Education Science and Management
https://www.acadlore.com/journals/ESM

Research on the Training Mode of Innovative and Practical High-End Talents Based on the OBE Concept

Zheng Sun*, Hao Xu

School of Management and Engineering, Capital University of Economics and Business, 100070 Beijing, China

* Correspondence: Zheng Sun (32021210103@cueb.edu.cn)

Received: 02-28-2024 **Revised:** 04-30-2024 **Accepted:** 05-05-2024

Citation: Sun, Z. & Xu, H. (2024). Research on the training mode of innovative and practical high-end talents based on the OBE concept. *Educ. Sci. Manag.*, *2*(2), 61-78. https://doi.org/10.56578/esm020201.

Abstract: The rapid advancement of the internet industry and the emergence of intelligent production models necessitate a transformative approach to talent cultivation in global universities. The Outcomes-Based Education (OBE) model demonstrates distinct advantages and adaptability within this evolving landscape. By defining explicit learning outcomes, incorporating flexible curriculum designs, emphasizing practical skills, adopting a philosophy of continuous improvement, implementing multi-dimensional evaluation mechanisms, and employing student-centered teaching methods, OBE establishes a robust theoretical framework and practical methodology for developing high-quality artificial intelligence (AI) talents suited to the demands of the new era. This study, centered on graduate students at the Capital University of Economics and Business, proposes three strategic dimensions for curriculum reform grounded in the OBE concept: the objectives of curriculum reform, innovative teaching models, and the implementation of the curriculum. The investigation highlights the significance of value cultivation in discipline construction, the establishment of a diversified talent training system, and the optimization of a scientifically integrated teaching framework. This research offers valuable insights, ranging from policy recommendations to practical applications, aimed at advancing the high-quality development of computer science disciplines in a contemporary context.

Keywords: Graduate students; Outcomes-based education concept; Talent training; Artificial intelligence

1. Introduction

In the context of rapid technological advancements and socioeconomic digital transformation, the global higher education system faces unprecedented challenges. There is an urgent need to shift from traditional curriculum-oriented education models to more flexible and open teaching philosophies. This necessity arises because traditional education models, while emphasizing the systematic and comprehensive nature of academic knowledge, often fail to adequately connect with societal, industry developments, and the diverse skills demanded by the workforce. OBE, as a forward-thinking pedagogical concept, shifts the focus from knowledge transmission to outcome orientation. It emphasizes cultivating innovative talents with independent thinking and creative capabilities, practical talents with solid hands-on skills, and high-end professionals with advanced expertise in specific fields. By clearly defining learning outcomes and aligning them with the knowledge, technical skills, and competencies required by society, OBE ensures that students understand what they need to learn and do, and the abilities they should possess before entering the workforce (Su et al., 2024). Therefore, the multi-level hybrid teaching model based on OBE fully meets the talent cultivation requirements of university curricula, aligns with the development direction of curriculum innovation, and holds significant theoretical and practical implications.

This study focuses on addressing the challenges of cultivating innovative and practical talents in higher education by exploring the reform of graduate curriculum systems based on OBE and providing corresponding implementation suggestions. The main questions of this study include: What are the current problems in the graduate curriculum system? How can innovative and practical high-end talents be cultivated in the context of AI, and how should the graduate curriculum system be reformed? How to construct a multidimensional course evaluation system based on the OBE concept? Through an in-depth discussion of these issues, the study aims to

reconstruct the existing curriculum system structure, optimize the setting of theoretical and practical courses, and thereby promote the process of cultivating innovative and practical high-end talents suited to the era of AI.

2. Related Research

2.1 Definition of Core Concepts

2.1.1 OBE

OBE, also known as outcome-oriented or goal-oriented education (Wang, 2024), is an educational concept proposed by American scholar W.G. Spady in his book *Outcome-Based Instructional Management: A Sociological Perspective*. According to him, "OBE means clearly focusing and organizing everything in the educational system around what all students are expected to successfully accomplish at the end of their learning experiences." OBE is an educational philosophy that directs the restructuring, implementation, and evaluation of teaching content based on anticipated outcome goals. This implies that teachers need to clearly understand what is important for students before organizing (Zhu, 2024), implementing, and assessing instruction, ensuring that such learning ultimately takes place. It is about designing the teaching process backward from the learning outcomes.

2.1.2 Multi-level blended teaching model

The construction of a multi-level blended teaching model has been guided by the course's teaching objectives and content, adopting appropriate teaching methods for "theoretical teaching, academic discussion, and project practice", as shown in Figure 1.

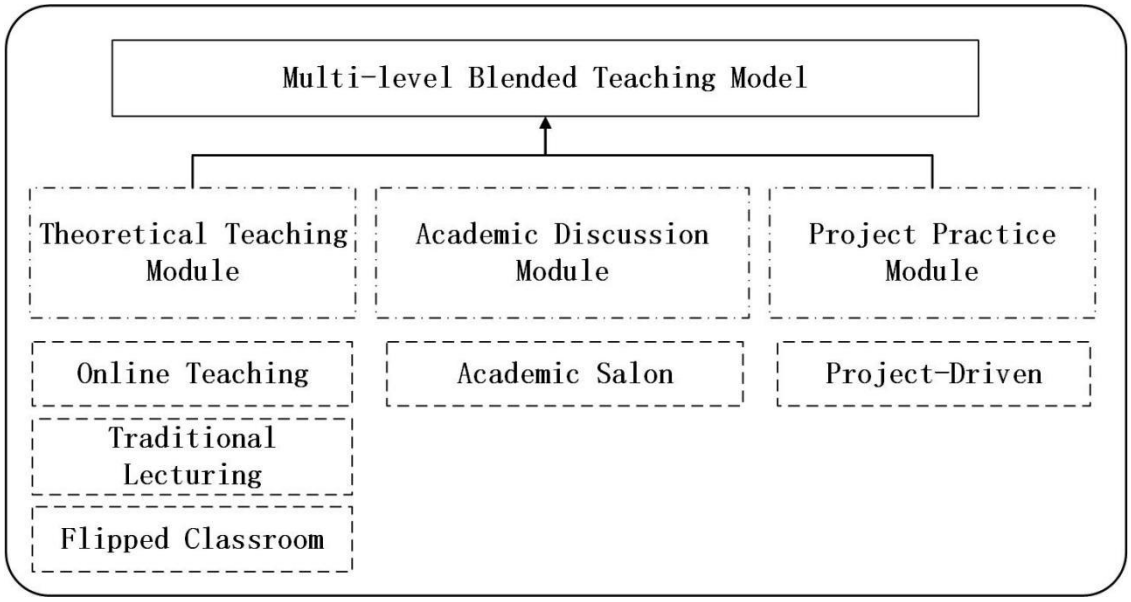

Figure 1. Diagram of the multi-level blended teaching model

In graduate courses, a combination of various teaching methods has been employed in the post-pandemic era to address the characteristics of the theoretical teaching module, including online teaching, traditional lecturing (Ding & Gai, 2024), and flipped classrooms. This approach retains the traditional face-to-face teaching mode while incorporating elements of flipped classrooms, thereby maximizing teaching effectiveness. The application of flipped classrooms on the foundation of traditional lectures enables students to better understand and apply the learned content, thus better meeting the actual needs of current graduate course teaching.

In the academic discussion module, academic salons are organized using a seminar-style teaching method, focusing on academic frontiers and AI technologies. This helps students develop skills in literature reading, summarization, and the ability to propose and analyze problems. For the project practice module, a project-driven teaching method is adopted, centered on students and guided by projects, with the teacher as the facilitator. This aims to cultivate students' abilities to solve real-world problems.

2.1.3 Teaching evaluation mechanism

The teaching evaluation mechanism refers to a series of systematic and continuous assessment methods and measures used to evaluate the teaching process and its outcomes. Its primary goal is to assess the effectiveness and quality of teaching activities, provide feedback, improve teaching practices, and enhance student learning

outcomes. The mechanism for evaluating teaching encompasses setting standards for assessment, choosing appropriate evaluation instruments, gathering and interpreting data, and offering feedback along with suggestions for enhancement. This mechanism not only considers students' academic results but also evaluates teachers' instructional approaches, course structure, and the use of educational materials in a holistic manner. Applying this evaluation system aids in elevating teaching standards and fulfilling educational objectives.

2.2 Research Progress

The OBE model first emerged from educational reforms in the foundational education systems of the United States and Australia. From the 1980s to the early 1990s, OBE was a highly popular term in American education. American scholar W.D. Spady conducted in-depth research on this model in his book *OBE: Critical Issues and Answers* (Burton et al., 2017). Spady defined OBE as an educational model that clearly focuses and organizes teaching activities around the key outcomes that all students are expected to achieve by the end of a learning phase. This means that before educational activities begin, there is a clear vision of the learning outcomes students should attain, and then courses are designed, teaching is organized, and evaluations are conducted to ensure these outcomes are achieved. The book defines OBE as "clearly focusing and organizing everything in an educational system (Looi et al., 2013) around what is essential for all students to be able to do successfully at the end of their learning experiences" (van der Vorst & Jelicic, 2019). He believes OBE represents a paradigm shift in education because, within the OBE framework, what students learn and their success are far more important than how and when they learn.

In 2001, the Accreditation Board for Engineering and Technology (ABET) in the United States released the new EC2000 engineering standards, specifying eight dimensions that engineering programs must meet: students, program educational objectives, student outcomes, continuous improvement, curriculum, faculty, facilities, and institutional support. This marked a shift from minimum-standard quality assurance to continuous quality improvement (Chen & Lv, 2017). In 2016, China became a formal member of the Washington Accord, and the concepts of student-centeredness, outcome orientation, and continuous improvement became important principles influencing the development and reform of Chinese higher education alongside the development of engineering program accreditation. The proposal and rapid global development of OBE are primarily due to its alignment with the macro-social transition from an industrialized to an information society. In 2010, Spady and others expanded OBE to the field of lifelong learning, creating a future educational model called Empowered Learning Communities (ELGs), which focuses on five learning outcomes: personal well-being, innovative and entrepreneurial abilities, communication and teamwork skills, vocational skills, and environmental sustainability. In 2012, the European Commission proposed a "rethinking education" strategy, urging its member states to focus on student learning outcomes, the knowledge, skills, and abilities students gain, and ensuring young people acquire the skills needed in the labor market.

In recent years, an increasing number of university teachers have applied OBE concepts to course teaching reforms. Li (2014) conducted an in-depth study and thorough analysis of OBE concepts. Zhao & Cui (2015) successfully applied OBE concepts in the teaching reform of the *Applied Stochastic Processes* course. Na Jiao's team (Jiao & Zheng, 2019). conducted teaching and research reforms guided by OBE concepts for graduate courses in finance, enhancing the quality of graduate education in finance. Luo & Huang (2019). explored teaching reforms for graduate courses in software engineering based on OBE concepts, improving the comprehensive abilities of software engineering graduate students. Wu et al. (2019) researched the teaching content and methods of the Web Front-End Development Technology course based on OBE concepts. Jin (2020) clarified the teaching objectives of the foundational programming course based on OBE concepts and reformed the teaching content, improving students' problem-solving abilities. Liu et al. (2019) also explored teaching reform ideas for computer systems courses guided by OBE concepts in the context of the new engineering disciplines, enhancing teaching effectiveness.

In this study, OBE was used as a keyword to search in China National Knowledge Infrastructure (CNKI), focusing on areas such as higher education, talent cultivation, and vocational education. From these, 478 articles were selected, and VOSVIEWER was used for literature analysis. The resulting keyword thematic map is shown in Figure 2. It is clear that current research mainly focuses on the foundational concepts of OBE, its applicable fields, and course design content. However, there is no systematic teaching framework for teaching models, evaluation systems, curriculum systems (Xu et al., 2024), or specific practices for course implementation. This indicates that the OBE teaching model is still in the exploratory stage. Figure 3 shows a research heatmap with OBE as the keyword.

Although OBE has made some progress in course teaching reforms (Hu, 2023), there are still shortcomings in the context of "AI + digitalization". Current research often focuses on specific applications of OBE but lacks a systematic teaching framework. Additionally, the implementation of course reforms still face issues such as insufficient awareness of course construction, incomplete systems, and inadequate results, which fall short of the high-level, innovative, and challenging goals of course construction. This study aims to explore a new talent

development model based on OBE through empirical analysis to construct a more comprehensive curriculum reform framework and curriculum evaluation system framework, with the goal of providing references for teaching reform and talent development in more higher education institutions.

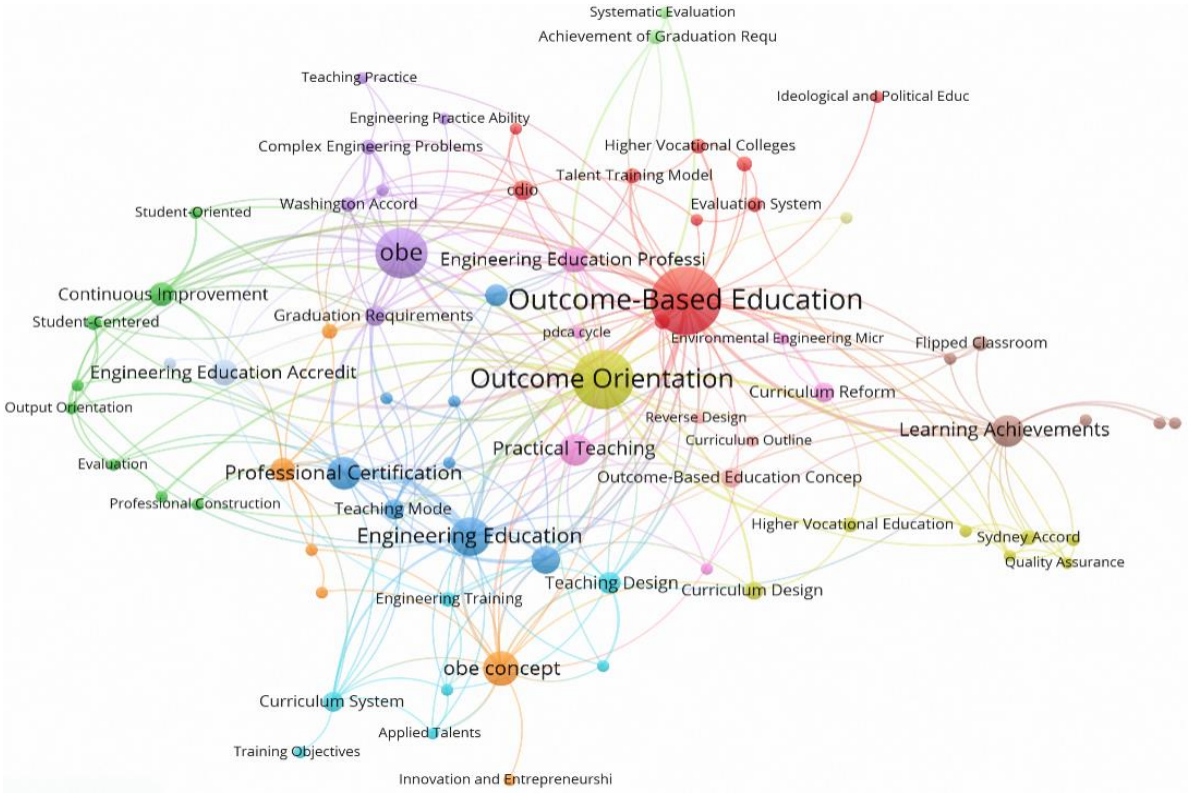

Figure 2. Research map with OBE as the keyword

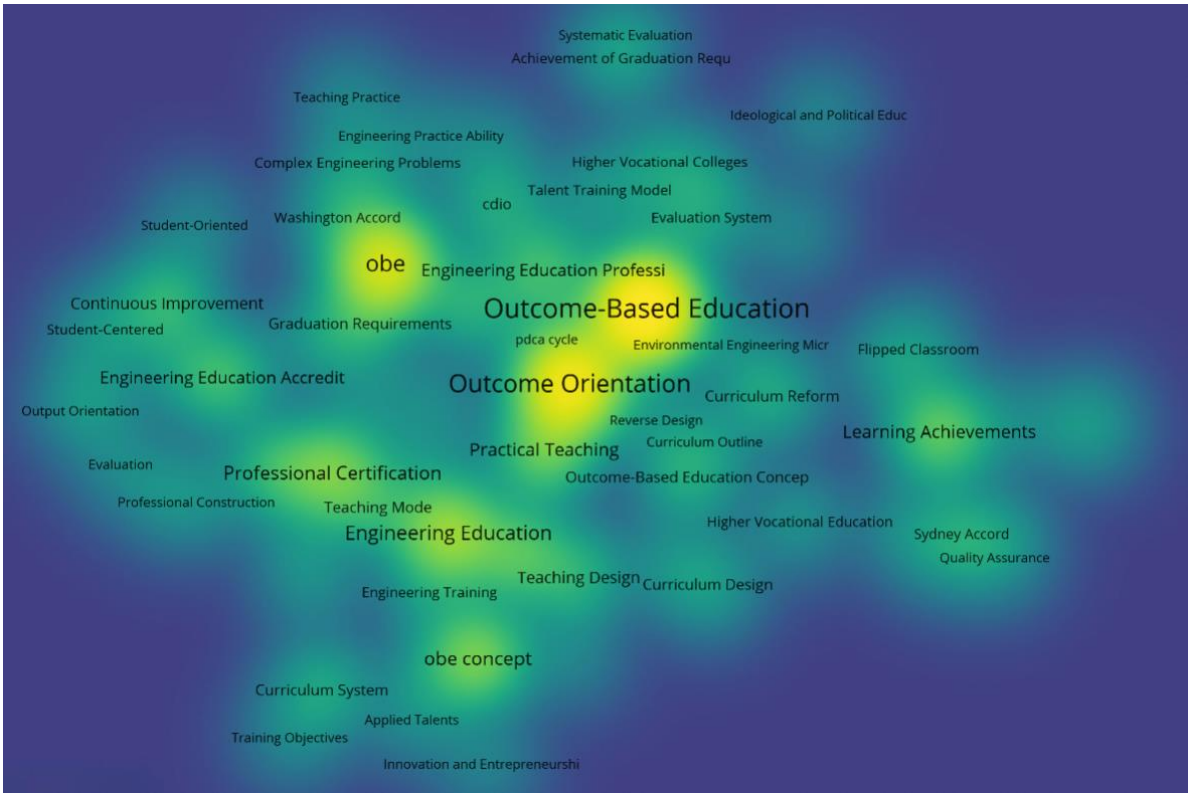

Figure 3. Research heatmap with OBE as the keyword

3. Design of Research Tools

3.1 Questionnaire Design

The questionnaire consists of two parts. The first part, which includes questions 1-5, gathers basic information about the respondents. This section covers gender, grade, birthplace, major, and willingness to pursue a doctoral degree. It aims to understand the basic demographics of the respondents to analyze the impact of personal background on course learning outcomes following curriculum reform.

The second part of the questionnaire is based on the curriculum reform framework proposed in this study, grounded in the OBE concept and the multi-level blended teaching model. It incorporates the effective teaching evaluation framework for flipped classrooms by Chunmei Yang and Xian Zhang to establish relevant indicator points and set up questionnaire questions around these indicators. Four primary indicators were established:

(a) Course evaluation: This measures students' overall satisfaction with the course content and structure, including four secondary indicators: professional training goals, course competency development, course challenge, and course advancement.

(b) Course learning situation: This evaluates students' learning effectiveness in the course, including theoretical knowledge acquisition and practical application ability, with three secondary indicators: pre-class learning ability, classroom participation ability, and classroom interaction ability.

(c) Teaching resources: This indicator assesses the effectiveness and availability of teaching resources, including textbooks, online platforms, and other learning materials, with four secondary indicators: academic resource allocation, classroom feedback, teaching resource quality, and learning platform quality.

(d) Learning outcomes and feedback: This indicator measures students' achievements and the feedback received in the course, as well as the impact of this feedback on the learning process, with two secondary indicators: personal research literacy and course feedback.

This section uses a Likert five-point scale, where one to five represent "strongly disagree", "disagree", "neutral", "agree", and "strongly agree", respectively. This scale is widely used in educational research and facilitates the calculation of indicator coefficients. To ensure the scientific validity and reliability of the questionnaire, the design process incorporated existing general educational field scales and adjusted them based on the specific OBE concept. A small-scale pre-survey was conducted, and the questionnaire was modified according to feedback to ensure its quality and reliability.

4. Design and Reliability Analysis of Research Tools

A questionnaire was distributed to undergraduates at Capital University of Economics and Business through the Wenjuanxing platform in an online format. A total of 124 questionnaires were collected, with 111 valid responses, yielding an effective response rate of 89.5%. SPSS was used to conduct reliability and validity analyses. The statistical data for the basic information are shown in Table 1, where the proportion distribution of science and engineering students and management students is relatively high, corresponding with the actual situation of the university. Figure 4 shows a pie chart of basic survey statistics.

Table 1. Basic statistics of the survey questionnaire

Variable	Characteristics	Frequency	Percentage
Gender	Male	47	42.34%
	Female	64	57.66%
Grade	First year	52	46.85%
	Second year	22	19.82%
	Third year	16	14.41%
	Graduated	21	18.92%
Birthplace	Local	28	25.23%
	Non-local	83	74.77%
Major type	Science and Engineering	47	42.34%
	Economics	21	18.92%
	Management	43	38.74%
PhD willingness	Yes	14	12.61%
	No	97	87.39%

4.1 Reliability Analysis

Reliability refers to the degree of consistency of the results obtained from repeated measurements of the same subject under identical conditions. In other words, reliability indicates the dependability of the measurement data. A commonly used indicator for measuring reliability is Cronbach's alpha (α) coefficient. Generally, a Cronbach's

α coefficient above 0.7 indicates acceptable reliability of the questionnaire, while a coefficient above 0.8 signifies very high reliability and stability of the questionnaire. Table 2 shows the confidence statistics.

Table 2. Confidence statistics

	Cronbach's α Coefficient	Number of Items
Current status	0.983	29

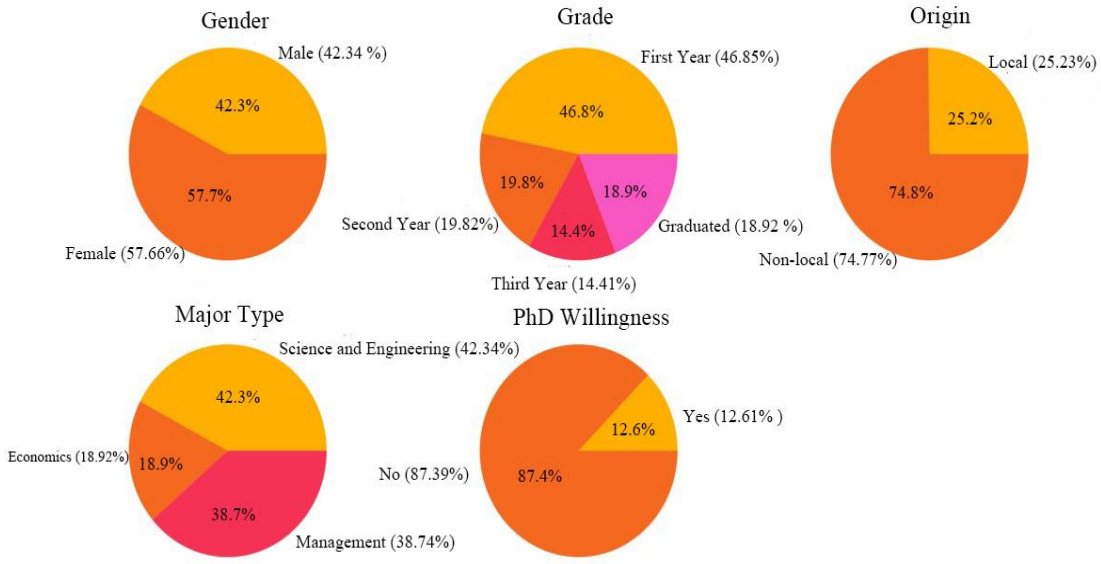

Figure 4. Pie chart of basic survey statistics

4.2 Validity Analysis

Validity refers to the degree to which an instrument accurately measures what it is intended to measure. This questionnaire was adapted from rigorous and widely used research findings, ensuring good content validity. For the analysis of construct validity, factor analysis was employed to extract common factors from the set of variables and to observe the relationships among variables, thereby testing the validity of the structure.

The closer the Kaiser-Meyer-Olkin (KMO) value is to 1, the more suitable the data is for factor analysis. As shown in Table 3, the KMO value for the questionnaire section is greater than 0.8, making it suitable for factor analysis.

Table 3. KMO and Bartlett's test

	Current Status
KMO value	0.940
Bartlett's sphericity value	3951.391
Degrees of freedom (df)	406
p-value	0.000

The first dimension is course evaluation, which includes a total of nine items from *a1* to *a9*. Each item underwent factor analysis, calculating both the factor loadings and communalities. The results showed that all values were greater than 0.4, indicating that the data is valid and that no items needed to be deleted or modified. Following the same method, factor analysis was conducted on the other three dimensions, resulting in the findings presented in Table 4.

A KMO value close to 1 indicates that the data is highly suitable for factor analysis. All indicators have factor loadings greater than 0.4, demonstrating a strong association with their respective factors. Additionally, most indicators have communalities ranging from 0.587 to 0.839, indicating that most of the variance can be explained by their respective factors, thereby validating the high reliability of measurements across dimensions. Overall, the factor analysis shows that most indicators perform well within their respective dimensions and successfully load onto their corresponding factors. Each dimension's KMO value is favorable, further validating the suitability of this method. Moreover, the high Bartlett's test values for most dimensions further support the effectiveness of the factor analysis.

Table 4. Factor analysis for each dimension

Dimension	Question	Factor Loading Coefficient	Communality	KMO Value	Bartlett's Sphericity Value	p-Value
Course evaluation	*a1*	0.916	0.751	0.943	1140.967	0.000
	a2	0.903	0.799			
	a3	0.894	0.723			
	a4	0.884	0.782			
	a5	0.882	0.815			
	a6	0.872	0.839			
	a7	0.886	0.778			
	a8	0.857	0.735			
	a9	0.850	0.760			
Course learning outcomes	*a10*	0.914	0.746	0.863	735.933	0.000
	a11	0.903	0.815			
	a12	0.900	0.587			
	a13	0.864	0.706			
	a14	0.864	0.746			
	a15	0.840	0.835			
	a16	0.766	0.810			
Teaching resources	*a17*	0.892	0.640	0.888	873.845	0.146
	a18	0.887	0.651			
	a19	0.878	0.732			
	a20	0.874	0.764			
	a21	0.859	0.770			
	a22	0.855	0.795			
	a23	0.807	0.787			
Learning outcomes and feedback	*a24*	0.800	0.738	0.872	373.704	0.000
	a25	0.919	0.715			
	a26	0.913	0.626			
	a27	0.845	0.844			
	a28	0.795	0.834			
	a29	0.791	0.632			

5. Application and Effect Analysis of Teaching Models Based on the OBE Concept

5.1 Overall Status Analysis

To understand the current application and effectiveness of the teaching model based on the OBE concept, the second part of the questionnaire investigates four dimensions: course evaluation, course learning situation, teaching resources, and learning outcomes and feedback. The results indicate that the average scores for each dimension are above 3, suggesting overall good performance. The statistical analysis of these results is shown in Table 5.

Table 5. Summary statistics for each dimension

Dimension	N	Minimum	Maximum	Mean	Standard Deviation
Course evaluation	111	1	5	4.2262	0.7690
Course learning situation	111	1	5	4.2741	0.7929
Teaching resources	111	1	5	4.1835	0.8254
Learning outcomes and feedback	111	1	5	4.0702	0.8167

Table 5 presents the score statistics for each dimension in the application of the OBE-based graduate teaching model. The four dimensions use a Likert five-point scale, with a midpoint of 3. This setup allows the scale to better differentiate between different levels of performance when measuring each dimension. Specifically, a midpoint score of 3 represents a relatively neutral or average level, while scores above 3 indicate higher levels of performance, and scores below 3 reflect lower levels.

Figure 5 shows a radar chart of the overall situation. Data feedback from the course evaluation dimension indicates that most students find the course objectives and requirements clear, and they are able to acquire new knowledge and skills. The data on the course learning situation dimension shows that students generally feel they can meet the course requirements and achieve results in learning activities, but the scores fluctuate greatly, possibly due to individual differences and varying learning styles among students. The mean score for the teaching resources dimension is 4.1835, indicating student satisfaction with teaching resources (Prodanova & Kocarev, 2023); however, the large standard deviation suggests room for improvement in resource diversity and accessibility.

The learning outcomes and feedback dimension shows lower student satisfaction with course feedback and grading, indicating a need to improve feedback mechanisms and evaluation systems. Overall, students' satisfaction with the OBE-based teaching model across different dimensions is high, reflecting the positive effects of this teaching model. However, the standard deviations in the data reveal significant individual differences in each dimension, necessitating educators' attention and the provision of personalized teaching support.

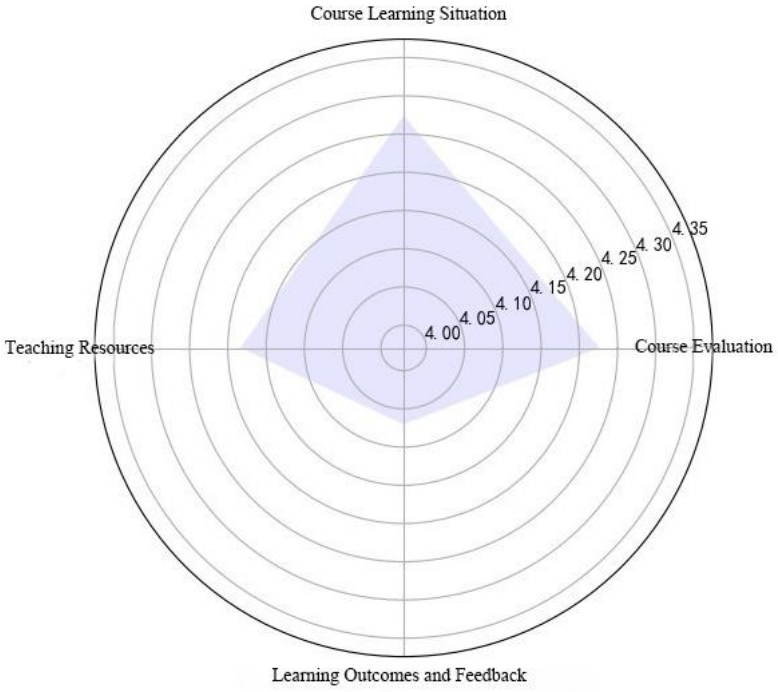

Figure 5. Radar chart of the overall situation

5.2 Analysis of Current Status by Dimension

5.2.1 Current status analysis of course evaluation

According to the statistical results of the course evaluation dimension, the average scores for all items are above 4.2. This indicates that students generally believe the course objectives and requirements are clear, and they are exposed to diverse knowledge points in their learning, reflecting high teaching quality and effectively promoting student ability enhancement. However, there are variations in students' experiences, particularly in terms of acquiring new knowledge and the level of challenge, suggesting that some students may have personalized needs in the course. This data suggests that educators should pay attention to individual differences in student experiences to further optimize teaching strategies. The course evaluation dimension consists of nine questions, and the statistical results are shown in Table 6.

According to the data mentioned above, all item averages are above 4.2, indicating that students generally believe the course objectives and requirements are clear and that they can engage with diverse knowledge points in their learning, as reflected in the high averages. However, the high standard deviation indicates a certain degree of divergence in students' course experiences, particularly in acquiring new knowledge and the level of challenge, suggesting that some students may have greater needs in terms of course depth and difficulty. The data reflect high teaching quality and effectively promote student ability enhancement while also suggesting that educators should pay attention to individual differences in student experiences to further optimize teaching strategies.

On this basis, the secondary indicator of professional training goals consists of items *a1* to *a5*, course ability training consists of items *a6* and *a7*, and course challenge and course frontiers correspond to items *a7* and *a8*, respectively. The average scores for each secondary indicator are shown in Figure 6.

The mean score for professional training objectives is 4.216, indicating clear course objectives, the provision of diverse knowledge, and the cultivation of professional skills and broad knowledge. The mean score for course ability training is 4.261, indicating that the course performs better in improving problem analysis and solving skills, as well as cooperation skills. The mean score for course challenge is 4.225, showing that students find the course challenging but slightly lower than other dimensions, suggesting a need to increase course difficulty and depth. The mean score for course frontier is 4.207, the lowest among the four dimensions, indicating that students have reservations about the course content keeping up with the forefront of the discipline, and suggesting a need to enhance content updates and integration with the latest research.

Table 6. Basic information on the course evaluation dimension

Title	N	Minimum	Maximum	Mean	Standard Deviation
a1 Clearly understand the objectives and requirements of each course.	111	1	5	4.2162	0.6796
a2 The courses provide opportunities to acquire new knowledge and ideas on different topics.	111	1	5	4.1891	0.8147
a3 The internships and practical courses in the major have clear objectives and requirements.	111	1	5	4.2252	0.7825
a4 The courses contribute to the development of professional skills and business ethics.	111	1	5	4.2072	0.7641
a5 The course design covers a broad range of professional knowledge.	111	1	5	4.2432	0.7533
a6 The courses improve your ability to understand and analyze problems.	111	1	5	4.2522	0.8142
a7 The courses enhance your ability to collaborate with other students.	111	1	5	4.2702	0.7501
a8 The courses present certain challenges (e.g., innovation, pioneering, or critical thinking).	111	1	5	4.2252	0.7825
a9 The course content incorporates the latest research or advancements in the field.	111	1	5	4.2072	0.7990
Mean	111	1	5	4.2261	0.7711

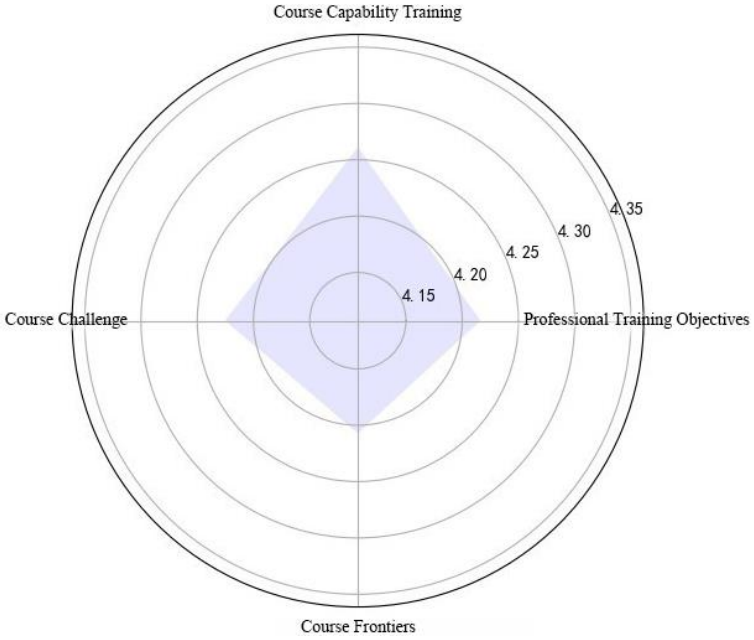

Figure 6. Radar chart of secondary indicators in the course evaluation dimension

5.2.2 Current status analysis of the course learning situation

In the dimension of the course learning situation, there are seven questions covering three secondary indicators: pre-class learning ability, classroom participation ability, and classroom interaction ability. Overall, students' evaluations of course learning conditions reflect the course's effectiveness in supporting autonomous learning and stimulating classroom participation. Students generally believe that the course has achieved positive outcomes in promoting learning autonomy and interactivity. However, they also pointed out areas where course design and teaching methods need further improvement. The statistical results are shown in Table 7.

The data shows high ratings from students in terms of independently completing learning tasks, adapting to pre-class preparation (Feroz Khan & Samad, 2024), and classroom interaction. Specifically, the average score for students independently watching learning videos, reading literature, or completing relevant pre-class tasks is 4.3603, indicating strong autonomous learning abilities. High scores in adapting to pre-class learning tasks and posing challenging questions also suggest their robust ability to cope with learning challenges.

The secondary indicator of pre-class learning ability consists of items *a10* to *a12*; classroom participation ability consists of items *a13* and *a14*; and classroom interaction ability consists of items *a15* and *a16*. The mean scores for each secondary indicator are shown in Figure 7.

Table 7. Basic information on the course learning situation dimension

Title	N	Minimum	Maximum	Mean	Standard Deviation
a10 Able to independently and completely watch learning videos, read literature, or complete relevant pre-class learning tasks.	111	1	5	4.3603	0.6848
a11 Able to adapt to pre-class learning tasks, gaining substantial benefits from pre-class learning.	111	1	5	4.1711	0.8298
a12 Able to raise difficult questions from pre-class learning and bring these questions to class.	111	1	5	4.1081	0.8458
a13 Able to actively participate in group discussions, classroom presentations, and peer teaching activities.	111	1	5	4.2612	0.8169
a14 Able to complete classroom assignments, projects, or presentations with other classmates.	111	1	5	4.3333	0.8015
a15 Effective student-teacher or student-student interactions, yielding fruitful outcomes.	111	1	5	4.3153	0.7975
a16 The classroom atmosphere is lively, democratic, and harmonious.	111	1	5	4.3693	0.7498
Mean	111	1	5	4.2741	0.7894

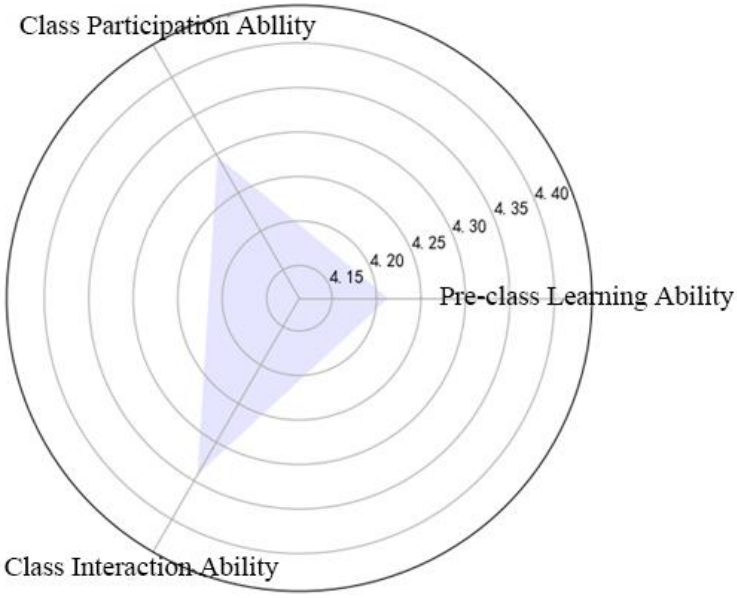

Figure 7. Radar chart of secondary indicators in the course learning situation dimension

In terms of classroom participation ability, students actively engage in group discussions, classroom presentations, and peer teaching activities, with an average score of 4.2612, indicating strong collaborative skills and willingness to interact. The score for completing classroom assignments, projects, or lectures with peers is 4.3333, demonstrating robust cooperative learning capabilities. High scores in classroom interaction ability reflect effective student-teacher and student-student interactions, contributing to a lively, democratic, and harmonious classroom atmosphere, which further enhances learning outcomes.

Overall, students exhibit outstanding performance in autonomous learning, classroom participation, and interaction abilities, providing strong support for creating a positive learning environment and promoting knowledge exchange. These performances not only improve classroom efficiency but also help students more comprehensively grasp and apply the knowledge they have learned.

5.2.3 Current status analysis of teaching resources

In the dimension of teaching resources, students express relative satisfaction with the opportunities to participate in academic activities and access resources, reflecting generally good resource allocation. However, students show lower satisfaction with opportunities to participate in academic competitions and exchange activities, as well as with receiving guidance from industry experts. The high standard deviation in these aspects indicates a wide variation in student experiences, revealing a potential need for improved academic resource distribution and enhanced opportunities for practical industry guidance. The statistical results of the eight questions in this dimension are shown in Table 8.

Table 8. Basic information on the teaching resources dimension

Title	N	Minimum	Maximum	Mean	Standard Deviation
a17 Opportunities to participate in various academic, professional, entrepreneurial, or design competitions.	111	1	5	4.1171	0.9019
a18 Opportunities to participate in various academic exchange activities.	111	1	5	4.0900	0.8999
a19 Opportunities to receive guidance from alumni and industry experts.	111	1	5	4.0360	0.8936
a20 Feedback on opinions regarding courses and teaching is provided in a timely manner.	111	1	5	4.2252	0.7825
a21 Course materials, teaching videos, or other course resources use clear language to explain abstract subjects.	111	1	5	4.2702	0.7739
a22 Course materials, teaching videos, or other course resources are engaging and inspire students' passion for learning.	111	1	5	4.2252	0.8054
a23 The learning platform facilitates teacher-student and student-student interactions.	111	1	5	4.2882	0.7673
a24 The learning platform offers a wealth of video or literature resources.	111	1	5	4.2162	0.7556
Mean	111	1	5	4.1835	0.8225

The data shows a mean score above 4.0, indicating that students are generally satisfied with the teaching resources, particularly in terms of courseware quality, instructional videos, and the interactivity of the learning platform. However, the relatively low scores for opportunities to participate in academic competitions and to receive guidance from industry experts suggest areas that need improvement.

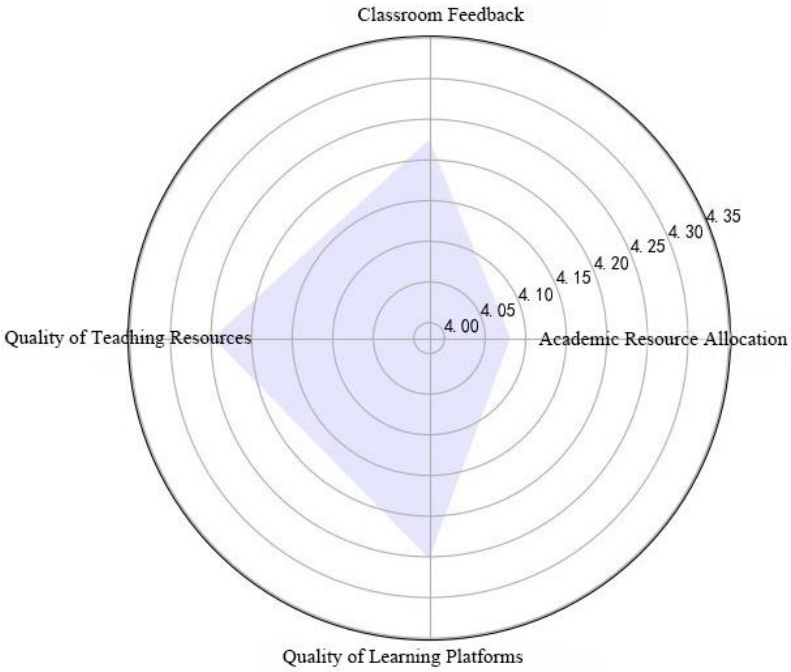

Figure 8. Radar chart of secondary indicators in the teaching resources dimension

Figure 8 shows a radar chart of secondary indicators in the teaching resources dimension. In the dimension of teaching resources, the average score for academic resource allocation is 4.081, indicating relative satisfaction among students regarding participation in academic competitions and exchange activities. However, it also suggests that some students may face obstacles such as limited resources or unequal opportunities. The average

scores for the quality of teaching resources (Clark & Kaw, 2020) and the learning platform are approximately 4.25, reflecting students' satisfaction with the course materials, instructional videos, and the interactivity and diversity of resources on the learning platform. Despite the overall high satisfaction, the lowest score in academic resource allocation highlights the need to better provide students with opportunities to engage in academic activities.

5.2.4 Current status analysis of learning outcomes and feedback

In the dimension of learning outcomes and feedback, the results indicate that the course has achieved certain success in promoting the practical application of knowledge and stimulating research interest. Additionally, the course performs well in providing timely feedback and evaluation. Overall, students' satisfaction with the course's learning outcomes and feedback is high, though there is room for improvement in fostering research interest and enhancing the ability to apply knowledge. The statistical results for the five questions in this dimension are shown in Table 9.

Table 9. Basic information on the learning outcomes and feedback dimension

Title	N	Minimum	Maximum	Mean	Standard Deviation
a25 I can flexibly apply professional knowledge to my daily life.	111	1	5	3.9729	0.8682
a26 I am very interested in scientific research.	111	1	5	3.9549	0.8462
a27 Feedback and evaluation are regularly integrated into classroom and pre-class learning activities.	111	1	5	4.0270	0.8029
a28 Timely feedback and evaluation are provided after relevant learning activities.	111	1	5	4.0720	0.8057
a29 Course performance assessment focuses on students' authentic task performance (e.g., presentations, project reports, experimental design, and operations).	111	1	5	4.3243	0.7155
Mean	111	1	5	4.0702	0.8077

In the dimension of learning outcomes and feedback, the average score above 3.95 reflects the course's significant success in promoting the practical application of knowledge and stimulating research interest. The feedback scores are around 4.0, indicating that the course effectively responds to students' needs, providing valuable feedback to help students better understand and improve their learning methods. The highest scores were given to the course's focus on authentic task performance in grading, showing that most students highly recognize this aspect. This highlights the positive role of practical assessments in enhancing students' hands-on skills and innovation capabilities.

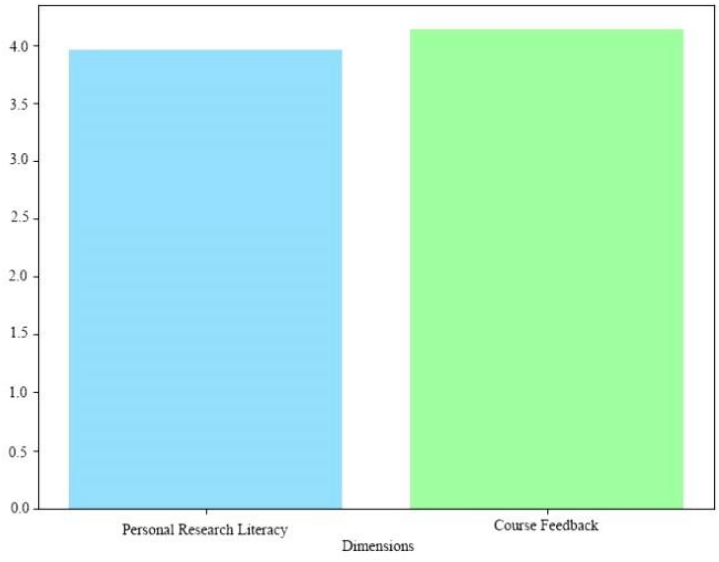

Figure 9. Bar chart of the learning outcomes and feedback dimension

Figure 9 shows a bar chart of the learning outcomes and feedback dimension. Within the learning outcomes and feedback dimension, students' self-assessed scores for personal research literacy average 3.964, reflecting their confidence and interest in applying knowledge to practice and research work. The course feedback scores are higher, averaging 4.141, indicating that students believe the course excels in providing timely feedback and

evaluation, especially in post-learning activity feedback and grading. Although the course has been effective in fostering research interest and practical application skills, students place greater importance on timely and targeted feedback, which has a significant impact on their learning process and outcomes.

5.3 Application and Effectiveness Analysis of Teaching Models Under Different Backgrounds

To further investigate the differences in the application and effectiveness of teaching models among graduate students under various background conditions, this section analyzes and summarizes the impact of factors such as birthplace, type of major, and willingness to pursue a doctoral degree as independent variables on the application and outcomes of teaching models.

5.3.1 Analysis of differences in teaching effectiveness by birthplace

To analyze the differences in teaching effectiveness among graduate students with different birthplaces (Javornik & Klemenčič Mirazchiyski, 2023), birthplace was used as the independent variable. Preliminary analysis of the data reveals minimal differences in teaching effectiveness between local and non-local students. The mean scores in course evaluation, course learning situation, teaching resources, and learning outcomes and feedback are similar for both groups. The results are shown in Table 10.

Table 10. Statistics of teaching effectiveness differences by birthplace

Dimension	Birthplace	N	Mean
Course evaluation	Local	28	4.1944
	Non-local	83	4.2369
Course learning situation	Local	28	4.2091
	Non-local	83	4.2960
Teaching resources	Local	28	4.1785
	Non-local	83	4.1852
Learning outcomes and feedback	Local	28	4.0642
	Non-local	83	4.0722

Further analysis indicates that while non-local students have slightly higher mean scores in the course learning situation and course evaluation dimensions compared to local students, the differences are negligible, with scores of 4.2960 versus 4.2091 and 4.2369 versus 4.1944, respectively. The difference in mean scores for teaching resources is the smallest, suggesting that birthplace has an insignificant impact on satisfaction with teaching resources. In terms of learning outcomes and feedback, the scores for both groups are close (Centoni & Maruotti, 2021), indicating no significant difference in students' perceptions of learning outcomes and feedback. Therefore, birthplace is not a major factor influencing the teaching effectiveness of graduate students. When formulating teaching strategies, institutions should focus on other potential influencing factors, such as course content design and teaching methods.

5.3.2 Analysis of differences in teaching effectiveness by field of study

Using major type as the independent variable, the differences in teaching effectiveness among graduate students were analyzed. The results show significant differences in teaching effectiveness across different major types. Students majoring in Economics and Science and Engineering have higher scores in course evaluation, course learning situation, teaching resources, and learning outcomes and feedback compared to students majoring in management. The results are shown in Table 11.

Table 11. Differences in teaching effectiveness by field of study

Dimension	Field of Study	N	Mean
Course evaluation	Management	43	4.0180
	Economics	21	4.3756
	Science and Engineering	47	4.3498
Course learning situation	Management	43	4.1096
	Economics	21	4.4013
	Science and Engineering	47	4.3677
Teaching resources	Management	43	4.0203
	Economics	21	4.2380
	Science and Engineering	47	4.3085
Learning outcomes and feedback	Management	43	3.9023
	Economics	21	4.0666
	Science and Engineering	47	4.2255

By analyzing the impact of different major types on the teaching effectiveness of graduate students, it was found that students majoring in Economics and Science and Engineering obtained higher scores in all dimensions compared to those majoring in Management. Students majoring in Economics excelled particularly in course evaluation (Ching, 2018) and course learning situation, with scores of 4.3756 and 4.4013, respectively. This may reflect advantages in teaching methods and resource allocation within economics courses. Students majoring in Science and Engineering scored higher in teaching resources and learning outcomes and feedback, indicating that these courses are more effective in practical teaching and feedback mechanisms. The lower scores of students majoring in Management suggest the need for improvements in teaching methods and feedback mechanisms.

Overall, the differences in teaching effectiveness among students of different majors reflect the distinct characteristics of their respective curricula and learning content. Universities should develop personalized teaching strategies based on the characteristics of different majors to better meet students' learning needs and enhance teaching effectiveness.

5.3.3 Analysis of differences in teaching effectiveness by doctoral aspirations

When considering PhD aspirations as an independent variable, the analysis shows that students with PhD aspirations scored significantly higher in all dimensions of teaching effectiveness compared to those without such aspirations. The results are shown in Table 12.

Table 12. Differences in teaching effectiveness by doctoral aspirations

Dimension	Doctoral Aspirations	N	Mean
Course evaluation	Yes	14	4.4920
	No	97	4.1878
Course learning situation	Yes	14	4.6020
	No	97	4.2268
Teaching resources	Yes	14	4.4196
	No	97	4.1494
Learning outcomes and feedback	Yes	14	4.4571
	No	97	4.0144

The data reflects significant advantages in teaching effectiveness for students with PhD aspirations. This difference may stem from stronger academic motivation and learning attitudes among these students. For instance, the average score for course learning is 4.6020 for PhD-aspiring students, compared to 4.2268 for those without such aspirations, indicating higher enthusiasm and engagement in learning among the former. In terms of teaching resources, PhD-aspiring students have an average score of 4.4196 (Zhao et al., 2022), suggesting higher utilization and possibly greater emphasis on these resources.

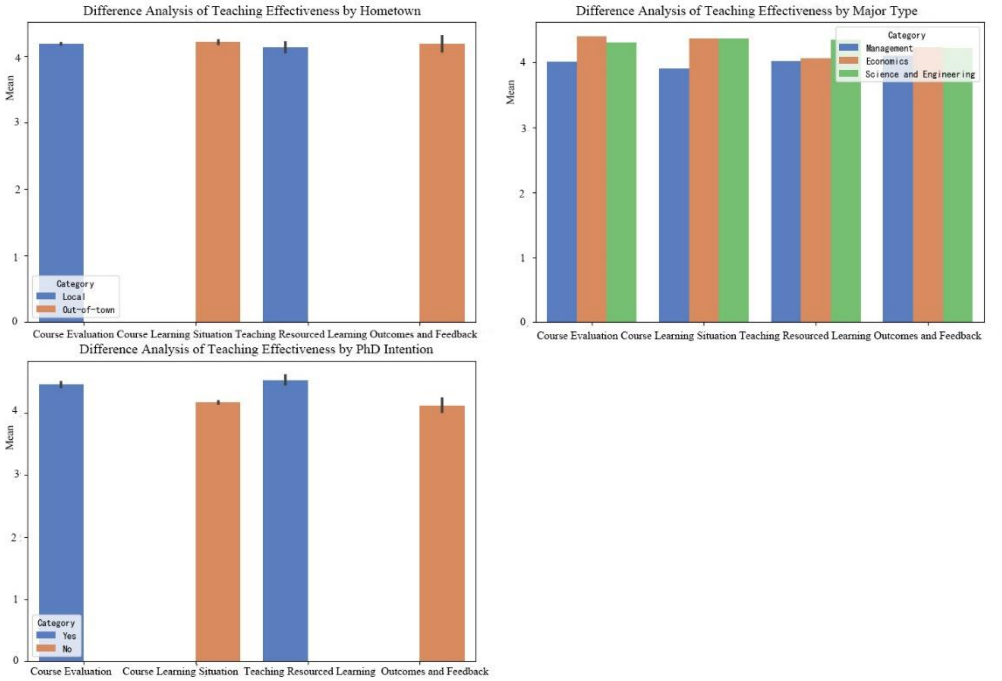

Figure 10. Summary of teaching outcomes by various factors

In the dimension of learning outcomes and feedback, PhD-aspiring students have an average score of 4.4571, significantly higher than their counterparts without PhD aspirations. This difference may be attributed to their stronger academic motivation and clear career planning. The notable impact of PhD aspirations on students' teaching effectiveness highlights the importance for educators to focus on stimulating academic interest and clarifying career goals to enhance overall teaching outcomes.

Figure 10 shows a summary of teaching outcomes based on various factors. When considering background variables such as birthplace, major type, and PhD aspirations, it was found in this study that these factors influence the application and effectiveness of teaching models to some extent. Specifically, the birthplace has a minimal impact on teaching effectiveness, while students majoring in Economics and Science and Engineering have higher scores across multiple evaluation dimensions. This suggests that different majors may require distinct teaching strategies. Furthermore, students with PhD aspirations demonstrate more positive academic motivation and learning attitudes. These findings underscore the importance of considering student background factors when designing teaching programs.

5.4 Strategies for constructing a teaching model based on the OBE concept

Facing the current severe issue of an inadequate mechanism for cultivating innovative and practical high-end talents, this study proposes a framework for an innovative and practical high-end talent cultivation model based on the OBE concept, focusing on the curriculum system framework and the teaching evaluation mechanism.

(a) Construction of a graduate curriculum system based on the OBE concept

The reform of the curriculum system for graduates at Capital University of Economics and Business, based on the OBE concept, sets out a framework structure for curriculum system reform in three aspects: curriculum reform goals, teaching models, and curriculum implementation. The reform framework is shown in Figure 11.

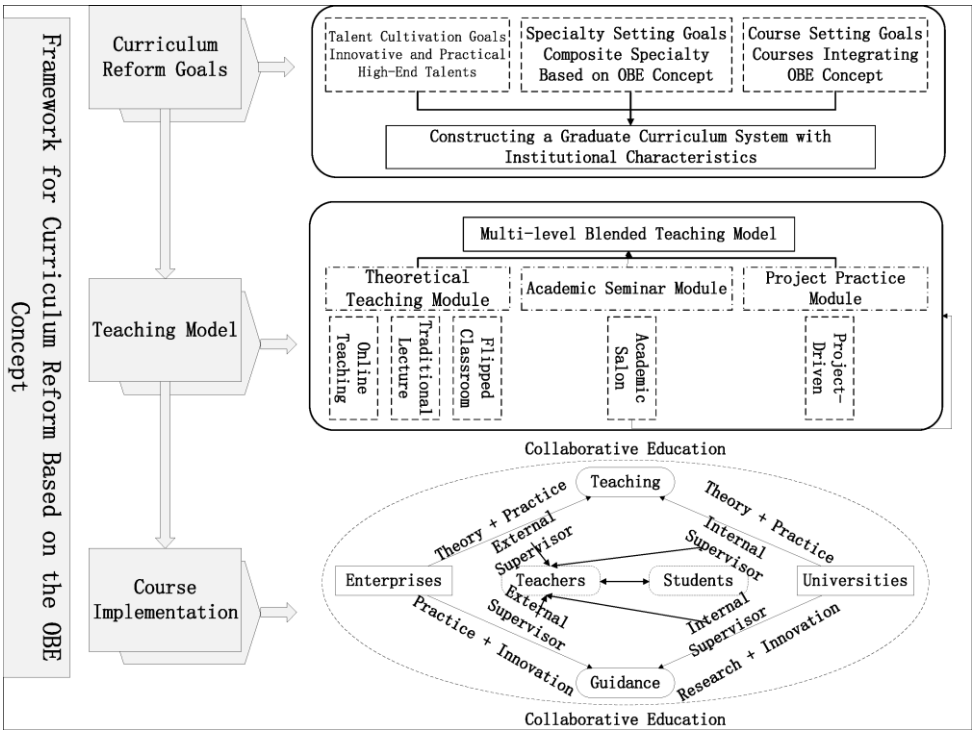

Figure 11. Framework of course system reform based on the OBE concept

The curriculum reform goals can be clarified by combining the cultivation of innovative and practical high-end talents, the professional setting goals based on the OBE concept, and the curriculum setting goals based on the OBE concept.

A multi-level blended teaching model around the course teaching goals and content can be constructed by adopting appropriate teaching methods for "theoretical teaching, academic seminars, and project practice." In the theoretical teaching module, combining traditional lectures with flipped classrooms makes the best of both, aligning with the current needs of graduate courses. For the academic seminar module, academic salons can be organized using the discussion-based teaching method, focusing on academic frontiers and AI technology to fully exercise students' literature reading and summarizing skills, as well as their ability to pose and analyze problems. For the project practice module, a project-driven teaching method can be adopted, with students as the main body,

projects as the main line, and teachers as guides, enabling students to learn problem-solving skills.

Graduate education should not only involve graduates and teachers but also include experts from industries and enterprises, as well as personnel from research institutions, in the course teaching, ensuring that graduates can genuinely immerse themselves in practical scientific research projects and work, thereby possessing strong practical and innovative abilities. By building a teaching community, carrying out collaborative education, and integrating theory, practice, and innovation into a new "trinity" collaborative education model, the availability of practical innovation opportunities can be increased, thereby promoting the mutual transformation and innovation of theoretical knowledge and practical application for graduates.

(b) Construction of a multi-dimensional graduate course teaching evaluation mechanism based on the OBE concept (Yang, 2024).

Drawing from international learning assessment theories and practices, course evaluations should periodically adjust to the adaptability of course goals, content, and outcomes. At the same time, evaluation results should provide guidance for other dimensions and monitor the overall curriculum system's integration and development with society, forming a spiral upward evaluation model. Based on this concept, a multi-dimensional graduate course teaching evaluation mechanism based on the OBE concept was established in this study, conducting evaluation activities from different perspectives of evaluation content, evaluation subjects, and evaluation indicators in a layered and modular manner, as shown in Figure 12.

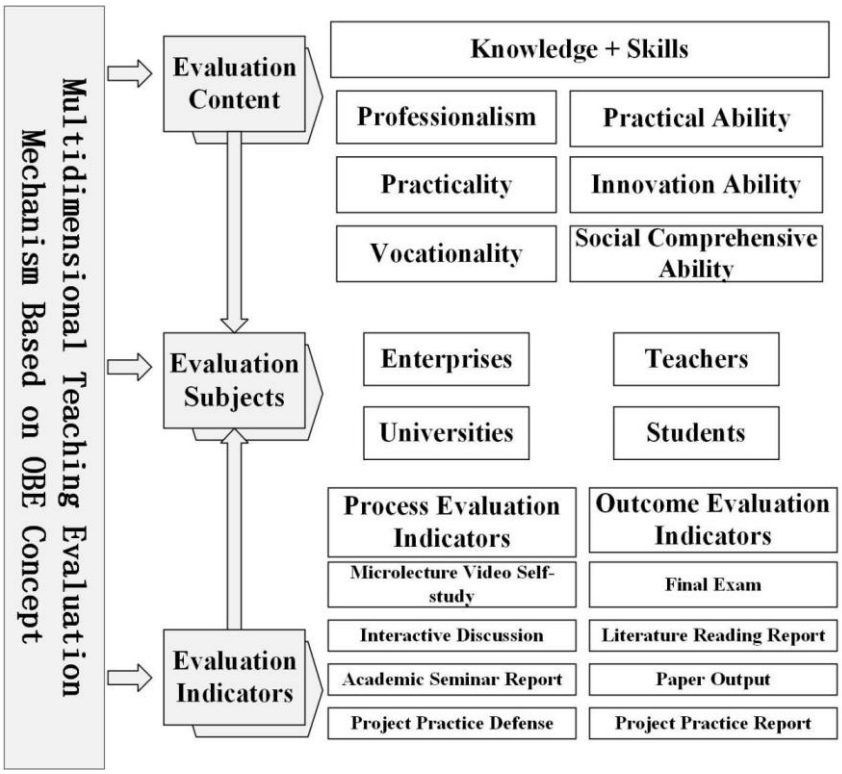

Figure 12. Multi-dimensional teaching evaluation mechanism based on the OBE concept

The evaluation content includes both the knowledge and abilities of the evaluated subjects. The evaluation of knowledge should be specialized, practical, and professional, given the positioning of high-level interdisciplinary talents. The ability module, encompassing practical skills, innovative abilities, and comprehensive social capabilities, is crucial for the sustainable development of graduates in their professional fields. These three aspects collectively promote the holistic, comprehensive, and sustainable development of graduates.

When selecting the evaluation subjects for the graduate curriculum system, a comprehensive determination can be made at the macro level of enterprises, the meso level of universities, and the micro level of teachers and students. During the evaluation process, the practical and procedural nature of graduates' learning innovations should be included, systematically and step-by-step, to conduct a qualitative and quantitative comprehensive value judgment. Evaluation should not only be based on results but should also ensure continuous monitoring to guarantee the quality of the entire system's operation.

Based on the evaluation content, course evaluation indicators were determined, including process evaluation and outcome evaluation. The process evaluation mainly reflects self-study situations, group interactive discussions, seminar reports, and the final defense outcomes of project practices, all of which determine the quality of the

learning process. Outcome evaluation extends beyond traditional final grades to include literature review reports, thesis outputs (Wang & Du, 2024), and project practice reports, ensuring a fair, scientific, and effective comprehensive assessment of multiple outcomes.

The targets for talent cultivation, job competence requirements, and the school's implementation of graduate training programs are interconnected, progressing in a hierarchical manner.

6. Conclusion and Outlook

Amid the rapid development of the digital economy, this study deeply analyzes the application of the OBE concept in cultivating innovative and practical high-end talents. Through an empirical study of the graduate curriculum system reform at Capital University of Economics and Business, this study identifies current challenges in the traditional education system for cultivating innovative practical talents and explores a series of possible solutions.

A curriculum reform system based on the OBE concept was proposed in this study, initially establishing interdisciplinary specialty settings and course objectives aligned with the OBE concept. The study introduces a multi-level blended teaching model integrating "theoretical teaching, academic seminars, and project practice," aiming to comprehensively meet the complex needs of teaching. Following the requirements of the multi-level blended teaching model, teaching activities were carried out across multiple dimensions, from theoretical teaching to academic seminars to project practice.

Specific implementation strategies cover course setting, teaching models, evaluation methods, resource allocation, and practical teaching, comprehensively planning the overall framework from curriculum structure to industry-university-research cooperation mechanisms.

In terms of course evaluation, a multi-dimensional graduate course teaching evaluation mechanism based on the OBE concept was proposed in this study. This mechanism aims to comprehensively consider market demand, the need for cultivating innovative, practical, high-end talents, and the completeness of the graduate curriculum system. Evaluation activities were conducted in a layered and modular manner from the perspectives of evaluation content, evaluation subjects, and evaluation indicators.

In addition, an OBE-based teaching reform framework and a course evaluation framework were proposed. However, this study has certain limitations. The research is only targeted at graduates of the Capital University of Economics and Business, so the findings may not be universally applicable. Since graduate learning situations often have individualized needs, the strategies proposed in this study should be dynamically adjusted and validated according to the individualized needs encountered in practice to ensure the universality and effectiveness of the reform strategies. Future research should expand the survey scope to include students from different majors in more universities and pay attention to the relationship between student needs in different educational environments, analyzing their evolutionary patterns, and dynamically adjusting the curriculum system and teaching evaluation model to ensure the cultivation of high-end talents who can meet societal demands.

Data Availability

The data used to support the research findings are available from the corresponding author upon.

Conflicts of Interest

The authors declare no conflict of interest.

References

Burton, E., Goldsmith, J., Koenig, S., Kuipers, B., Mattei, N., & Walsh, T. (2017). Ethical considerations in artificial intelligence courses. *AI Mag.*, *8*(2), 22-34. https://doi.org/10.1609/aimag.v38i2.2731.

Centoni, M. & Maruotti, A. (2021). Students' evaluation of academic courses: An exploratory analysis to an Italian case study. *Stud. Educational Eval.*, *70*, 101054. https://doi.org/10.1016/j.stueduc.2021.101054.

Chen, J., & Lv, W. J. (2017). Artificial intelligence and new engineering talent cultivation: Major shifts. *Res. Higher Eng. Educ.*, *6*, 23-28. https://www.cnki.com.cn/Article/CJFDTotal-GDGJ201706004.htm

Ching, G. (2018). A literature review on the student evaluation of teaching: An examination of the search, experience, and credence qualities of SET. *Higher Educ. Eval. Dev.*, *12*(2), 63-84. https://doi.org/10.1108/HEED-04-2018-0009.

Clark, R. M. & Kaw, A. K. (2020). Benefits of adaptive lessons for pre-class preparation in a flipped numerical methods course. *Int. J. Math. Educ. Sci. Technol.*, *51*(5), 713-729. https://doi.org/10.1080/0020739X.2019.1617439.

Ding, N. & Gai, Y. D. (2024). Exploration of linear algebra blended teaching model based on OBE Concept. *Res.*

Integr. Ind. Edu., 6(2), 71-78. https://doi.org/10.6938/iie.060207.
Feroz Khan, A. B. & Samad, S. R. A. (2024). Evaluating online learning adaptability in students using machine learning-based techniques: A novel analytical approach. *Educ. Sci. Manag.*, *2*(1), 25-34. https://doi.org/10.56578/esm020103.
Hu, S. (2023). An investigative study of factors affecting talent development systems in higher education management programs under the OBE philosophy. *Training*, *5*(24), 174-179. https://doi.org/10.25236/IJNDE.2023.052428.
Javornik, Š. & Klemenčič Mirazchiyski, E. (2023). Factors contributing to school effectiveness: A systematic literature review. *Eur. J. Invest. Health Psychology Educ.*, *13*(10), 2095-2111. https://doi.org/10.3390/ejihpe13100148.
Jiao, N. & Zheng, A. D. (2019). Teaching reform and practice of finance professional degree postgraduates in agricultural universities based on OBE concept. *Western Qual. Educ.*, *10*, 175-177.
Jin, H. F. (2020). Teaching reform and practice of 'Programming Fundamentals' course based on OBE concept. *Chin. Educational Informatization, 8*, 38-41.
Li, Z. Y. (2014). Analysis on outcome-based concept of engineering education accreditation. *Chin. Higher Educ.*, *17*, 7-10.
Liu, Y., Zhao, H., Yang, K., & Huang, L. (2019). Outcome-based computer system course teaching reform under new engineering background. *Comput. Educ., 7,* 1-4.
Looi, C. K., Mccalla, G., Bredeweg, B., & Breuker. (2013). *Artificial Intelligence in Education: Supporting Learning Through Intelligent and Socially Informed Technology: Vol 125*. IOS Press, Amsterdam.
Luo, M. & Huang, H. (2019). Application of flipped classroom teaching mode based on OBE concept in software graduate courses. *Comput. Educ., 7*, 142-145. https://www.cnki.com.cn/Article/CJFDTOTAL-JYJS201907035.htm
Prodanova, J. & Kocarev, L. (2023). Universities' and academics' resources shaping satisfaction and engagement: An empirical investigation of the higher education system. *Educ. Sci.*, *13*(4), 390. https://doi.org/10.3390/educsci13040390.
Su, D., Wang, B., Wang, S., & Yang, H. (2024). Teaching design and practice research of "Career planning and employment guidance for college students" based on OBE concept. *Curriculum Teach. Method.*, *7*(3), 146-153. https://doi.org/10.23977/curtm.2024.070322.
van der Vorst, T. & Jelicic, N. (2019). Artificial intelligence in education: Can AI bring the full potential of personalized learning to education? In *30th European Conference of the International Telecommunications Society (ITS): "Towards a Connected and Automated Society".* Helsinki, Finland.
Wang, L. (2024). Reform and practice of college English reading teaching based on OBE concept. *Front. Educational Res.*, *7*(5), 194-199. https://doi.org/10.25236/FER.2024.070531.
Wang, Y. T. & Du, J. Q. (2024). A study on the influencing factors and enhancement strategies of undergraduates' research quality in the context of online education. *Educ. Sci. Manag., 2(*1), 35-49. https://doi.org/10.56578/esm020104.
Wu, H. T., Li, Z., & Yuan, Y. Q. (2019). Teaching reform of web front-end development technology course based on OBE concept. *Comput. Educ., 11*, 91-93.
Xu, B., Wang, D., & Xue, X. (2024). Discussion and practice of 'Three-Dimension Five-Star' teaching method under OBE concept—Take the course 'College Computing' for example. *Adv. Comput. Signals Syst., 8*(2), 82-87. https://doi.org/10.23977/acss.2024.080213.
Yang, F. (2024). Enhancing course evaluation with achievement pathways in outcome-based education frameworks. *Educ. Sci. Manag., 2*(1), 10-24. https://doi.org/10.56578/esm020102.
Zhao, L., Xu, P., Chen, Y., & Yan, S. (2022). A literature review of the research on students' evaluation of teaching in higher education. *Front. Psychology*, *13*, 1004487. https://doi.org/10.3389/fpsyg.2022.1004487.
Zhao, Y., & Cui, L. (2015). Master's course reform based on OBE teaching mode: A case study of 'Applied Stochastic Processes'. *Asia-Pac. Educ.*, 34, 149-150.
Zhu, Q. (2024). Analysis on the teaching reform of comprehensive accounting course based on OBE teaching concept. *Int. J. New Developments Educ.*, *6*(3), 112-117. https://doi.org/10.25236/IJNDE.2024.060319.