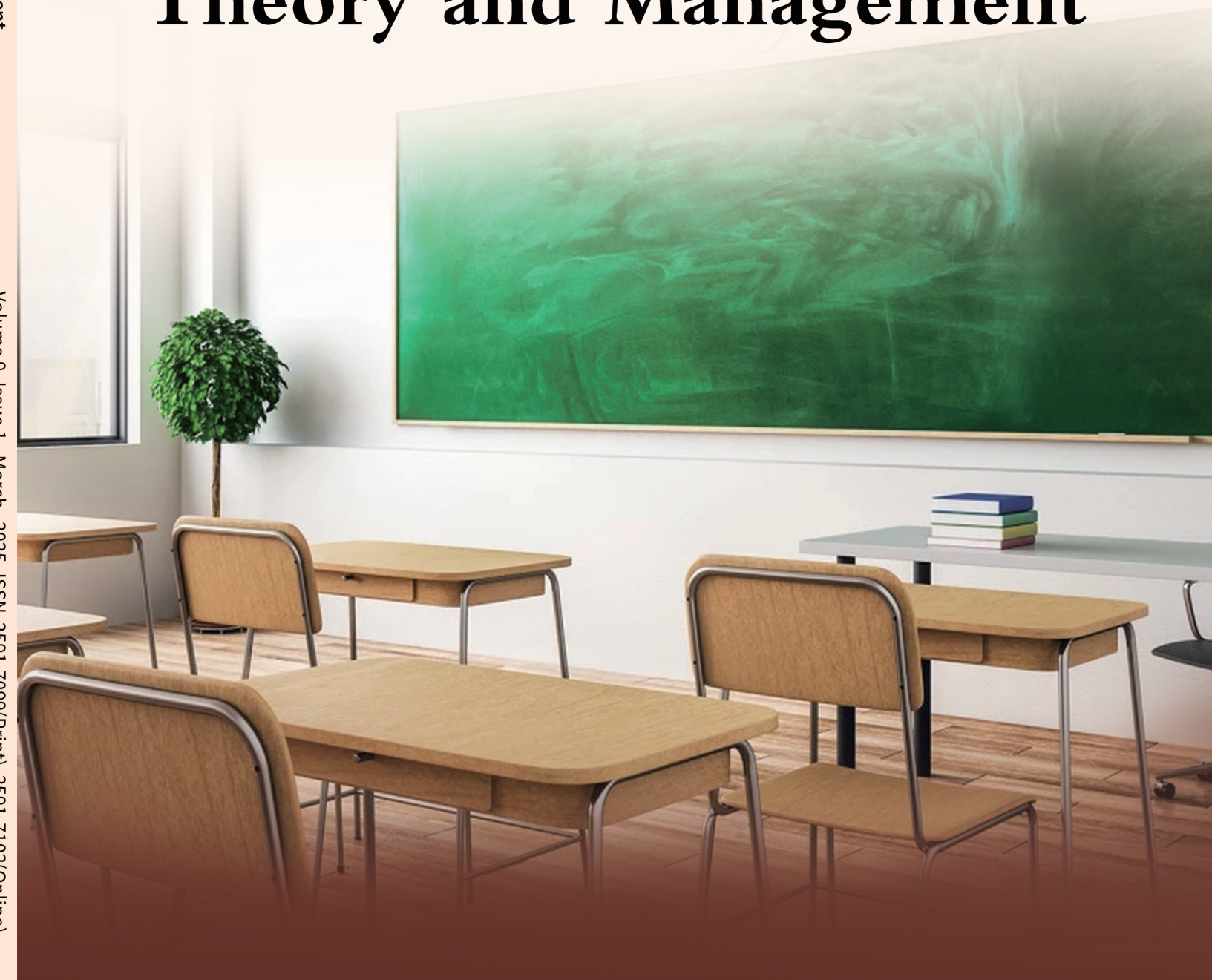


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Editor-in-Chief

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Exploration of the Reform in the Integrated Development of Nursing Education and Innovation & Entrepreneurship Education

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ABSTRACT

The integrated development of nursing education and innovation & entrepreneurship education is a crucial approach to cultivating high-quality nursing professionals and advancing the discipline of nursing. This paper discusses the main issues currently faced in the integration process and provides reform suggestions from six aspects: curriculum system, teaching methods, practical teaching platforms, project competitions, faculty development, and evaluation systems. These explorations aim to offer theoretical support and practical references for promoting the deep integration of nursing education and innovation & entrepreneurship education, ultimately enhancing students' innovation and entrepreneurial capabilities.

Innovation is the core driving force of social progress, while entrepreneurship is a key means to promote economic and social development and improve people's livelihoods. In 2016, the State Council of China issued the "National Innovation-Driven Development Strategy Outline," which clearly proposed that China aims to be at the forefront of innovative countries by 2030 and build a world-leading technological innovation power by 2050^[1]. To achieve the goal of building an innovation-driven nation, the cultivation of innovative, entrepreneurial, and interdisciplinary talents is one of the essential foundations. Innovation and entrepreneurship education has become an important part of talent cultivation in higher education, and the integration of professional education with innovation and entrepreneurship education has gradually

emerged as a critical pathway to achieving the goals of innovation and entrepreneurship education. For nursing education, the question of how to effectively realize the deep integration of professional education with innovation and entrepreneurship education remains a key challenge.

1. The Significance of the Integrated Development of Professional Education and Innovation & Entrepreneurship Education

1.1 Meeting the Demand for High-Quality Nursing Talent in Society

The "Healthy China 2030" Planning Outline emphasizes the need to advance the construction of a Healthy China^[2]. In the context of "big health," nursing professionals

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have become a crucial force in achieving the goals of Healthy China [3]. With the rapid development of health-care and the growing demand for higher quality nursing services, traditional nursing education models are increasingly unable to fully meet the current and future talent needs. Integrating professional education with innovation and entrepreneurship education can cultivate high-quality nursing professionals who possess both solid professional knowledge and innovative practical skills. Through this integration, students not only master fundamental nursing skills but also develop the ability to innovate in solving complex clinical problems, optimizing nursing processes, and developing nursing technologies. These interdisciplinary nursing professionals can better adapt to diverse professional environments and make significant contributions to advancing standardized, precise, and personalized services in the nursing field.

1.2 Promoting the Development of the Nursing Discipline and Facilitating the Integration of Industry, Academia, and Research

The development of the nursing discipline requires new insights, theories, skills, and perspectives as its foundation and driving force [4]. The integration of professional education with innovation and entrepreneurship education provides new momentum for both practical and theoretical innovations in nursing. By strengthening this integration, nursing education can better align with industry and research needs, guiding students to engage in real-world industry-academia-research projects and enhancing their research and practical abilities. This model not only drives breakthroughs in nursing disciplines in areas such as academic research, technology development, and service innovation, but also promotes collaborative innovation between industry, academia, and research, improving the conversion rate and commercialization of nursing technologies and products. This creates sustained momentum for the advancement of the nursing discipline. At the same time, the innovation awareness and practical abilities developed by students in this process will also feed back into the reform of nursing education, establishing a virtuous cycle of interaction between the discipline and society.

2. Issues in the Integrated Development of Professional Education and Innovation & Entrepreneurship Education

2.1 Unclear Educational Objectives

In the process of integrating nursing professional education with innovation and entrepreneurship education,

there is often a lack of clearly defined educational objectives. On one hand, nursing education focuses on developing students' professional abilities and clinical skills. On the other hand, innovation and entrepreneurship education emphasizes stimulating students' innovative thinking and entrepreneurial abilities. When these objectives are unclear or not effectively aligned, students struggle to understand the overall direction of their curriculum, which hinders their ability to integrate knowledge from both areas.

2.2 Disjointed Curriculum System

In many higher education institutions, there is an absence of a well-established curriculum system for integrating nursing education with innovation and entrepreneurship education [5]. Nursing programs typically focus on basic medical knowledge and nursing skills, while innovation and entrepreneurship courses are often set up independently, lacking a close connection with professional knowledge. This disjointed curriculum system prevents students from effectively applying innovation and entrepreneurship knowledge in their professional learning, leading to poor integration of the two educational components.

2.3 Difficulty in Resource Integration

The integration of nursing education and innovation and entrepreneurship education requires different types of resources, such as clinical practice platforms and spaces for innovation and entrepreneurship activities. However, due to being managed by different departments or schools, resource integration is often inefficient. Additionally, there is an unequal distribution of resources across institutions. This situation limits students' practical opportunities in the integrated educational model, impeding the effectiveness of the educational process.

2.4 Insufficient Faculty Capacity

Currently, nursing education instructors primarily focus on the professional field and lack knowledge and practical experience in innovation and entrepreneurship. On the other hand, instructors specializing in innovation and entrepreneurship education have limited understanding of nursing-specific requirements, making it difficult for them to meet the dual demands of integrated education. As a result, the implementation of courses is less effective. Some teachers lack hands-on experience in innovation and entrepreneurship and primarily rely on theoretical instruction, which hinders the quality of innovation and entrepreneurship education. Consequently, the potential for teachers to act as guides for students is not fully realized [3].

2.5 Inadequate Evaluation Mechanism

The integration of nursing and innovation & entrepreneurship education lacks a scientific and systematic evaluation mechanism. The current teaching evaluation system mainly focuses on assessing students' operational skills and theoretical knowledge, while the evaluation of innovation capabilities and entrepreneurial qualities is often neglected. Due to the absence of a reasonable assessment of students' innovation and entrepreneurial achievements, students often lack clear goals and motivation when participating in innovation and entrepreneurship education. This reduces the potential for maximizing the effectiveness of the education process.

3. Constructing Pathways for the Integrated Development of Professional Education and Innovation & Entrepreneurship Education

3.1 Constructing an Integration-Oriented Curriculum System Based on Nursing Professional Needs

Starting from the demands of the nursing profession, a curriculum system that integrates innovation and entrepreneurship should be designed based on the characteristics of nursing education. In the curriculum design, elements of innovation and entrepreneurship should be incorporated, creating a seamless connection between foundational nursing courses, clinical nursing professional courses, and innovation & entrepreneurship courses. For example, innovative case-based teaching can be introduced in basic courses such as anatomy and pathology, and clinical nursing courses can include topics such as medical innovation product design and nursing service model innovation. In courses like geriatric nursing, discussions on China's aging population, the status of chronic disease rehabilitation, the needs and operations of nursing homes both domestically and internationally, and the future prospects of the elderly care industry can be introduced, encouraging students to explore entrepreneurial opportunities in the elderly care sector and providing relevant support^[6]. Additionally, elective courses or special lectures can be set up to broaden students' entrepreneurial perspectives in the nursing field. By establishing a clearly modular curriculum system, students will be ensured to master solid professional skills while stimulating their innovative capabilities and entrepreneurial potential.

3.2 Reforming Teaching Methods to Cultivate Innovative Thinking

A variety of flexible and diversified teaching methods should be adopted to cultivate students' innovative think-

ing. For instance, project-driven learning (PBL) based on innovation and entrepreneurship projects, case-based teaching of innovation and entrepreneurship education, small group innovation discussion-based learning, and simulation techniques can be used to embed innovation and entrepreneurship knowledge within the nursing curriculum. At the same time, students should be encouraged to research and analyze clinical issues, exploring innovative solutions from real-world problems. This approach not only enhances their enthusiasm and motivation for innovation but also improves their teamwork and communication skills^[7]. Moreover, teachers can guide students to approach nursing challenges and opportunities from multiple perspectives through open-topic designs and interdisciplinary cooperation, thus fostering students' abilities to identify, analyze, and solve problems.

3.3 Establishing an Integrated Practical Teaching Platform for Professional Education and Innovation & Entrepreneurship Education

Building an integrated practical teaching platform is key to promoting the fusion of professional education and innovation & entrepreneurship education. Universities can leverage on-campus training bases, affiliated hospitals, and community service centers as off-campus practical training bases to introduce innovation and entrepreneurship practice modules, such as simulating medical product development or optimizing nursing service processes. At the same time, it is important to actively collaborate with off-campus innovation and entrepreneurship platforms and enterprises to establish a collaborative education mechanism, offering students more opportunities for real-world practice. Furthermore, virtual simulation labs and innovation labs can be used to strengthen students' hands-on ability and experiential understanding of innovation and entrepreneurship, thereby achieving a deeper integration of professional education with innovation and entrepreneurship education.

3.4 Building a Dual-Qualified Faculty Team

A dual-qualified faculty team is a critical guarantee for the integrated development of professional education and innovation & entrepreneurship education. Only with excellent educational resources can we cultivate high-level innovation and entrepreneurship talents^[8]. Universities should adopt multiple approaches to cultivate and recruit teachers who possess both a nursing professional background and knowledge in innovation and entrepreneurship. On one hand, existing faculty members should be encouraged to participate

in innovation and entrepreneurship training programs to enhance their teaching abilities. On the other hand, industry experts and business executives with rich entrepreneurial experience should be hired as part-time instructors to fill gaps in the teaching staff. For example, clinical nursing staff with strong innovation capabilities could be selected to serve as innovation mentors^[9], and healthcare institution managers or healthcare entrepreneurs could be invited to serve as entrepreneurship mentors. This would contribute to building a professional external mentor team, which would jointly participate in the integration of innovation and entrepreneurship education in nursing practice training^[10].

3.5 Focusing on Projects and Competitions as Main Pathways

Project-based learning organizes students and teachers around specific tasks, promoting interdisciplinary collaboration and research. When combined with competition-based learning, it not only emphasizes the competitive aspect but also fosters the integration and exchange of knowledge, helping to elevate students' self-standards. Innovation and entrepreneurship education can utilize both project-based and competition-based learning models to construct three levels of projects: technological projects, research projects, and innovation and entrepreneurship training projects. This would enhance students' learning capabilities and overall competitiveness^[11]. Technology innovation project-based learning helps deepen students' understanding of knowledge, cultivates their ability to select topics, form teams, and choose mentors, and promotes interdisciplinary collaboration and resource sharing. Research project participatory learning allows students to engage in faculty-led research, gain exposure to cutting-edge knowledge and technologies, improve their innovative thinking and problem-solving abilities, and enhance their practical skills, all of which contribute to technological innovation. Innovation and entrepreneurship training projects foster teamwork, entrepreneurship skills, and entrepreneurial ethics by incubating and training innovative projects. This helps merge interdisciplinary work and professional practice, enabling students to enhance their entrepreneurial competencies and increase their innovation and entrepreneurship levels.

3.6 Optimizing the Student Evaluation System

A scientific evaluation system is a key measure for assessing the effectiveness of integrated professional and innovation & entrepreneurship education. When optimizing the evaluation system, it should comprehensively assess

multiple dimensions such as knowledge mastery, skill application, innovative capacity, and overall competencies. A combination of formative and summative assessments can be introduced, such as evaluating students through project reports, case analyses, and presentations of innovation and entrepreneurship achievements. Additionally, attention should be paid to assessing students' soft skills, such as communication, teamwork, and problem-solving abilities. By constructing a diversified evaluation system, students' enthusiasm for learning can be stimulated, providing strong support for their future development.

4. Conclusion

The integrated development of nursing professional education and innovation & entrepreneurship education is an essential pathway for cultivating high-quality interdisciplinary nursing talents and serves as a key driving force for the innovation and advancement of the nursing discipline. This paper proposes specific reform pathways in six areas: curriculum system construction, teaching method reforms, practical teaching platform development, faculty team building, focus on projects and competitions, and optimization of the evaluation system. These suggestions provide theoretical support and practical guidance for achieving the integration of professional and innovation & entrepreneurship education. Through these explorations, nursing education can better align with the requirements of the new era's Healthy China strategy and meet the societal demand for high-quality nursing talent. In the future, with the deepening of reforms, the integration of innovation and entrepreneurship will further support the collaborative development of nursing disciplines with industry and research, driving nursing education from traditional models to innovation-driven approaches. This will make a positive contribution to the development of nursing and the enhancement of national health standards.

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A Study of Blended Learning Student Engagement and Teacher Teaching Strategies

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ABSTRACT

Student engagement in learning is a concern for teachers in the implementation of blended learning, which reflects the effectiveness of the pedagogical measures taken by teachers. Blended learning encompasses traditional blended, blended online, and blended synchronous, which combine synchronous and asynchronous teaching and learning activities. This paper adopts an inductive approach to investigate and analyse students' engagement in learning from three dimensions: behavioural, affective and cognitive, specifically focusing on three meta-categories, namely, course structure and arrangement, choice of teaching and learning activities, and teacher's role in relation to the course, to investigate the teaching of teachers of different disciplines in three vocational colleges and to analyse the pedagogical strategies that the teachers use in order to improve students' engagement in blended learning. The findings suggest that communicating about the course at the beginning of the semester, clarifying course requirements, and building a trusting relationship with students play a key role in increasing student engagement in blended learning, and that the use of digital tools is an important means of promoting students' behavioural and emotional active participation in learning.

1. Introduction

Student engagement in teaching and learning has received a great deal of attention over the past decade or so as a key component of the demonstrated effectiveness of teaching and learning activities in higher education. Learning engagement has a significant impact on perseverance, deep learning, and academic outcomes. Student engagement in learning is in turn influenced by situational changes. Therefore, it is of great relevance to examine how teachers can improve student engagement in a given learning environment. Blended learning is a fusion of face-to-face learning and online learning. It has the

convenience of synchronous communication and the flexibility of online activities, is closely related to the wide application of digital technology in education, and has a positive effect on improving student learning engagement, a model that is becoming increasingly popular in higher education. Although a number of studies have suggested increasing student engagement in blended learning, few studies have focused on how students can self-improve their engagement and how teachers can improve student engagement through teaching strategies. Therefore, it is necessary to study the issue of how teachers improve students' learning engagement in the teaching process. Based on the findings, this paper focuses on analysing how

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teachers in vocational colleges and universities use teaching strategies to increase student engagement in blended learning.

2. Literature Review

2.1 Conceptual overview

2.1.1 Student engagement

Student engagement, which is considered a complex and multifaceted pedagogical indicator, is rooted in actions, including the amount of time and energy students invest in the learning process, among others. Scholars have defined student engagement as three interrelated dimensions - behavioural, affective and cognitive. In a course, student behavioural engagement refers to their participation in activities and adherence to rules or norms, student affective engagement (which can also be referred to as emotional engagement) refers to students' emotional responses to activities, peers, and instructors as well as their sense of belonging to the course, and student cognitive engagement. 'Engaged students are more than just participating in learning activities or demonstrating learning outcomes, but also include behaviours in which they work hard and persistently self-regulate towards goals, challenge and exceed themselves, and enjoy challenge and learning'

2.1.2 Blended Learning

Blended learning mixes synchronous and asynchronous teaching activities, face-to-face teaching and online teaching in one, which combines both the advantages of synchronous interaction and the flexibility of online learning in terms of time, location and even learning pace. Blended learning models have partially replaced face-to-face learning activities. Three common types of blended learning are traditional blended, blended online and blended synchronous. Traditional blended learning combines face-to-face and asynchronous online training and learning activities; blended online learning combines synchronous and asynchronous online training and learning activities; and blended synchronous learning combines asynchronous online and synchronous face-to-face and online activities for both on-campus and distance students.

2.1.3 Student Engagement in Blended Learning

Through the combination of asynchronous and synchronous learning modes, blended learning combines a variety of teaching and learning activities to promote differentiated and personalised teaching and learning. It combines the strengths of synchronous and asynchronous com-

munication, aims to 'extend thinking and discourse over time and space' and is 'specifically designed to enhance (student) engagement' (Vaughan et al., 2013)³, and uses digital technology to reinforce and highlight learner-centredness. Therefore, many researchers consider blended learning to be a fertile ground for optimising student engagement. Halverson et al. were early to mention the term 'engagement' in their literature review, but did not provide a specific definition. The term 'engagement' is often used in research on blended learning (Halverson et al., 2014).⁴ However, there is very little literature devoted to the study of student engagement in blended learning, and most of the studies focus on a particular aspect of it, such as Liu Guimei's 'Western Culture Course as an Example of the Blended Learning Model'. A Study of Online Learning Engagement of Higher Vocational Students' (Liu Guimei, 2016)⁵; or a certain aspect of students' engagement in learning activities, such as Jiang Li's proposal to use teaching strategies to guide the design of teaching activities and teaching activities to promote students' active participation in blended learning. Therefore, it is essential to study students' engagement in blended learning.

2.2 Literature review

Student engagement can be extended through pedagogy, which is influenced by the instructor's teaching strategies, such as the instructor's encouragement of student participation in their course. Teachers first provide students with a variety of learning resources (e.g., texts, videos) through asynchronous online delivery to increase student engagement. In subsequent synchronous instruction, students continued to remain engaged through active instructional collaboration. Finally, the authors emphasised the importance of student interaction in promoting student engagement. In another study, scholars investigated how instructors of a traditional blended business course, which included both face-to-face and asynchronous online modes, increased undergraduate student engagement. The results of the study showed that student learning engagement was better in face-to-face instruction than in asynchronous online instruction. Some faculty also monitored student engagement online by submitting assignments or through private emails to engage students in learning activities. Despite these initiatives, teachers' strategies to increase student engagement were superior to the online model in face-to-face instruction. The study concludes that increasing student engagement requires teachers to integrate a variety of asynchronous and synchronous activities to fully realise the potential of blended learning.

3. Research design

3.1 Formulation of the research question

Few studies have been conducted specifically on vocational students' learning engagement in blended learning, and even fewer of these studies have investigated how teachers use instructional strategies to increase student engagement. The research findings presented above pave the way for research on this topic, in which investigations into the application of teacher strategies were either not extensive (e.g., digital technology applications), or limited to within a particular course. In addition, almost all of these studies involved undergraduate courses in traditional blended learning, and not many studies related to vocational college courses and students in blended learning, especially in blended online or blended synchronous courses, where the issue of how to increase vocational college students' engagement in learning remains to be investigated. How teachers in vocational colleges and universities can improve students' learning engagement through teaching strategies in a blended environment has also not yet been studied.

3.2 Research Objectives

In order to understand how teachers in vocational colleges and universities use teaching strategies to improve students' learning engagement in a blended environment.

pedagogical strategies to improve students' learning engagement, teachers from several different majors and different institutions were selected to participate in this study. The participants were selected as purposeful and targeted teachers (professors or lecturers). Twelve teachers participated in this survey, six of each gender. They had between 5 and 23 years of teaching experience and taught courses in a variety of disciplines, ranging from humanities (e.g., Chinese education, English education, marketing, etc.) to engineering (e.g., big data applications, computers, etc.) sciences. Teachers

Numbered P1 to P12.

3.3 Research Content

The influence of course structure and progression, choice of teaching and learning activities, teacher role and course relationship on the behavioural, affective and cognitive dimensions of students' learning engagement.

3.4 Research Method

This study mainly uses the questionnaire survey method, and the data obtained from the questionnaire survey will be analysed to reveal which teaching strategies are

more effective in improving vocational college students' learning engagement in blended learning.

3.4.1 Data collection

The participating instructors administered the questionnaire primarily around a course they teach in a blended environment. In the questionnaire, participants were first asked to explain how their course was organised, aiming to gather initial information about the sequence of synchronous and asynchronous activities. Next, the questionnaire was designed with respect to the three dimensions involved in student engagement in learning (behavioural, affective and cognitive) and participants were asked to relate their answers to these dimensions as much as possible. They were asked to talk about course situations where they noticed high levels of student engagement in any of the three dimensions and what they did to develop or maintain it; they were also asked to talk about situations where they noticed low levels of student engagement in any of the three dimensions and what they did to re-engage students. In order to maintain an objective and neutral position, the questionnaire was designed to ask questions using open-ended questions to get more details from the participants.

3.4.2 Data Analysis

After the collection of materials, the survey content was analysed and categorised and coded through a general elicitation approach. Tomas coding steps were used: initial reading of the text, identification of data segments relevant to the objectives, labelling of data segments into emergent categories, refinement of categories to avoid redundancy, and highlighting of salient categories. Throughout the coding process, codes were proofread, refined and layered to minimise redundancy and overlap (Tomas, 2006).⁹ Each code was further refined and categorised into categories of teacher strategies. The strategy categories are associated with students' behavioural, affective, and cognitive inputs.

4. Analysis and Discussion of Results

4.1 Analysis of results

After in-depth data analysis, it was found that there are three meta-categories of teacher strategies to increase student learning engagement in a blended learning environment: course structure and progression, choice of teaching and learning activities, and teacher role and course relationship.

4.1.1 Course Structure and Pacing

Blended learning implies that students switch modes

between synchronous (face-to-face or online) and asynchronous modes, and therefore most teachers emphasise course structure and pacing as the key to increasing student engagement in learning. Firstly, most teachers developed students' behaviours and emotions by providing a clear, continuous and consistent lesson structure. It involves when, what and where instructional activities are completed (face-to-face, synchronous online or asynchronous online). 'At the beginning of each semester, in the first class, I will arrange a face-to-face offline session on this course to give students a detailed explanation of how the course is structured throughout the semester, which makes it easier for students to understand in advance what the course is scheduled to cover and what is required for them to learn. When students understand a clear programme for the whole semester, they will have clarity of purpose without anxiety and restlessness' (P1).

Most teachers also increased students' engagement in learning by making connections between asynchronous and synchronous activities and clearly emphasising their interrelationships. They often complement asynchronous teaching activities with synchronous teaching (face-to-face or online). In this way, students become aware of the necessary role of synchronous engagement. This in turn creates a positive emotional response to asynchronous teaching and learning activities, thus promoting behavioural and emotional engagement. An explicit schedule of synchronous teaching activities may facilitate students' active reinforcement of what they have been taught in previous asynchronous activities, helping them to deepen their understanding of the course content and stimulating their cognitive engagement. 'When appropriate in synchronous teaching, students are asked to review important course content that they have learnt in previous asynchrony and to highlight the importance of this teaching content; I think this is very helpful in reinforcing students' knowledge and the feedback from the students corroborates this' (P10). Some teachers would assign pre-class preview content before synchronous teaching to increase students' interest in participating in teaching activities during synchronous teaching, thus generating affective engagement. After synchronous instruction, some teachers encourage student engagement by assigning asynchronous homework. The post-lesson assignments continued to deepen students' understanding of the content and deepened their knowledge of the interconnections between synchronous and asynchronous instructional activities. Most teachers emphasised that maintaining consistency of teaching and learning activities throughout the semester could contribute to increased student engagement in learning.

Ensuring coherent scheduling throughout the course,

whether teaching synchronously or asynchronously, stimulates student engagement. In the asynchronous mode of teaching, teachers help students to maintain a consistent pace of learning throughout the semester through a diverse set of activities throughout the course in order to develop their behavioural and affective habits. 'It is important to design each instructional activity in such a way that it is deeply related to the content, but also to ensure that each activity is designed differently so that it continues to hold students' attention and avoids interest fatigue' (P9). The teacher further explained that such activity design facilitates students' overview of the content while balancing the activities throughout the semester. Teachers can also promote student engagement by carefully structuring synchronous (face-to-face or online) teaching activities to avoid disjointedness and maintain a high level of interaction. This produces a positive emotional response to increasing students' engagement in learning, which in turn promotes their behavioural and emotional engagement.

4.1.2 Choice of teaching and learning activities

Whether synchronous or asynchronous, teachers can enhance students' engagement in learning by orchestrating active or interactive teaching and learning activities. In the asynchronous mode of teaching, most teachers reported that they would promote student engagement through the use of supporting digital tools (e.g. slides, interactive videos, learning-based game design, online quizzes, discussion forums, etc.) in order to stimulate student participation and capture students' attention. 'I designed a game with the vocabulary word 'connect the dots'. This is a small game that students like to play. They gave feedback that through the vocabulary word 'connect-the-dots' game can help them to recognise and review what they have learnt quickly, easily and interestingly, which is one of the reasons why students like to participate' (P6). In teaching vocational college courses, most teachers also frequently use online assessments (e.g., online quizzes) to ensure that students remain active in asynchronous environments, thus stimulating their engagement behaviours. In addition, most instructors also assess students' learning outcomes longitudinally over the course of the semester so that students continue to improve as they deepen their understanding of the content. Summative learning reports promote student engagement, while longitudinal assessment and continuous feedback from teachers stimulate students' engagement mentality, thus enhancing their behavioural and cognitive engagement.

In synchronous teaching, most teachers emphasised that facilitating active learning enhances behavioural engagement. Depending on the course content, teacher

facilitation behaviours include problem-solving oriented activities, case studies, role plays or team discussions. When appropriate, teachers can enhance students' engagement in learning by arranging debate activities among students. For example, if students discuss a topic or work on a case study in a group, conducting group discussion activities will stimulate behavioural engagement. When groups share their findings, it may lead to inter-group debates, which in turn promote students' cognitive engagement. Several teachers also used the interactive application 'Shake' randomly selected on the SuperStar Learning Access program to increase student engagement and attention during synchronous teaching and to develop participatory behaviours. 'I have noticed that students are more attentive when I use the 'Shake It' randomly selected interactive app. Every student has the possibility of being selected, unlike simply having a student initiate the answer by raising their hand. This digital tool of random selection with uncertainty is interesting and students find it fun and exciting' (P8).

'Often, hot social or internet topics spark debates, and both students who participate in online and face-to-face classes are very engaged. Each student has his or her own ideas about hot topics. Teachers need to make sure that every student speaks up so that they can keep motivating students to participate. I think this hot topic debate makes the lesson more dynamic' (P2).

One teacher also noted that he used different topics to better engage different students in his lessons, explaining that topics or questions that made students feel uneasy also stimulated participation. Most teachers used lesson content to stimulate student behaviour by integrating and experiencing to deepen learning in synchronous and asynchronous instruction, and the integration and deepening of content facilitated their cognitive engagement.

'I typically preset pre-lesson topic discussions through asynchronous online before the lesson, and then arrange for students to share their ideas or discuss them further among classmates during the lesson, and finally the whole class examines the relatively focused ideas under the guidance of the teacher. The goal of engaging students through this sharing of ideas or common discussion is achieved' (P5).

'I would tell students that the learning of the course is their own business, that the teacher is only a guide to the course content, and that they need to develop personalised learning objectives that take into account their individual learning habits. Emotionally, this is a way of engaging students in active participation. In addition, I would place special emphasis on the importance of the course to their future careers, cognitively pushing them to think in terms

of specific real-life situations. And such an approach will motivate students to take action' (P8).

When appropriate, teachers providing selective topics, resources, or assignments can also promote student engagement. Several teachers indicated that allowing students the freedom to choose their favourite topics for discussion or assignments from predetermined content enhances their affective and cognitive engagement.

'I leave students with some choice in the selection of topics and assignments in my classroom, and they can select 1-2 topics of great interest from the range of topics I have set aside through independent discussion. In this way the whole class will actively participate because they experience the feeling that they are the masters of the class' (P9).

3. Teacher Roles and Curriculum Relationships

All teachers emphasised that students' enthusiasm for participation is stimulated if they are guided and supported from the beginning of the school year to the end of the term, whether in groups, teams or individually. Whether teaching synchronously or asynchronously, clear teacher disclosure of the course schedule, goals and expectations to students at the beginning of the semester can stimulate behavioural and emotional engagement in advance.

'In the first lesson of the school year, I show my students the semester plan and schedule for the course. Explaining to them in detail each of the course schedule's aspect of the course' (P11).

Clearly informing students about how the course is organised in blended learning, whether synchronous or asynchronous activities, encourages their behavioural and emotional engagement. Particularly in vocational education courses, several teachers indicated that they needed to spend one or two synchronous sessions to clearly explain the course structure, arrangement and interactions in order to promote students' emotional and behavioural engagement. Clear communication between teachers and students at the beginning of the school year would reduce anxiety and negative emotional responses and could increase students' motivation to engage in activities.

'Sometimes I would spend a lot of energy explaining how these course activities will be organised, and based on the learning characteristics of vocational students who do not have a high level of concentration, this arrangement needs to be more detailed and sometimes repeated, as students may miss some important information and feel anxious, so it is essential to take the time and energy to communicate the course arrangements to the students of the programme' (P6).

From the beginning of the term, teachers can also

increase students' emotional engagement by building a trusting relationship between teachers and students. 'More often than not, we are more like elders or older siblings to our students, and the establishment of this trusting relationship facilitates all teaching and learning activities because students can feel comfortable entrusting learning-related matters to someone they can trust' (P4). Most of the teachers used ice-breaking activities in synchronous teaching to develop students' sense of belonging to the course, thus increasing students' emotional engagement. Some teachers invited students to share personal examples of course-related practice in class and reused and presented students' experiences in subsequent synchronicities with a view to gaining students' trust. Personalised contact between students and teachers throughout the semester may also increase student engagement in the course. Some instructors enhance students' sense of group belonging and psychological engagement by inviting them to assist in participating in commenting on other students' work, thereby increasing their affective and cognitive engagement. 'Assisting the teacher and participating in commenting on peers allows students to recognise that they are part of the class' (P6). Teachers guiding students throughout the semester, both synchronously and asynchronously, promotes their engagement in the course. Teachers' clear explanations of the objectives of asynchronous and synchronous activities can stimulate students' engagement and thus their participatory behaviour. 'For each course module, I identify specific learning objectives and skills to be mastered, specify how we will achieve them, and then ask students to be actively involved' (P7).

Asynchronous communication (e.g. emails or messages on the course platform) to remind assignments of deadlines or important subject matter can similarly stimulate student behaviour and interest and emotional engagement. It helps students to complete important activities while highlighting the teacher's care and concern, making students feel warm and fuzzy. Several teachers felt that minimising distance, for example by sending special audio and video resources to students at irregular intervals, increased students' engagement in teaching and learning. Some teachers felt that providing additional short news items to stimulate students' interest could stimulate emotional engagement. 'In the social media groups set up by the students, I would share topics from time to time and tell the students that it was relevant to the class content and would be discussed in the classroom; sometimes I would also send out group notifications to remind them of relevant learning content or assignments. These very simple actions are welcomed by students and they feel cared for and supported by the teacher' (P9).

Teachers can encourage students' cognitive engagement by asking questions to reorganise or restart the discussion in an asynchronous or synchronous manner. In addition to answering questions, students' cognitive engagement can be facilitated by stimulating discussion or reflection. 'I would say to students 'Imagine how you would handle this situation if it happened to you'. I would challenge students and motivate them to solve problems' (P5). Several teachers also mentioned that they stimulate students' behavioural and cognitive engagement in their own lessons, e.g. assessment or feedback appropriately tailored to a particular activity in an asynchronous or synchronous situation can increase students' cognitive engagement. Some teachers mentioned that giving positive feedback to the whole group can also increase students' emotional engagement. In terms of individual feedback, some teachers provided audio or video feedback to increase student emotional engagement. 'In terms of student engagement, the importance of feedback is that they understand what the outcome was and why it was the way it was' (P3). In addition, students with specific difficulties need to be provided with additional and personalised support to promote their emotional engagement and help them to get through the term successfully. Some students may experience severe difficulties. 'If necessary, I make a private appointment with them to meet to resolve the problem, or multiple appointments if I can't resolve it once' (P7). Whether synchronously online, face-to-face, or sometimes online asynchronously (via email), students were keen to be helped. They feel supported by their teachers and it makes them feel at ease.

4.2 Discussion of results

This study aims to present a comprehensive and broad picture of the teaching strategies used by teachers in vocational education to increase student engagement in blended learning. Three different vocational colleges with different majors in different blended learning environments were investigated to examine the strategies used by teachers in synchronous or asynchronous teaching to increase students' engagement in learning, which were related to the dimensions of students' engagement in learning (behavioural, affective, and cognitive) as much as possible. The study explores this in detail from an external perspective (course structure and pacing) to an internal perspective (teachers' roles and course relationships).

4.2.1 Lesson Structure and Pacing

From an external perspective, ensuring that blended learning courses are well structured and paced is key to increasing student engagement in learning. This is con-

sistent with McGee and Reis' findings that a clear course structure improves students' behavioural and emotional engagement (McGee, Reis, 2012)¹]. Based on blended learning with synchronous and asynchronous teaching and learning activities, this study identifies specific strategies for teachers to increase student engagement in learning, for example, by designing synchronous teaching and learning activities (face-to-face or online) to unify the course structure. These can be complementary to asynchronous teaching activities, making clear the strong link between the two parts of teaching and maintaining continuity throughout the semester. In response, some faculty who lacked experience with blended learning expressed unease about students learning in asynchronous online modes while their courses exhibited a lack of connection and continuity between asynchronous and synchronous modes. Experienced teachers, on the other hand, generally make full use of both modes to adapt and fully exploit the potential of blended learning. As Bruggeman et al. suggest, it is important for teachers to fully understand what a blended learning model is, to invest time in experimenting and reflecting on their course models and to seek professional guidance and support (Bruggeman et al., 2021)⁷.

The study also highlights that maintaining a rhythm of continuity in blended learning in both synchronous and asynchronous modes improves students' behavioural and emotional engagement. Specific strategies include avoiding disjointedness and maintaining a high level of interaction in synchronous instruction and diversifying activities in asynchronous instruction; as well as pacing synchronous online instruction, which is usually shorter than face-to-face instruction; and motivating teachers to energise students' engagement.

In conclusion, in order to fully increase student engagement in blended learning, teachers need to reflect on whether their course structure and pacing are reasonable and whether they optimise their course design to stimulate the potential of blended learning. The teachers who participated in the survey in this study maintained consistency in their instructional design from start to finish, regardless of the size of the classes they taught or the mode of instructional activities they adopted.

4.2.2 Choice of teaching and learning activities

Promoting student motivation in synchronous teaching, whether individually (e.g., problem solving) or collaboratively (e.g., debating), increases behavioural and cognitive engagement, but the exact effect depends on whether the synchronous teaching is conducted face-to-face or online, the size of the group, the content of the course, and the type of activity. For example, in traditional blended in-

struction, teachers often use role-playing methods, whereas in blended online or blended synchronous instruction teachers mainly use discussion activities. This may be related to teachers' lack of use of digital teaching tool technology. In conclusion, most teachers choose the teaching strategies they are most familiar with and best at based on course content and class size.

Activities, themes, or related instructional content play an important role in increasing students' cognitive and affective engagement. Teachers can increase students' cognitive engagement by integrating, experiencing and/or deepening synchronous teaching and learning activities, and by restructuring the curriculum to highlight the complementary nature of synchronous and asynchronous teaching and learning activities. Some teachers believed that providing students with choices could increase students' affective and cognitive engagement. Most teachers believed that students were only given choices in the discussion sessions or in the selection of assignment topics. They believed that these choices were sufficient for students to feel ownership of their participation in the teaching and learning activities, and were sufficient to increase students' affective and cognitive engagement. In addition, in both synchronous and asynchronous teaching, the arrangement and design of teaching activities need to be carefully considered in order to maintain students' enthusiasm for participation.

4.2.3 Teacher Roles and Curriculum Relationships

How to conduct the first course teaching is particularly important. Most teachers usually start with synchronous (face-to-face or online) course teaching. On the one hand, clearly communicating to students how the blended course will unfold, demonstrating a schedule of synchronous and asynchronous teaching and learning activities, was highlighted by teachers as an important part of promoting students' behavioural and emotional engagement. In particular, the purpose of asynchronous activities and the corresponding expectations needed to be explained in order to increase student engagement in the blended instructional activities so that they would fully benefit from both modalities. This understanding echoes Shea et al. who argue that students may feel uncertain about what they need to do with asynchronous online instruction, which is why it is said to be particularly important to clarify instructional goals and expectations (Shea et al., 2006)¹²]. On the other hand, teachers need to emphasise the need to build trusting relationships in blended learning from the outset. For example, activities such as icebreakers or sharing experiences increase students' emotional and cognitive engagement. Creating personalised connections

between students and teachers and sharing with peers can also stimulate affective and cognitive engagement. Teachers can also increase students' affective and cognitive engagement through instructional strategies such as having multiple conversations with students or guiding students to establish personal learning goals at the beginning of the semester.

In addition, teacher guidance has an impact on increasing students' engagement in learning. Some teachers believed that reminding students of deadlines for learning tasks, reviewing key points, etc. could increase students' behavioural and affective engagement. Some teachers believe that it is important to capture students' attention and to guide and reassure them in a gradual manner. Particularly in the asynchronous mode, teachers remind students that teachers are available to provide guidance and support at any time, which can increase students' affective and cognitive engagement. This is consistent with Shea et al.'s study, which showed that high levels of teacher activity in asynchronous online instruction increased students' sense of connectedness and ability to learn (Shea et al., 2006)[2]. Farrell and Brunton's study, 'The Role of Reassurance and Support,' also demonstrated that teachers were more active in blended online courses by providing content. Online courses by providing content explanations, encouragement, and strategic guidance for learning can increase students' cognitive and affective engagement. In particular, this study highlights that teachers' readiness to provide support and assistance to students during synchronous and asynchronous teaching activities can be a significant motivator for students to participate in blended learning (Farrell and Brunton, 2020).

5. Conclusion

This study collected a large amount of data in three different vocational colleges in different disciplines and did an extensive and comprehensive research on the teaching strategies used by teachers in blended environments, documenting in detail the teaching strategies used by teachers in asynchronous and synchronous blended modes of teaching and learning in order to increase students' engagement in their learning and analysing them as far as possible in terms of behavioural, affective and cognitive engagement of students. This study concludes that course structure and progression, choice of teaching and learning activities, and teacher roles in relation to the course have a direct impact on increasing student engagement in learning. It is argued that in blended learning, teachers optimise synchronous and asynchronous teaching modes according to students' realities in order to improve students' learning engagement. However, there are some limitations to

this study in that it did not delve deeper into the teaching strategies used by teachers in specific subjects, but only provided a broad and comprehensive scheme of teaching strategies to understand how teachers can improve student engagement in each subject. Future research could explore teachers' use of instructional strategies for a particular subject in blended learning, or a comparison of instructional strategies in different subjects. This investigation mainly collected materials from teachers' perspectives, but not from students' perspectives. Therefore, future research could be designed more longitudinally.

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Exploration of a New Educational Model Based on Generative AI-Empowered Interdisciplinary Project-Based Learning

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ABSTRACT

This study explores a novel educational model of generative AI-empowered interdisciplinary project-based learning (PBL). By analyzing the current applications of generative AI technology in information technology curricula, it elucidates its advantages and operational mechanisms in interdisciplinary PBL. Combining case studies and empirical research, the investigation proposes implementation pathways and strategies for the generative AI-enhanced interdisciplinary PBL model, detailing specific applications across three phases: project preparation, implementation, and evaluation. The research demonstrates that generative AI-enabled interdisciplinary project-based learning can effectively enhance students' learning motivation, interdisciplinary thinking capabilities, and innovative competencies, providing new conceptual frameworks and practical approaches for educational model innovation.

1. Introduction

With the advancement of artificial intelligence technology, the application of generative AI in education has become increasingly widespread, demonstrating significant potential in interdisciplinary project-based learning (PBL). Traditional teaching methods predominantly focus on single-subject knowledge transmission, often neglecting interdisciplinary integration and the cultivation of innovative thinking, whereas solving complex modern societal problems requires the synthesis of multidisciplinary knowledge. Interdisciplinary PBL addresses this gap by integrating knowledge across disciplines to guide students in exploring authentic, multifaceted challenges, fostering innovative thinking, problem-solving skills, and

collaborative competencies. Leveraging its capabilities in information retrieval, synthesis, and creative generation, generative AI provides robust support for interdisciplinary PBL. It can rapidly construct multidisciplinary knowledge frameworks, elucidate interdisciplinary connections, and dynamically generate personalized learning pathways and materials, thereby addressing the limitations of traditional educational resources.

This study aims to investigate the operational mechanisms of generative AI in interdisciplinary PBL and analyze its application strategies and value across project preparation, implementation, and evaluation phases. Through case studies and practical explorations, it reveals how generative AI empowers interdisciplinary PBL to facilitate deep learning and innovative practices among

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teachers and students.

2. The Operational Mechanisms of Generative AI in Interdisciplinary Project-Based Learning

Compared to traditional teaching models, teachers leveraging generative AI can design challenging, authentic problem scenarios that simulate complex societal, scientific, or engineering issues, providing students with immersive and interactive learning environments. Such contextual design stimulates students' curiosity, guiding them to apply interdisciplinary knowledge to solve real-world problems, thereby cultivating innovative thinking and problem-solving skills. The operational mechanisms of generative AI in interdisciplinary PBL are manifested through the following key processes:

2.1 Personalized Learning Pathway Design

Teachers utilize generative AI to intelligently analyze learning needs and dynamically generate personalized learning materials tailored to project themes, effectively addressing the limitations of traditional resources in interdisciplinary integration. By evaluating students' project performance, the AI recommends suitable learning resources and tasks, enabling students to better comprehend and apply interdisciplinary knowledge.

2.2 Multi-Turn Dialogues and Role-Playing Simulations

In interdisciplinary PBL, generative AI facilitates students' understanding of complex issues through multi-turn dialogues and role-playing simulations. For instance, students interact with AI to assume roles from diverse disciplinary backgrounds, exploring multidisciplinary solutions to problems, thereby enhancing interdisciplinary thinking capabilities.

2.3 Project Guidance and Creative Assistance

Generative AI provides students with targeted guidance during project implementation, including methodological support, data analysis suggestions, and literature review frameworks. In tasks involving programming or design, it assists students in completing complex creative work, reducing project difficulty and improving efficiency. Teachers leverage generative AI to help students build

personalized learning frameworks, designing highly customized learning pathways based on individual learning histories, behavioral patterns, and preferences.

2.4 Fostering Innovative Thinking and Team Collaboration

By offering diverse solutions and innovative ideas, generative AI stimulates students' creative thinking. In team-based projects, it serves as a virtual assistant, supporting task allocation, progress tracking, and outcome presentation, thereby enhancing collaborative competencies.

2.5 Enabling Self-Directed Learning Pathways

Through data analytics and intelligent recommendations, generative AI tailors personalized learning pathways for students in interdisciplinary PBL. It dynamically adjusts learning content and task difficulty based on individual learning behaviors, interests, and knowledge mastery levels.

2.6 Real-Time Feedback and Evaluation

Generative AI analyzes students' learning behaviors and project progress in real time, delivering targeted feedback and evaluations. Its intelligent assessment and feedback mechanisms monitor learning outcomes and progress continuously, offering precise recommendations for pedagogical adjustments. This approach addresses the limitations of traditional evaluation methods, which often prioritize outcomes over the learning process itself.

3. Implementation Pathways and Strategies for Generative AI-Empowered Interdisciplinary Project-Based Learning

In interdisciplinary PBL scenarios, this study focuses on the domain of interdisciplinary project-based learning and integrates the intrinsic mechanisms of generative AI to analyze its core value propositions in empowering PBL. Based on the roles of generative AI in interdisciplinary PBL processes, we categorize its applications into two dimensions: stakeholders (teachers and students) and project phases (preparation, implementation, and evaluation). The analysis highlights the intelligent support functions provided to teachers and the smart assistance tools offered to students, as summarized in Table 1.

Table 1. Strategies for Generative AI-Empowered Interdisciplinary PBL

Stakeholder	Project Preparation Phase	Project Implementation Phase	Project Evaluation Phase
Teacher	Project Planning & Design	Project Support & Guidance	Outcome Assessment & Reflection
Student	Topic Selection & Preparation	Integration & Execution	Outcome Presentation & Exchange

3.1 Intelligent Support for Teachers in Project-Based Instruction

Generative AI serves as a critical smart tool to assist teachers in implementing project-based learning (PBL).

During the Interdisciplinary Project Preparation Phase, teachers leverage AI to integrate multidisciplinary knowledge, curate diverse teaching resources and case studies, and rapidly generate interdisciplinary project design frameworks. These frameworks include project objectives, task breakdowns, and expected outcomes, enabling the creation of comprehensive and systematic project plans. AI helps teachers design differentiated instructional plans with integrated and challenging project scenarios, ensuring alignment with the diverse needs of students at varying proficiency levels.

During the Interdisciplinary Project Implementation Phase, generative AI acts as a virtual teaching assistant, providing real-time pedagogical feedback to teachers. It supports adaptive teaching strategies by offering personalized guidance tailored to each group's performance in PBL activities.

During the Interdisciplinary Project Evaluation Phase, generative AI facilitates intelligent assessment, feedback, and post-project reflection. Teachers utilize learning data collected throughout the project to conduct multi-dimensional evaluations. AI further assists in generating actionable recommendations for iterative improvements, enabling teachers to refine and update project designs.

3.2 Intelligent Assistance for Students in Interdisciplinary Project-Based Learning

Across all three phases of interdisciplinary PBL, generative AI offers students on-demand, personalized smart assistance.

During the Project Preparation Phase, students use generative AI to brainstorm project-driven questions and creative ideas. By exploring AI-generated project proposals and reviewing relevant literature, they rapidly familiarize themselves with project themes, identify novel areas of interest, and leverage AI-generated content as a springboard for innovation, ultimately formulating their project plans.

During the Project Implementation Phase, generative AI streamlines resource retrieval, freeing students from tedious manual research. It enables seamless integration of knowledge across disciplines to construct interdisciplinary frameworks. Students employ AI to execute complex creative tasks (e.g., coding, design) and treat the AI as a multidisciplinary tutor, engaging in iterative questioning and critical dialogue to deepen their understanding of project challenges.

During the Project Evaluation Phase, generative AI

generates detailed assessment reports, helping students evaluate their performance, engage in self-reflection, and synthesize learning outcomes.

4. Practical Exploration of Generative AI-Empowered Interdisciplinary Project-Based Learning

This study investigates how generative AI empowers both teachers and students to address real-world, complex problems through interdisciplinary PBL. The process is divided into three phases: preparation, implementation, and evaluation. Throughout the project, students are expected not only to apply disciplinary knowledge but also to understand how to transfer this knowledge to real-life contexts. Below, we use the "Creation of a Promotional Poster for Changyu Wine" project as a case study to illustrate the practical pathways of generative AI-enhanced interdisciplinary PBL.

4.1 Interdisciplinary Project Preparation Phase: Generative AI Empowers Teachers and Students in Project Design

Teachers leverage the robust data collection, generation, and creative capabilities of generative AI to design projects rooted in real-world contexts. By integrating cutting-edge disciplinary knowledge with students' lived experiences and interests, teachers formulate meaningful instructional tasks.

In the "Creation of a Promotional Poster for Changyu Wine" project, the task originates from an authentic corporate need: in a competitive market, how can the brand's unique identity be highlighted to capture consumer attention? This becomes the core challenge of the project. Teachers use AI tools, such as Wenxin Yiyan, to provide project topic suggestions, sparking creativity and inspiration. Simultaneously, generative AI assists students in brainstorming, generating innovative project ideas and approaches to ensure the topic is both creative and practical. For example, students use AI tools to collect, filter, and organize materials related to wine history, wine culture, graphic design, and information technology. By integrating knowledge from multiple disciplines, students quickly acquire rich background knowledge and a research foundation, saving time and improving the efficiency of subsequent project phases.

4.2 Interdisciplinary Project Implementation Phase: Generative AI Supports Teachers and Students in Project Execution

During the implementation phase, teachers act as guides, students as learners, and generative AI as a facil-

erator, supporting the interdisciplinary PBL process. The specific empowerment pathways include below.

Project Launching, the teacher introduces the task of creating a promotional poster for Changyu Wine, aiming to deepen students' understanding of wine culture, enhance their graphic design and IT skills, and foster teamwork and communication. Using AI, the teacher analyzes students' learning behaviors and interests, guiding them to identify core problems and establish design criteria. The poster must showcase unique creativity and innovative presentation, highlighting Changyu Wine's brand identity and cultural significance. It should have strong visual and promotional appeal to attract consumer attention and enhance brand recognition. It must adhere to graphic design principles, such as color coordination, layout composition, and typography. It should effectively utilize IT tools, such as image editing software. Team members must collaborate effectively with clear roles and responsibilities.

The teacher guides students in developing project plans. Students are divided into groups of 5-6 based on interests and expertise, such as graphic design, marketing, and wine culture. The teacher explains the project background, objectives, and requirements, emphasizing the creation of a promotional poster. Groups use generative AI to retrieve news, social media trends, and academic papers, generating multiple draft ideas. Through brainstorming and market research, teams discuss creative concepts, sketch designs, and refine layouts, color schemes, and visual elements. The teacher provides AI-driven suggestions to optimize designs.

During project execution, the teacher monitors group progress, offering guidance as needed. For technical challenges, specialized support from art teachers is provided, supplemented by generative AI resources. Finally, students use generative AI to refine their posters, ensuring optimal results.

4.3 Interdisciplinary Project Evaluation Phase: Generative AI Empowers Teachers and Students in Project Assessment

Teachers and students use generative AI to produce diverse project outputs, such as detailed reports, slides, charts, animations, and audiovisual materials. Teachers input predefined evaluation criteria, and generative AI, leveraging its powerful data analysis capabilities, generates comprehensive evaluation reports. These reports provide insights into students' performance across various dimensions. Generative AI offers self-assessment tools, enabling

students and teachers to reflect on their work, identify areas for improvement, and engage in deeper post-evaluation reflection.

5. Conclusion

In summary, this exploration of generative AI-empowered interdisciplinary project-based learning (PBL) pathways reveals the significant potential and practical value of generative AI in education. The practical investigation demonstrates that generative AI provides intelligent support functions for teachers and personalized smart assistance for students across the preparation, implementation, and evaluation phases of projects. This, in turn, facilitates the integration and application of interdisciplinary knowledge.

Looking ahead, as generative AI technology continues to advance and its educational applications deepen, it will play an increasingly expansive and profound role in interdisciplinary PBL. By driving innovation in educational models and enhancing the overall quality of education, generative AI will contribute significantly to cultivating the creative talents needed in the new era.

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Research on the Teaching Mode of Translation Course for English Majors from the Perspective of OBE Concept

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ABSTRACT

This paper mainly discusses the innovative teaching mode of translation for English Majors under the guidance of OBE education philosophy. Firstly, by analyzing the current situation of translation teaching for English majors, this paper points out the main problems, and combined with the OBE education concept, through optimizing the top-level design, updating the teaching content, improving the teaching methods, and scientifically using the evaluation methods, constructs a student-centered and outcome-oriented teaching mode. It is hoped that this study can improve students' translation ability and comprehensive quality, and provide a useful reference for the reform of translation teaching for English majors.

1. Introduction

With the progress of science and technology and the development of globalization, the society has higher and higher requirements for English majors. Translation ability, as the core ability of comprehensive use of English, determines the level of its English application. Translation course for English majors is the core course to cultivate students' translation skills and intercultural communicative competence, and its teaching quality directly affects the training quality of English majors. However, the traditional translation teaching focuses on the explanation and training of different kinds of translating skills. The teaching methods are not rich and diverse enough, and the teaching content is lack of practicality and interest, which

cannot meet the diversified requirements of today's society. Therefore, the reform of translation teaching should be student-centered, output-oriented, and continuous improvement-oriented. It should focus on what English majors have learned and what they can do after graduation, and reverse design the curriculum system and teaching process to improve the quality of English Majors.

2. OBE and Its Key Elements

OBE (outcome-based education) education concept is also called outcome-oriented education, ability-oriented education, goal-oriented education or demand-oriented education. This concept is an advanced educational concept put forward by American scholar William Spady in 1981.

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It is a concept of curriculum system construction based on outcome-oriented, student-centered and reverse thinking.

“OBE educational philosophy focuses on every aspect of education. It starts with clear learning objectives and then refines each teaching component to support these objectives while paying attention to the student learning process.” (Spady, 1994) OBE teaching philosophy believes that before the start of teaching activities, students’ specific achievements in knowledge, skills and literacy should be clearly defined after completing the course. These results should be measurable, attainable and relevant, and provide a clear direction for teaching activities.

The OBE education philosophy of “outcome-oriented and student-centered” emphasizes starting from the teaching objectives and requires teachers to reverse design teaching plan on the basis of clarifying teaching contents, teaching objects, teaching methods and teaching tasks. OBE concept is to implement educational activities centered on learning output, focusing on students’ learning outcome and emphasizing the output of learning process. OBE emphasizes putting students at the core of teaching and paying attention to the learning needs, learning styles and learning progress of each student. Teachers should flexibly adjust teaching strategies according to the actual situation of students, and provide personalized learning support and guidance for students.

OBE education philosophy emphasizes continuous improvement and believes that the teaching process is a dynamic and continuous optimization process. Through the continuous evaluation and feedback of students’ learning outcomes, teachers can find the problems in teaching in time, and adjust the teaching plan accordingly, so as to improve the teaching quality and ensure that students can achieve the expected learning outcomes.

3. Problems in Current Translation Teaching

The traditional English classroom mainly focuses on translation skills and translation exercises, and the teaching and talent training objectives cannot meet the requirements of social development. At the same time, it is difficult to mobilize students’ learning enthusiasm due to the problems of classroom teaching mode, outdated teaching content and lack of interest, and incomplete evaluation methods. The problems in the traditional translation classroom are mainly manifested in the following aspects.

3.1 Vague Teaching Objectives

The teaching objectives of translation courses for English Majors in some colleges and universities are not closely combined with social needs and students’ career

development planning, which has the problems of broad objectives and lack of pertinence. The teaching objectives often focus on the teaching of language knowledge and the explanation of translation skills, but pay less attention to the cultivation of students’ translation practice ability, intercultural communication ability and innovative thinking ability.

3.2 Insufficient teaching methods

In the traditional teaching of translation courses, teachers usually adopt the teacher-centered teaching method. In the classroom, teachers mainly explain translation theories and skills, and students just imitate the skills in exercises. This teaching method ignores the dominant position of students, and students lack initiative and creativity in the process of learning, so it is difficult to really improve their translation ability.

3.3 Disconnection Between Teaching Content and Actual Needs

The teaching content of translation course is mainly based on textbooks. The translation materials in textbooks are often outdated and do not meet the actual translation market demand. In addition, the teaching content lacks systematic training in different fields and different types of text translation, which makes it difficult for students to flexibly use the knowledge and skills they have learned in the face of real translation tasks.

3.4 Imperfect Evaluation System

At present, the evaluation of translation courses for English majors is mainly based on the final examination results, and the evaluation methods are not diversified enough. The evaluation content focuses on the examination of translation knowledge and skills, ignoring the evaluation of students’ learning process, translation practice ability and comprehensive quality. This evaluation system cannot comprehensively and accurately reflect students’ learning achievements and ability level, and is not conducive to stimulating students’ learning enthusiasm and initiative.

Therefore, from the perspective of OBE education concept, combined with the characteristics of English majors, the focus of English teachers’ research should over the topics of how to optimize the top-level design of the syllabus, match the optimal teaching content, update teaching methods, and improve the effectiveness of the evaluation mechanism.

4. Teaching Mode of Translation Course for English Majors from the OBE Perspective

From the perspective of OBE education concept, in order to cultivate high-quality English professionals with patriotic sentiment, global vision and professional skills, teachers must carry out comprehensive reform from the aspects of training objectives, teaching methods, teaching modes and evaluation methods. Translation teachers should target professional training objectives, optimize and update teaching content, reasonably develop teaching activities, and cultivate students' critical and practical ability. Boldly update the teaching methods and improve the interest and knowledge of the course. The translation workshop is supposed to be adopted to strengthen the cooperation and communication between students and the application of translation theory, so as to improve the translation skills and efficiency. At the same time, advanced translation technologies such as CAT (Computer Assisted Translation) and AI technology are introduced to realize a multi-modal, multi-angle and student-centered teaching mode, so that teaching can be combined with fun and practice. Promote the visualization and scientific development of teaching results, and improve students' translation appreciation and translation practice ability. The usual assessment adopts the combination of individual translation and group activities. The division of labor for group activities shall be clear, and the works shall be shared and displayed.

4.1 Clarifying Teaching Objectives

Teachers should participate in the practice of translation industry and understand the needs of the industry. Research and sort out the teaching objectives of the translation course to improve the compatibility between the course and the orientation of talent cultivation. Clarify the teaching objectives of translation courses for English majors according to the social demand for translation talents and the training mode of English majors. Teaching objectives should cover three dimensions: knowledge, skills and literacy. Through the study of this course, students are supposed to understand the basic theory of translation, the background knowledge of translation and the basic skills of translation training, and are capable to complete the text translation of different styles. Students can participate in group learning, have a sense of teamwork, and improve the ability of comprehensive application of various communication skills.

Through curriculum construction, the teaching objectives will be three-dimensional and diversified. Through the study of this course, students can not only understand

the basic theory and skills of translation, complete the translation of different styles of words, but also correctly understand the culture, thinking mode and language phenomenon in translation, and effectively solve the cultural conflict in the process of translation. Students should not only have a sense of teamwork, but also care about current events, master literature retrieval methods, improve autonomous learning ability, and improve students' comprehensive humanistic quality.

4.2 Optimizing Teaching Content

According to the teaching objectives and standards of translation course, the main teaching content of translation theory and practice course is divided into two parts: basic knowledge and skills of translation and translation practice of different genres. The basic knowledge and skills of translation include: translation and culture, Chinese and English thinking mode and language comparison, lexical translation, syntactic translation, rhetorical translation, sentence function reproduction and other chapters. Translation practice of different genres includes: translation of political document, prose translation, academic paper translation, scientific translation, tourism translation and other genres.

At the same time, teachers should pay close attention to the dynamics and needs of the translation market, update teaching materials in time, introduce translation texts with the characteristics of the times and practicality, optimize teaching content, and invite experts to guide, discuss and determine the key design of this course. Update the teaching content in time, select appropriate current events articles, and supplement current events content at the same time. In the teaching process, a large number of actual translation cases are adopted. Through the analysis and explanation of the cases, students can understand the actual work process and requirements of the translation industry, and master the translation skills and methods of different types of texts. In the process of translation, cultivate students' understanding of different cultures and different thinking modes in translation. Let students better grasp the cultural differences between China and the west, effectively solve cultural conflicts in the process of translation, improve students' comprehensive humanistic quality, and enhance students' patriotic sentiment, global vision and professional skills.

4.3 Improving Teaching Methods

The course of translation theory and practice focuses on the cultivation of translation ability, and the use of task-driven teaching can better cultivate students' practi-

cal ability. In classroom teaching, the teaching content of translation course is divided into a series of specific tasks, each of which is carried out around a specific translation topic or skill. Teachers assign tasks in the classroom and guide students to complete the tasks through autonomous learning, group discussion, etc. Specific steps can be taken as text interpretation, individual translation, classroom discussion, style comparison, finalization, and teaching discussion.

In order to achieve student-centered teaching, heuristic, project-based and discussion-based teaching methods should be adopted to strengthen the interaction of the classroom and pay attention to the supervision of the teaching process. In the teaching process, translation workshops are used to stimulate students' interest in learning, widely participate in translation practice, and strengthen cooperation and exchange among students. Translation of different styles should be shared and communicated in the form of achievements.

At the same time, enrich teaching resources and means by using modern information technology, such as translation software, online translation platform, corpus, etc. Teachers can guide students to use these tools to assist translation learning and improve the efficiency and quality of translation. At the same time, through the online teaching platform, teachers can interact with students in real time, answer students' questions in time, and provide students with personalized learning guidance.

4.4 Building a Diversified Evaluation System

In the course performance evaluation, teachers should pay attention to three combinations, namely, the combination of process evaluation and summative evaluation; the combination of self-evaluation, peer evaluation and teacher evaluation; the combination of multiple evaluation. The usual evaluation adopts the combination of individual translation and group activities. The group activities should have a clear division of labor, pay attention to the contribution of the group, and the works should be shared and displayed. Use the interactive function of the network to guide students to participate in the evaluation of homework and discussion results. Each class group work and translation practice evaluation are assigned to students' mutual evaluation and teachers' score in a certain proportion to improve students' participation and enthusiasm. At the same time, pay attention to the optimization process evaluation to test the students' translation practice ability. If students are willing to improve their grades, they can submit translation manuscripts many times or participate

in translation comments. Teachers should also pay attention to the evaluation of students' translation practice ability, intercultural communication ability, innovative thinking ability, team cooperation ability, autonomous learning ability and so on. Through building a diversified evaluation system, it can comprehensively and objectively reflect students' learning achievements and ability level.

4.5 Continuous Improvement

OBE education concept emphasizes continuous improvement and believes that the teaching process is a dynamic and continuous optimization process. Therefore, during the process of teaching, in addition to the combination of formative evaluation and summative evaluation, teachers should make targeted adjustment through multi-channel feedback. For example, teachers can regularly carry out a questionnaire survey of students to understand their views on teaching content and methods. Organize a student forum to encourage students to speak freely. At the same time, teachers carry out mutual evaluation and exchange teaching experience and problems. According to the evaluation and feedback results, analyze the problems existing in teaching. If it is found that students do not master a certain knowledge module well, the teaching progress can be adjusted and the explanation and practice of this part can be increased. If the effect of a teaching method is not good, replace it with a more appropriate method in time to ensure that teaching is always optimized in the direction of achieving the expected learning results.

5. Conclusion

The teaching mode of translation course for English majors from the perspective of OBE is guided by students' learning achievements. By clarifying teaching objectives, innovating teaching methods, optimizing teaching contents and building a diversified evaluation system, it effectively solves the problems existing in the traditional teaching mode, helps to improve students' translation ability and comprehensive quality, and meets the social demand for translation talents. All these require the joint efforts of teachers and students to constantly improve the teaching mode and ensure the continuous improvement of teaching quality. In the future, with the continuous updating of educational philosophy and the rapid development of the translation industry, the teaching mode of translation course for English majors needs to be constantly explored and innovated to cultivate more high-quality translation talents to meet the needs of the new era.

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Innovative Approaches to Reforming Physiology Experiment Teaching under the New Medical Sciences Framework

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ABSTRACT

The construction of the New Medical Sciences aims to cultivate interdisciplinary medical talents, placing higher demands on physiology experiment teaching. In light of the challenges of traditional teaching, such as outdated content, a single assessment mechanism, low student engagement, and limited research experience among instructors, this study proposes a reform pathway centered on research competence development, supported by diversified evaluation methods and the deep integration of ideological and scenario-based teaching. By optimizing teaching content, introducing innovative projects, establishing a multidimensional assessment system, and strengthening faculty development, the proposed reforms effectively enhance students' innovative ability and practical skills. This study provides theoretical insights and practical experience for training interdisciplinary medical professionals to meet the demands of the new era.

The construction of New Medical Sciences is a crucial support for the "Healthy China" strategy, emphasizing interdisciplinary integration in medical education. It aims to cultivate well-rounded medical professionals who possess clinical skills, research capabilities, and humanistic qualities. As a fundamental discipline in medical education, physiology plays a key role in bridging theoretical knowledge and clinical practice. However, traditional physiology experiment teaching often suffers from rigid content, monotonous teaching methods, and insufficient student innovation. This paper systematically explores reform pathways for physiology experiment teaching under the framework of New Medical Sciences, aiming to provide a theoretical basis for educational practice.

1. Overview of New Medical Sciences and Physiology Experiment Teaching

1.1 The Concept and Development of New Medical Sciences

New Medical Sciences represent both an upgrade to the existing medical education system and an enhancement of interdisciplinary integration. This approach places a strong emphasis on cultivating medical professionals with cross-disciplinary literacy, innovative thinking, and practical abilities. By breaking traditional disciplinary boundaries, New Medical Sciences incorporate interdisciplinary integration (e.g., medicine with artificial intelligence and big data), dynamic adjustments to teaching models, and

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a heightened focus on clinical practice and research capabilities^[1]. With rapid technological advancements, the development trend of New Medical Sciences has become increasingly evident. Emerging fields such as precision medicine and smart healthcare continue to drive medical education to higher levels. Consequently, New Medical Sciences impose greater demands on medical education—not only must students acquire solid medical knowledge, but they must also develop cross-disciplinary thinking and innovative practical skills. These competencies are essential for adapting to the complex and evolving healthcare landscape and contributing to global health solutions.

1.2 The Importance of Physiology Experiment Teaching

Physiology serves as a cornerstone of medical education, providing an in-depth exploration of the physiological phenomena and functional regulations within living organisms. As a core subject, it is essential for medical students, as it links theoretical medical knowledge with practical applications^[2]. Physiology experiment teaching acts as a bridge between theory and hands-on practice. By conducting experiments, students can transform abstract physiological theories into tangible experiences, thereby deepening their understanding, reinforcing their knowledge, and improving retention. Moreover, experimental teaching offers a valuable platform for students to develop practical skills. From operating laboratory equipment to collecting and analyzing experimental data, each step enhances their hands-on abilities and scientific thinking. Additionally, physiology experiment teaching fosters a rigorous scientific attitude and teamwork spirit, laying a solid foundation for students' future careers in medical and related fields. As such, it is an indispensable component in training high-quality medical professionals.

2. Challenges in Physiology Experiment Teaching

2.1 Limitations of Teaching Content and Methods

Traditional physiology experiment teaching often suffers from rigid content. For a long time, experimental courses have primarily focused on confirmatory experiments, where students follow predefined steps, analyze experimental data under teacher guidance, and submit a report afterward. This approach is monotonous, mechanical, and lacks engagement^[3], making it difficult for students to deeply understand the principles and significance behind the experiments. Furthermore, the teaching model remains largely traditional, with instructors providing detailed step-by-step explanations while students passively

follow along. This “spoon-feeding” method lacks interactivity, resulting in low student engagement and limiting their motivation to learn. Additionally, the slow update of teaching content fails to incorporate cutting-edge research findings and real-world clinical cases in a timely manner. This gap between current teaching methods and the interdisciplinary, innovation-driven goals of New Medical Sciences restricts students' exposure to broader perspectives and hinders the development of their comprehensive skills.

2.2 Deficiencies in the Assessment Mechanism

The current assessment mechanisms in physiology experiment teaching present several shortcomings in evaluating students' experimental competencies. Assessment methods are often singular, relying primarily on laboratory reports and final exam scores. Laboratory reports tend to focus heavily on presenting results while overlooking students' practical skills, analytical thinking, and teamwork performance. Final exams, which are mostly theory-based, fail to comprehensively evaluate students' hands-on abilities and practical application skills. Such a narrow assessment approach does not accurately reflect students' experimental proficiency, leading to rote memorization of procedures and outcomes instead of fostering genuine skill development and scientific reasoning. Additionally, the lack of dynamic evaluation throughout the learning process prevents early identification of student challenges, limiting the opportunity for targeted guidance and hindering the continuous improvement of their experimental skills.

2.3 Low Student Engagement and Insufficient Innovation Training

Students in traditional physiology experiment courses often exhibit low enthusiasm for learning, stemming from multiple factors. Firstly, the limitations of teaching content and methods make experimental courses less engaging and challenging, reducing students' sense of achievement and motivation. Secondly, the weak connection between experimental teaching and clinical practice results in students failing to recognize the real-world value of their knowledge, further diminishing their drive to learn. For instance, in experiments related to respiratory regulation, such as endotracheal intubation, the primary focus is placed on the main operator, limiting opportunities for all students to engage actively and develop creativity. Moreover, traditional teaching emphasizes knowledge transmission while neglecting the cultivation of innovation, critical thinking, and teamwork skills. Students are accustomed

to passively receiving information rather than actively exploring and independently analyzing problems. In team experiments, unclear division of labor and ineffective collaboration often arise, failing to cultivate essential teamwork skills. These challenges hinder students' overall development and fall short of the competencies required for medical professionals under the New Medical Sciences framework.

3. Exploration of Innovative Teaching Pathways

3.1 Optimizing Teaching Content and Innovating Teaching Models

3.1.1 Enriching Experimental Teaching Content

To meet the requirements of the New Medical Sciences, physiology experimental teaching content should be appropriately expanded. Cutting-edge research findings should be actively integrated, such as incorporating cases of gene-editing technology applications in physiology studies, allowing students to stay updated on the latest disciplinary advancements and broaden their perspectives. Moreover, a significant proportion of experiments should emphasize comprehensive and innovative approaches. Comprehensive experiments should integrate knowledge across multiple systems; for example, designing an experiment that involves the cardiovascular, respiratory, and nervous systems to help students understand their interactions. Implementing project-based team collaboration not only fosters students' innovative and practical abilities but also enhances teamwork skills, preparing them as interdisciplinary professionals with both creativity and cooperation skills^[4]. This approach not only stimulates innovative thinking but also improves problem-solving abilities, making experimental teaching more profound and extensive.

3.1.2 Innovating Teaching Methods

The Problem-Based Learning (PBL) approach should be adopted, where instructors pose thought-provoking questions, such as "How do different physiological systems coordinate during exercise?" to guide students in independently gathering information, analyzing problems, formulating hypotheses, and solving challenges, thus cultivating independent thinking and self-learning abilities. Team-based scientific research projects should also be encouraged, dividing students into groups to conduct small-scale research projects. Diverse interactive methods, such as group discussions and project presentations, effectively stimulate students' enthusiasm and motivation, fostering communication, collaboration, and comprehensive skill

development^[5]. This approach not only strengthens teamwork but also provides hands-on experience in scientific research, enhancing students' research interests and innovation skills while making the learning process more interactive and exploratory.

3.1.3 Integrating Modern Teaching Technologies

Modern educational technologies provide new opportunities for physiology experimental teaching. Virtual laboratories enable students to conduct high-risk or high-cost experiments in a simulated environment, such as simulating human cardiac surgery, thereby avoiding operational risks while allowing repeated practice to deepen understanding. Multimedia tools can vividly present abstract physiological processes through animations and videos, such as demonstrating neural impulse transmission, helping students grasp complex physiological mechanisms. Additionally, online teaching platforms allow instructors to share resources, assign homework, and facilitate discussions, achieving a blended online-offline teaching model that improves teaching efficiency and quality.

3.2 Improving the Assessment System

3.2.1 Diversifying Continuous Assessment

A more comprehensive evaluation system should be implemented to assess students' learning progress. Classroom performance should be considered, including attendance, participation in discussions, and innovative insights. Group discussions should evaluate teamwork, communication skills, and contributions to the discussion topics. The experimental operation process should also be incorporated into assessments, focusing on students' proficiency in handling laboratory instruments, adherence to experimental procedures, and ability to handle unexpected problems. A diversified assessment system provides timely feedback on students' learning progress, encouraging active participation in both theoretical and practical learning.

3.2.2 Refining the Evaluation Criteria for Experimental Reports

Experimental report evaluation should be more detailed and scientific. The experimental design section should assess the rationality, innovation, and clarity of objectives. The data analysis segment should examine students' ability to process data, apply statistical methods appropriately, and derive insights from experimental results. The conclusion should evaluate whether students can derive accurate and logical conclusions while reflecting on and discussing their findings in depth. Additionally, aspects such as report structure, writing quality, and logical coherence should be

included in the evaluation criteria. A refined assessment system ensures that students focus on the quality of their reports while cultivating a rigorous scientific attitude.

3.2.3 Aligning Teaching Objectives with Competency Development

Teaching objectives should focus on cultivating students' comprehensive abilities rather than merely reinforcing knowledge retention. Under the New Medical Sciences framework, physiology experimental teaching objectives should be categorized into knowledge acquisition, skill development, and attitude formation. Beyond introducing experimental principles, objectives, methods, and procedures, long-term goals should include independent experimental design to foster innovative thinking and problem-solving skills.

3.3 Strengthening Faculty Development

3.3.1 Establishing a Professional Talent Hierarchy

Building a well-structured faculty team is crucial for improving physiology experimental teaching quality. Efforts should be made to recruit high-level experts with significant research achievements in physiology to infuse fresh perspectives and expertise. Simultaneously, professional development opportunities should be provided for mid-career faculty members, such as attending national and international academic conferences and training programs, ensuring they stay abreast of disciplinary advancements. A mentorship system should be implemented, where experienced faculty members guide younger educators through hands-on training, facilitating professional growth. Encouraging faculty engagement in teaching research and reform projects further enhances instructional capabilities, leading to a balanced, high-quality teaching team.

3.3.2 Incentive Measures and Faculty Development

Incentive mechanisms should be established to encourage faculty participation in advanced studies and innovative teaching. Special funding should be allocated to support faculty attendance at prestigious academic seminars and professional training programs, broadening their academic horizons. Outstanding achievements in teaching reform and scientific research should be rewarded through financial incentives and public recognition, such as awarding "Excellence in Teaching" and "Innovation in Research" honors. A comprehensive faculty evaluation system should be implemented, linking performance assessments with promotions and salary adjustments, motivating faculty members to enhance teaching quality. Additionally, cross-disciplinary research and teaching col-

laborations should be encouraged to expand faculty development opportunities.

3.4 Integrating Ideological and Political Education into Curriculum

Integrating ideological and political education into physiology courses aligns with modern higher education requirements. Rather than directly delivering moral lessons, this approach incorporates real-life cases, experimental observations, and historical developments in physiology to inspire students' engagement. Methods such as problem-based learning, case-based teaching, scenario simulations, and role-playing should be explored to stimulate active participation and critical thinking^[2,3]. Additionally, ethics in animal experiments should be emphasized; medical students should develop a profound understanding and respect for animal welfare and bioethics^[6]. Regulations prohibiting unauthorized photography or sharing of experimental animal images should be reinforced^[7], and proper procedures for handling experimental animals post-experiment should be followed. Furthermore, incorporating the stories of Nobel Prize-winning physiologists into teaching can inspire students to embrace scientific innovation.

4. Effectiveness of Teaching Reforms

The physiology experimental teaching reforms at our institution have yielded positive results. According to an anonymous student survey, overall satisfaction with the revised curriculum reached 92.8%. The "virtual-real hybrid teaching model" (combining virtual simulations with hands-on experiments) was favored by 82.4% of students for addressing equipment shortages and time constraints in traditional experiments. The newly introduced "self-designed experiment module" received 85.1% approval, making it the most popular reform initiative. In terms of cultivating innovative abilities, our students achieved the best results in history at the 2024 National Undergraduate Basic Medical Innovation Research and Experimental Design Competition, winning three provincial third prizes and two national third prizes. Additionally, in the 2024 National Undergraduate Life Sciences Competition, they secured one provincial second prize, one provincial third prize, and one national third prize. These teaching reforms have played a positive role in enhancing the quality of practice-oriented education and establishing an innovative talent cultivation model.

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