to master methods and skills to solve specific problems with knowledge, and to develop actual ability to solve problems. Since 2017, the Ministry of Education of China has been actively promoting the development of new engineering and related disciplines. The goal is to effectively translate theoretical knowledge into actionable and verifiable teaching practices, enabling concepts to be put into action and to effectively improve the overall quality of classroom teaching. Therefore, a more scientific evaluation of project-based teaching quality can focus on students' conceptual learning and transforming learning opportunities in class, explore and summarize advantages and disadvantages of teaching by front-line teachers in current higher engineering education, and provide references for improving teaching status and classroom teaching quality.

2 LITERATURE REVIEW

The project-based learning (PBL) model has been implemented in various educational settings worldwide. Results show that such a learning model can effectively help students understand the real-life situations, build connection between individuals and society, and enable the internalization of acquired knowledge. In comparison to traditional learning methods, PBL actively engages students, promotes their active participation in learning process and enhances the effectiveness of learning. This teaching model has been implemented in the United States, Germany, Japan, South Korea and other developed countries. These countries continue to

explore new ways to implement this teaching approach. In particular, development of China's new engineering makes project-based teaching bear responsibility of meeting requirements of the times and cultivating more innovative and practical talents in higher engineering education. In terms of the teaching effectiveness of project-based teaching, Chiang et al. [1] conducted research on students from two vocational high schools in Taiwan, specializing in specific majors. The students were divided into experimental group and control group. The research results showed that PBL not only improves students' learning motivation in vocational schools but also facilitates their problem-solving abilities. Cakici et al. [2] demonstrated that the project-based teaching model effectively improves children's learning motivation and performance. Liu et al. [3] suggested that PBL is a project-based learning method that emphasizes learning through hands-on experiences. In their empirical research on the training of pre-service teachers, they found that the integration of multimedia courseware within the project-based teaching mode could enhance teachers' ability to integrate information-based teaching resources. Chen et al. [4] analyzed 30 journal articles published between 1998 and 2017, and the results showed that PBL had a moderate to large positive impact on students' academic achievement. Chen et al. [5] analyzed the influence of integrating creative thinking teaching through PBL in engineering courses. In a comparative experiment conducted between a control group and an experimental group, the results showed that PBL methods can enhance students' creative thinking, especially in terms of fluency and flexibility. Mafruudloh et al. [6] adopted a pre-experimental design method, and found that PBL had a significant impact on students' oral English ability, which was deemed as an effective oral teaching method that promoted students' active and innovative participation in class. Ergul et al. [7] in their study used an experimental model of pre-test and post-test control group, and they found that PBL and teaching was beneficial in the experimental group. Senyuva et al. [8] showed that project-based teaching had no effect on students' social ability, and suggested that educational activities should be organized, improved, and structured in nursing courses to promote the development of students' social skills. Bilgin et al. [9] explored the impact of PBL on undergraduate academic achievement in science teaching courses within the primary education department of a Turkish state university. The results showed that the post-test performance of the experimental group was superior to that of the control group. Additionally, students in the experimental group were more inclined to actively express their opinions about their learning experiences. Shin [10] explored impact of PBL on students' learning motivation and self-efficacy. The results supported that PBL had a positive influence on students' learning motivation and could improve students' cooperation skills. Issa et al. [11] observed that PBL was a modern teaching method designed for students. Their study results showed that there was a significant statistical difference between traditional learning methods and PBL strategies. PBL strategies were found to enhance students' creative thinking, reflective thinking, communication ability, and cooperation ability. Mahasneh et al. [12] examined the influence of PBL on teacher self-efficacy and student's academic achievement using a quasi-experimental research design. The results showed statistical differences in self-efficacy and academic achievement between the experimental and control groups, indicating that PBL was beneficial to students in the experimental group. Craig et al. [13] found that PBL had positive effects on increasing STEM (Science, Technology, Engineering, and Mathematics) learning compared to traditional teaching methods. Bagheri et al. [14] showed that project-based teaching significantly improved learners' autonomous learning skills. Abuhmaid [15] suggested that in online learning, students had a positive attitude toward learning based on a

project-based teaching model, and students who learned in classroom have stronger opinions about PBL than those who learned online. Chang et al. [16] believed that project-based teaching had a statistically positive impact on learners' self-perception and academic performance. Lin [17] found that under computer-supported collaborative learning environment, the project-based teaching model improved the level of collaborative learning among teams and individuals, enhanced the group consciousness of project learning among learners, and actively participation in student mutual evaluation. Lou et al. [18] designed creative instructional design indicators for hybrid PBL, and used the fuzzy Delphi method to analysis expert questionnaires. The study aimed to select the most suitable indicators for college students. Lin et al. [19] emphasized the importance of enhancing students' online participation in project-based teaching to improve the quality of teacher-student interaction, information exchange and project outcomes during the teaching process. Krajcik et al. [20] found that students who received project-based instruction achieved higher scores on standardized science tests and had higher levels of introspection and cooperation when engaging in scientific activities. Kubiatko et al. [21] observed that PBL was a way to cultivate students' thinking ability, which could significantly improve students' problem-solving ability. From the existing research literature, it can be observed that studies on project-based teaching, both domestically and internationally, have primarily focused on practical research. In particular, the implementation object and scope of project-based teaching has expanded its reach to include colleges, middle schools, with an increasing variety of subjects being incorporated [22]. Nevertheless, a significant portion of the literature adopts quasi-experimental research design method to analyze the impact of project-based teaching. The consensus among these studies is that project-based teaching method can effectively cultivate students' communication and collaboration skills, problem solving abilities and critical thinking learning behaviors. However, there is a limited amount of research literature that focuses on how teaching process of project-based teaching method influences teaching quality. Therefore, this study adopts the SBM-DEA model to conduct an empirical study involving students from four colleges and universities in Hainan Province. By utilizing the SBM-DEA model to assess the insufficiencies in project-based teaching, as the study aims to identify the fundamental factors that affect teaching quality within the process of project-based teaching. This research provides reference for improving students' critical thinking ability and learning activities, and encouraging students' critical thinking skills in university courses.

3 RESEARCH METHOD

3.1 Model introduction

The main focus of this study is comprehensive evaluation of project teaching quality. In the evaluation of education teaching quality, the DEA is a widely used and highly effective. The DEA model has reached a high level of maturity and is extensively applied in medicine, economy, management, education and other industries, and has been widely recognized worldwide as a robust model for analyzing the analyzing the decision-making unit. One notable advantage of the DEA model is that it does not require the reassignment of weights to input and output index, and can calculate the best frontier surface of the decision making unit. DEA models are typically classified into radial models and non-radial models. The DEA-CCR model is a radial model, and its original and dual models are represented by formula (1).

$$\begin{aligned} &\min h_{j0} = \frac{\sum_{r=1}^{s} u_r y_{rj0}}{\sum_{i=1}^{m} v_i x_{ij0}} \\ &s.t.\ \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1, j = 1, 2, \mathbf{K}\ , n \\ &\quad u \ge 0, v \ge 0 \end{aligned} \tag{1}$$

In formula (1), y_{rj} refers to the r^{th}-class output of the j^{th} decision unit, x_{ij} refers to the i^{th} input of the j^{th} decision unit, u refers to weight coefficient of the output variable, and v refers to weight coefficient of the input variable. For linear programming with fractions such as equation (1), its dual form can be used to solve, and its dual model is represented by formula (2).

$$\begin{aligned} &\min \theta \\ &s.t. \left\{ \begin{array}{l} \sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = \theta x_{i0}, i = 1, 2, \mathbf{K}\ , m \\ \sum_{j=1}^{n} y_{rj}\lambda_j - s_i^+ = y_{r0}, r = 1, 2, \mathbf{K}\ , n \\ \lambda_j \ge 0, j = 1, 2, \mathbf{K}\ , n \end{array} \right\} \end{aligned} \tag{2}$$

The traditional DEA model does not consider relaxation or congestion of input and output variables, but neglecting these factors may lead to issues in efficiency assessment, resulting in inaccurate assessment. Therefore, in order to prevent such problems, Tone [23] proposed a measure based on relaxation variables for integrated SBM-DEA, which fully considers both the input and output relaxation variables. The SBM-DEA model is represented by formula (3).

$$\rho^* = \min \frac{1 - \frac{1}{m}\sum_{i=1}^{m} \frac{s_i^-}{x_{i0}}}{1 + \frac{1}{s_1 + s_2}\left(\sum_{r=1}^{s_1} \frac{s_r^g}{y_{r0}^g} + \sum_{r=1}^{s_2} \frac{s_r^b}{y_{r0}^g} \right)} \tag{3}$$

In addition, SBM-DEA model can also adjust input and output variables through relaxation to improve efficiency. The adjustment mode of variables is represented by formula (4).

$$\begin{aligned} &x_0 = X\lambda + s^- \\ &y_0^g = Y^g\lambda - s^g \\ &y_0^b = Y^b\lambda + s^b \\ &s^- \ge 0, s^g \ge 0, s^b \ge 0, \lambda \ge 0 \end{aligned} \tag{4}$$

When the result is ρ* = 1, and all slack variables are 0, it represents that decision unit is effective. When ρ* < 1, it represents that decision unit is non-effective. It can then adjust the original input to improve efficiency through slack variables. Adjustment form of corresponding variables is represented by formula (5).

$$\begin{aligned} x_0 &\leftarrow x_0 - s^- \\ y_0^g &\leftarrow y_0^g + s^g \\ y_0^b &\leftarrow y_0^b - s^b \end{aligned} \tag{5}$$

As this study primarily focuses on analyzing the quality of project-based teaching, specifically the impact of various factors on efficiency of teaching results, it can find key elements to improve quality by analyzing relaxation variables of various elements in the process of teaching. By identifying adjustment of relaxation variables of teaching input, more effective teaching strategies are provided for project-oriented teaching of higher engineering education. In other words, quality of project-based teaching is improved by adjusting the size of input variables of project-oriented teaching.

3.2 Indicator system

In higher engineering education, the quality of project-based teaching cannot be simply understood as the maximization of teaching output. Instead, it should focus on achieving the maximum learning effectiveness for students by considering the input of various elements of established teaching resources. Therefore, project-based teaching should not simply assess students' academic performance and honors, but rather compare and analyze the maximum efficiency achieved between each learner's learning input and learning output. In this study, the effects of project-based teaching are also measured from the perspectives of teaching input and output, and specific suggestions are proposed to optimize the teaching process. Based on a large number of literatures, an indicator system for assessing the effectiveness of project-based teaching, as shown in Table 1, has been established.

Table 1. Indicator system of project-based teaching effect

Indicator Type	Indicator Name	Indicator Number	Indicator Meaning
Input indicator	Project-based syllabus	X-1	Content richness and rationality of the syllabus setting
	Project-based teaching aids	X-2	Completeness of experiential teaching tools such as physical objects, video and software in teaching
	Project-based teaching experience	X-3	Realizing scene fidelity of project-based teaching through environment, teacher simulation, etc
	Teaching ability	X-4	Online evaluation scores of teachers' project-based teaching courses in previous year
	Teacher engagement	X-5	Degree to which teachers participate in guiding students' autonomous learning in teaching
	Interaction between teachers and students	X-6	Degree of interaction between students and teachers in project based teaching
Output indicator	Student Achievements	Y-1	Average of test scores and practical operation scores
	Student evaluation	Y-2	Student evaluation of experiential teaching course learning
	Teacher and expert evaluation	Y-3	Evaluation from teaching peers and teaching experts

3.3 Data source

Hainan province, located in the southernmost part of China, is experiencing rapid development in higher engineering education. The project-based teaching method is predominantly implemented through real-life scenarios and well-defined tasks. It collects data, makes plans, and uses independent collaboration to realize teaching process. Computer-related majors in Hainan Province, exhibit strong demand and have excellent prospects for professional development. Therefore, this study takes computer science and technology majors from Haikou University of Economics, Qiongtai Normal University, Hainan Tropical Ocean University, and University of Sanya in Hainan Province as examples. Computer science and technology majors from these four universities all adopt project-based teaching methods in the first semester of 2021–2022. It selects 30 students from one junior class of each school to participate in the case study. In order to facilitate data collection and collation on effectiveness of project-based teaching, it holds symposiums and obtains the most original data from students on teachers' project-based teaching by issuing study questionnaires. The questionnaire adopts classic Likert's five-point scale, and evaluation criteria are as follows. 1 represents difference, 2 represents poor, 3 represents general, 4 represents fair and 5 represents good.

4 RESULTS ANALYSIS

4.1 Descriptive statistical analysis

Table 2. Descriptive statistical results

Name	Mean ± Standard Deviation	Variance	Standard Error	IQR	Kurtosis	Skewness	Coefficient of Variation
X-1	4.092±0.907	0.823	0.083	1	–0.109	–0.801	22.178%
X-2	3.925±0.954	0.91	0.087	2	–0.234	–0.616	24.308%
X-3	3.717±1.039	1.079	0.095	1.75	–0.078	–0.596	27.945%
X-4	3.858±0.998	0.997	0.091	2	0.061	–0.638	25.873%
X-5	4.242±0.799	0.639	0.073	1	0.261	–0.867	18.840%
X-6	3.892±1.019	1.039	0.093	2	–0.598	–0.555	26.187%
Y-1	4.092±0.979	0.958	0.089	1	–0.312	–0.843	23.920%
Y-2	4.133±0.925	0.856	0.084	1	–0.143	–0.853	22.384%
Y-3	4.075±0.954	0.91	0.087	1	0.815	–1.037	23.413%

From the analysis of Table 2, it is evident that there is no outliers in the current dataset, indicating that results of this questionnaire are highly satisfactory, indicating that college students have a good understanding of the input and output indicators associated with teachers' project-based teaching.

4.2 Results of SBM-DEA model

Table 3. Project-based teaching effects of 120 students

Student Number	Efficiency Value	X-1	X-2	X-3	X-4	X-5	X-6	Y-1	Y-2	Y-3
Item 1	1	0	0	0	0	0	0	0	0	0
Item 2	1	0	0	0	0	0	0	0	0	0
Item 3	0.9583	0	0	0	0	1	0	0	0	0
Item 4	1	0	0	0	0	0	0	0	0	0
Item 5	1	0	0	0	0	0	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...
Item 115	0.6583	1	2	1	2	2	2	0	0	0
Item 116	0.7583	1	2	2	1	1	0	0	0	0
Item 117	1	0	0	0	0	0	0	0	0	0
Item 118	1	0	0	0	0	0	0	0	0	0
Item 119	0.7	1	2	2	2	1	1	0	0	0
Item 120	0.7	1	2	2	2	1	1	0	0	0

As can be seen from Table 3, there are only 24 students with an efficiency of 1, accounting for only 20%, which indicates that although students in the four universities under investigation have received project-based teaching from teachers, their learning efficiency has not been comprehensively improved. This conclusion inspires teachers in colleges and universities to adopt project-based teaching. However, it is important to acknowledge that project-based teaching is just one instructional approach. To improve quality of project-based teaching, teachers' personal qualities and students' enthusiasm need to be improved in many aspects, and more systematic teaching management methods need to be adopted to ensure quality of project-based teaching. Relaxation variable analysis of input indicator of project-oriented teaching in four schools is the key research content of this study, as represented in Table 4.

Table 4. Relaxation variables of input indicators of each decision making unit

School	X-1	X-2	X-3	X-4	X-5	X-6
School 1	0.0290	0.3269	0.3195	0.2910	0.0887	0.1686
School 2	0.0562	0.3480	0.3420	0.2112	0.0700	0.0915
School 3	0.0338	0.3389	0.3551	0.2617	0.0317	0.0739
School 4	0.0000	0.4350	0.4699	0.4190	0.0166	0.0977

(1) As can be seen from Table 4, input degree of project-oriented teaching aids (X-2) and project-oriented teaching experience (X-3) are variables that have the greatest influence on each decision-making subject, and final project-oriented teaching output of almost four universities is seriously affected by these two aspects. In particular, lack of project teaching experience in School 4 is primarily due to factors that includes late implementation of project-based teaching and lack of timely construction of experience facilities and equipment for project teaching, project-based teaching is relies on the learners to self-experience a variety of teaching situations, and to solve a variety of complex problems in different teaching situations to improve

their knowledge level. At the same time, deficiency degree of project-based teaching aids is also a relatively large number in all decision-making units, which to some extent also reflects that project-based teaching focuses on letting students personally participate in project-based teaching. This is especially relevant in computer science and technology courses, such as circuit principle and analog electronic technology, which have a substantial amount of theoretical knowledge. The long-standing traditional teaching methods have resulted in college students developing a strong resistance towards mundane knowledge acquisition. To address this issue, teachers need to adopt more project-based teaching methods. Well-designed project-based teaching aids and immersive learning experiences play an important role in engaging students psychologically and enhancing their practical experiences.

(2) Teaching ability (X-4) also has a large numerous deficiencies, indicating that teachers' ability to control project-based teaching is still insufficient. This could be attributed to the fact that teachers the surveyed universities, specializing in computer science and technology, mostly hold master's degree holders without extensive practical experience and teaching expertise. In particular, with the emergence of new engineering concept, more and higher engineering institutions need to update their teaching requirements and adopt new teaching approaches. However, many teachers find it challenging to adapt to the rapid changes within a short period and fail to enhance their teaching ability. At the same time, in the recent years these colleges and universities in Hainan Province have introduced more number of young teachers, whose theoretical level is relatively low and whose professional level is limited, making it difficult for some teachers to grasp key points and challenges involved in project-based teaching. In particular, new curriculum standards related to computer science and technology have increased social and practical activities and other new content. Many teachers are finding it challenging to complete all teaching tasks in limited class hours. Due to the pressure to keep up with course progress, these teachers are compelled to rely on teaching methods that may not be well-suited to the new teaching requirements. This highlights the need for university management departments to place greater emphasis on supporting young teachers in staying updated with emerging technologies. It is important to acknowledge the objective fact that teachers' low professional level leads to poor teaching effect.

(3) Relaxation variables of project-based teaching syllabus (X-1), teacher participation (X-5), and teacher-student interaction (X-6) can be seen to have a certain impact on teaching decision-making units with backward teaching output, but it is not substantial. It shows that teachers demonstrate relatively good performance in terms of project-based syllabus design, student participation, and teacher-student interaction. From calculation results, it can be seen that teaching input of completeness of teaching syllabus has no obvious influence on final teaching output. Primary reason for that is the fact that teachers are very familiar with teaching syllabus, and therefore in project-based teaching, relatively good teaching syllabus can be developed to meet the requirements of teaching quality. At the same time, in project-based teaching mode, students need to take initiative to master practical knowledge, and teachers must participate in the whole process. According to results of this study, degree of teachers' participation in project-based teaching in these four universities is very high, indicating that these universities have developed relatively good drastic methods to promote teachers' participation. In addition to teaching process, teachers' participation in project-based teaching also includes teaching evaluation. Teachers' positive teaching evaluation can be fed back to students, promoting learners to reflect on their learning behaviors according to their learning characteristics and content, and promoting them to participate in teaching more actively.

5 DISCUSSION

The effective implementation of project-based teaching requires attention to the hardware aspect, including the provision of experiential teaching aids, teaching environment, and other supporting equipment. It is crucial to ensure the availability of sufficient funds for the normal operation and maintenance of these resources. Only through intuitive operation and experience can students truly understand gain a deep understanding and apply their knowledge flexibly, fostering their individuality and potential for creative learning. Human factors, such as teachers' participation and guiding role in project-based teaching, degree of teachers' participation and interaction with students also play an important role. In project-based teaching, students take on an active role as both learners and participants, while teachers play a crucial role in ensuring the effectiveness and guidance of the teaching process. The output of teaching effectiveness also accumulates over time. Through evaluation of distribution of colleges and universities, it can be found that four colleges and universities have little difference in the scores of project-based teaching effectiveness. This suggests that these schools consistently achieve favorable results in project-based teaching over the years. However, considering the independence of teachers, syllabus and teaching development, teaching skills and modes, there may be external factors that influence the implementation of project-based teaching activities. As project-based teaching is an ongoing attempt, it inevitably involves sharing and exchange of teaching experiences, gradually improving external conditions. As teachers' gain more teaching experience and other factors gradually improve over time, the teaching effectiveness tend to show an increasing trend year by year. It is crucial for teachers to engage in continuous reflection, summary, and communication. Only by deepening and rationalizing their understanding and participation in experiential teaching, teachers can ensure continuous improvement of teaching effectiveness. Therefore, in future research, it is important to further accumulate relevant teaching data from colleges and universities and expand the time range of the research object.

6 CONCLUSIONS

Higher engineering education holds significant importance within the realm of higher education. It cultivates higher engineering talents with more active learning abilities, independence, and individuality, ultimately transforming them into the central figures of their own educational journey. PBL, as a modern way of learning, focuses on students' participation, respects their dominant position, focuses on cultivating their core abilities, and enhances their enthusiasm for learning. Such a teaching method is quite in line with requirements of new curriculum reform of Chinese colleges and universities, which advocate for innovative teaching methods. This study takes 120 students who are pursuing a major in computer science and technology across four universities in Hainan Province. The primary objective is to assess the learning efficiency of these 120 students using the SBM-DEA model. This study draws two main conclusions. Firstly, only 20% of the 120 students achieved a learning efficiency of 1, which indicates that although project-based teaching is adopted by students in surveyed schools, their learning efficiency has not been comprehensively improved. Therefore, it is necessary to pay more attention to the influence of other non-teaching process factors such as school learning atmosphere and learning reward mechanism on teaching quality. Secondly, the study identifies project-based teaching aids and insufficient investment in project-based teaching experience as the two primary factors leading to low teaching quality. It is suggested that further research should be carried out

in the aspects such as defining teacher competence standards for project-based teaching, how cohesion degree of project-based teaching process influence students' learning motivation, systematization of more scientific evaluation indicators, and objectification of statistical data.

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