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Article

Reform Practice and Exploration of Blended Teaching Guided by Target-Problem Orientation—Taking the Course of Chemical Engineering Principles as an Example

Le Zhang, Jinyi Li, Linhai Duan and Xiuhong Meng *

School of Chemical Engineering, Guangdong University of Petrochemical Technology, Maoming 525000, China

Abstract: In response to the problems in traditional teaching, low classroom participation, and weak innovative thinking and engineering practice abilities, this study proposes a target-problem oriented blended teaching mode and applies it in the course of Chemical Engineering Principles. This mode takes the "trinity" of value guidance, capability cultivation and knowledge impartation as the teaching objective, and realizes the effective achievement of teaching objectives through the chain circulation and reinforcement of process evaluation constructed by the target-problem oriented teaching mode. The reform measures include organizing teaching with the target-problem oriented teaching mode, reconstructing teaching content, integrating online and offline blended teaching, incorporating life and scientific and technological innovation cases, optimizing chapter addition and subtraction teaching design, matching experiments and training activities, and strengthening process evaluation and assessment. After the teaching reform, students' practical application ability and innovation ability have been significantly improved, their learning interest and autonomous learning ability have been enhanced, and the quality of course teaching has been obviously improved. The teaching achievements have won awards many times in national and provincial professional competitions and have been promoted in other university.

Keywords: blended teaching; target-problem orientation; teaching mode

1. Preface

Against the background of current higher education reform [1 – 3], how to effectively improve teaching quality and enhance students' practical application ability and innovation ability has become an important topic in the education field [4–6]. In traditional teaching methods, students are often in a passive state of knowledge reception, with low classroom participation and insufficient cultivation of innovative thinking and engineering practice ability. To address these problems, we propose the "target-problem oriented" blended teaching mode and apply it in the teaching practice of the course of Chemical Engineering Principles. The "target-problem oriented" blended teaching mode takes the "trinity" of value guidance, capability cultivation and knowledge impartation as the teaching objective, and realizes the effective achievement of teaching objectives by constructing the chain circulation of knowledge points and strengthening process evaluation. This mode not only reconstructs the teaching content, but also combines online and offline blended teaching, incorporates life and scientific and technological innovation cases, optimizes the chapter addition and subtraction teaching design,

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* Corresponding: Xiuhong Meng (1119382821@qq.com)

and matches the experimental and training activities. The purpose of this study is to solve the pain points in traditional teaching, such as passive learning, low classroom participation, weak innovative thinking and engineering practice ability, etc. through the implementation of the "target-problem oriented" blended teaching mode. At the same time, this study also discusses the effectiveness of this mode in improving students' practical application ability and innovation ability, as well as its impact on students' learning interest and autonomous learning ability.

2. Pain Points in Teaching Reform

Course teaching is the primary aspect to realize the goal of professional talent cultivation and reflect the educational objectives of university. In traditional teaching, we have found the following common problems: (1) Students are accustomed to passive learning, with low classroom participation, and poor initiative in thinking and exploring problems, which is manifested in the inability to raise questions in class and the high similarity of homework. How can we make students return to individualized and group inquiry learning state? (2) The traditional teaching of chemical engineering principles focuses on principle derivation and theoretical calculation, resulting in weak engineering practice ability and innovative thinking ability of students. How can we effectively improve students' practical application and innovation ability? (3) The course covers a variety of unit operation types, involving complex unit equipment structures and diverse design and calculation methods, resulting in students generally considering the course to be difficult and the content obscure and hard to understand. Therefore, students are not interested in daily learning but prefer to cram before exams.

3. Innovative Reform and Practice of Blended Learning Mode

3.1. General Design Idea

In the online and offline blended teaching design, student-centered and strengthen the "interaction" element; carefully plan chapters and classes, take target problems as the guide and skillfully integrate course ideological and political education to highlight the "High order, innovation and challenge"; the teaching content pursues both depth and breadth, with equal emphasis on professionalism, applicability and interest; with the help of Xuetangx.com Online (MOOC resources) and Rain Classroom APP, comprehensively strengthen the assessment of learning achievements and improve students' participation. See Figure 1 for details.

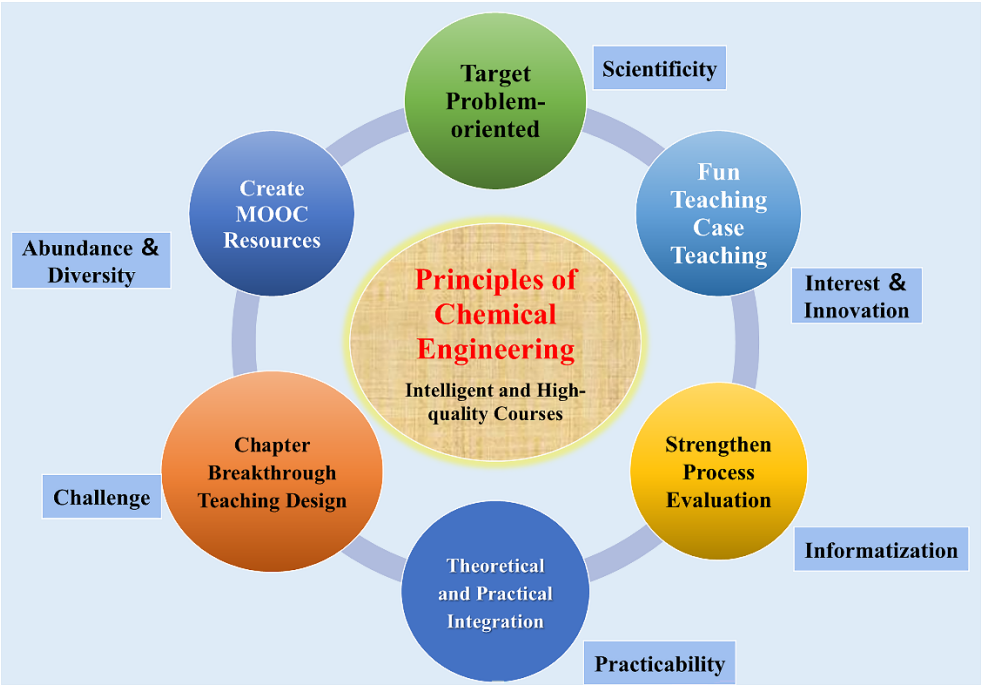

Figure 1. Course design of principles of Chemical Engineering.

3.2. Blended Teaching Reform Based on Target-Problem Oriented

The "target-problem oriented" teaching design is closely carried out around the three-in-one goal of value guidance, capacity cultivation and knowledge impartation. In teaching practice, we take the core problems of knowledge points as the research object, carefully design the "basic problems" for students to self-study before class, guiding them to explore independently; In class, we focus on in-depth analysis of "key problems" and organize group discussions to tackle "difficult problems", so as to improve students' abilities to analyze and solve problems. At the same time, by introducing cases close to life or industrial production practice as "practical problems", the practical application ability of students is enhanced. After class, students are encouraged to explore "expansion problems" by studying technological innovation cases and expanding knowledge points, stimulating their innovative thinking and forming a long chain of in-depth and continuously expanding knowledge learning. In the process of problem design, we pay attention to excavating the ideological and political education elements contained behind theory, phenomenon and practical cases, so that students can receive ideological education imperceptibly and effectively solve the pain points of teaching.

3.3. Reform Chapter Teaching Design

It aims to solve the problem of insufficient class hours caused by the increase of classroom "interaction". Specifically, firstly, the knowledge points are designed by the addition and subtraction method: for the subtracted knowledge points, students are encouraged to learn autonomously; for the added knowledge points, the "target-problem oriented" teaching is adopted to ensure that the teaching focus is prominent and efficient. Secondly, the chapter summary is strengthened. By making chapter videos, mind maps, graphic summaries and unit tests, etc., the chapter content is systematically combed, providing a solid guarantee for solving the "pain point" problem.

3.4. Practice Teaching Reform

(1) Each unit operation is equipped with corresponding experiments, and an on-campus Chemical Engineering Principles Experiment Competition is held regularly. By selecting outstanding contestants to participate in the National College Students' Chemical Engineering Experiment Competition, the comprehensive experimental ability of students is effectively improved.

(2) In cooperation with senior engineers from Guangyou-Ruipai Innovation Design Institute, students are guided in course design. This cooperation not only enhances the practical ability of students, but also significantly improves their comprehensive design ability.

(3) We actively guide students to participate in innovation and entrepreneurship projects, and encourage them to take part in provincial "Challenge Cup" and "Material Innovation Competition" and other competitions. Through these practical activities, the aim is to cultivate students' scientific innovation ability and lay a solid foundation for their future research and entrepreneurship.

4. Innovation and Reform of Teaching Content and Teaching Methods

Chemical Engineering Principles is a highly engineering and practical course. The learning of each unit operation can be divided into five parts: basic principles, theoretical calculation, supporting equipment, practical application and technological innovation. This course is suitable for the teaching mode driven by target problems and cases. Through analysis and exploration, cooperative discussion, flipped classroom and inspired exploration, a long-chain learning path is constructed as shown in Figure 2. Cases of life, production and technological innovation are introduced in the course. Among them, cases in life can effectively stimulate students' interest, cases in production practice can urge students to think deeply, and cases in technological innovation can guide students to explore innovatively, so as to inject vitality into the course teaching.

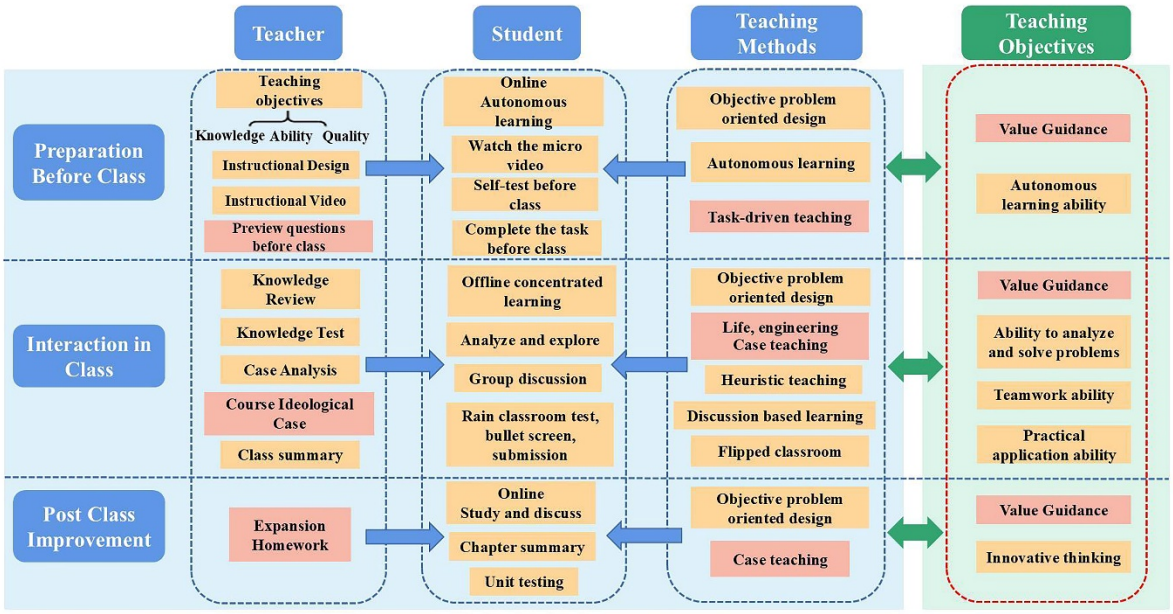

Figure 2. Teaching Process Diagram.

4.1. Enhanced Assessment of Usual Performance

To ensure the effective implementation of the "target-problem oriented" teaching mode, this course focuses on strengthening the assessment of usual performance to urge students to actively participate in online preview, discussion and offline classroom teaching. For details of the specific assessment method, see Figure 3. Through a scientific and comprehensive assessment mechanism, we can ensure that students participate in the teaching process in an all-round and deep-seated way, and improve their learning effects and ability qualities.

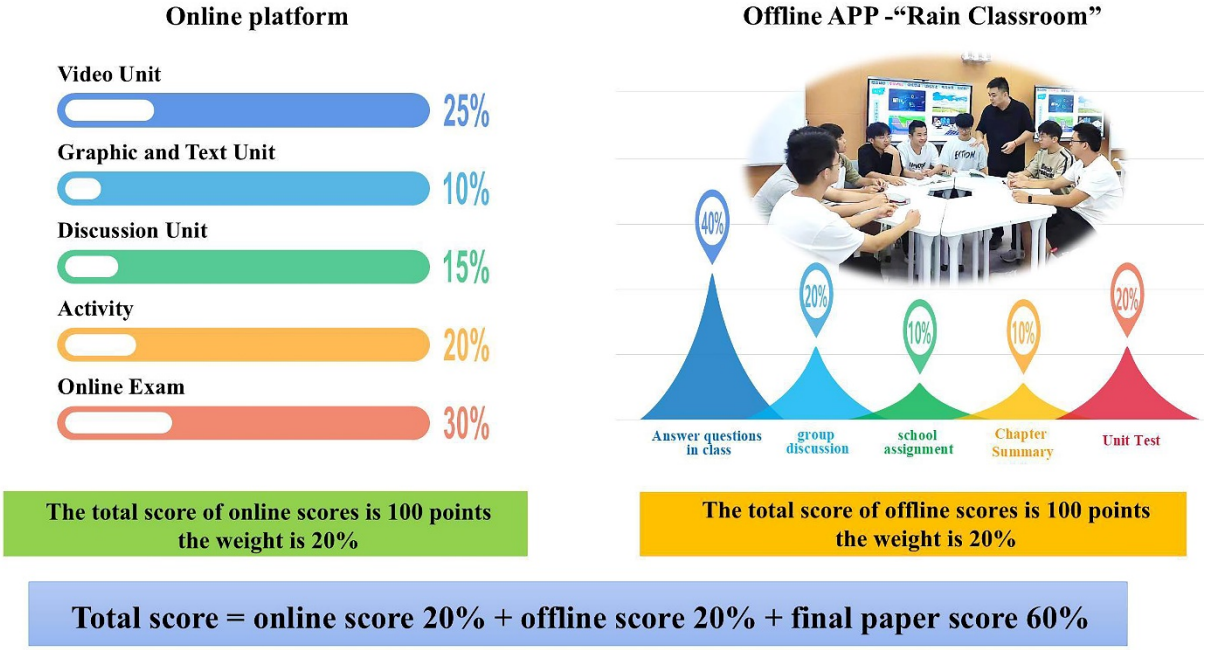

Figure 3. Method for assessing the total score.

4.2. Practice of Blended Teaching Based on Target-Problem Orientation

To address the above teaching pain points, we have innovatively designed a target-problem oriented blended

teaching mode as shown in Figure 4, aiming to achieve efficient teaching. We take the "trinity" concept of "value guidance, capacity cultivation and knowledge impartation" as the overall teaching policy and apply this concept to the teaching of knowledge points, striving to reach multiple goals such as stimulating learning interest, inspiring in-depth thinking, enlightening wisdom, shaping literacy and internalizing values.

Figure 4. Schematic diagram of teaching design of knowledge points.

The teaching design mainly includes two levels: First, the target-problem oriented teaching mode is adopted to reconstruct the scattered knowledge into interrelated knowledge chains through five types of target problems (including basic problems, key problems, difficult problems, practical problems and expansion problems), which progress in a cyclic and progressive manner. By evaluating the achievement of teaching objectives in each class, adjustments and optimizations are continuously made to ensure students' long-term mastery and in-depth understanding of the knowledge system. Second, a dynamic adjustment mechanism around the teaching objectives is constructed, that is, targeted knowledge teaching is carried out to gradually narrow the gap with the established teaching objectives. Meanwhile, combined with teaching evaluation and profound reflection, teaching methods and strategies are continuously improved to more efficiently achieve teaching objectives and improve teaching quality.

To ensure the effective implementation of the target-problem oriented teaching mode, as shown in Figure 5, we have deeply constructed the course from the following six dimensions:

(1) The target-problem oriented blended teaching mode is adopted and approved for provincial online and offline first-class courses and two provincial educational reform projects.

(2) The provincial online open course "Principles of Chemical Engineering in Life" was constructed to expand the influence of the course.

(3) Cases of life, production and technological innovation were deeply integrated into teaching to make the classroom full of vitality and activity.

(4) Course ideological and political cases were effectively integrated to play a role in cultivating virtue.

(5) Exercise library of knowledge points, discussion questions, case questions and ideological and political questions of the course were constructed to enrich teaching resources.

(6) Relying on the national training platform, provincial industrial colleges and provincial experimental centers, an integrated teaching of theory, experiment and practice was carried out to improve students' comprehensive practical ability.

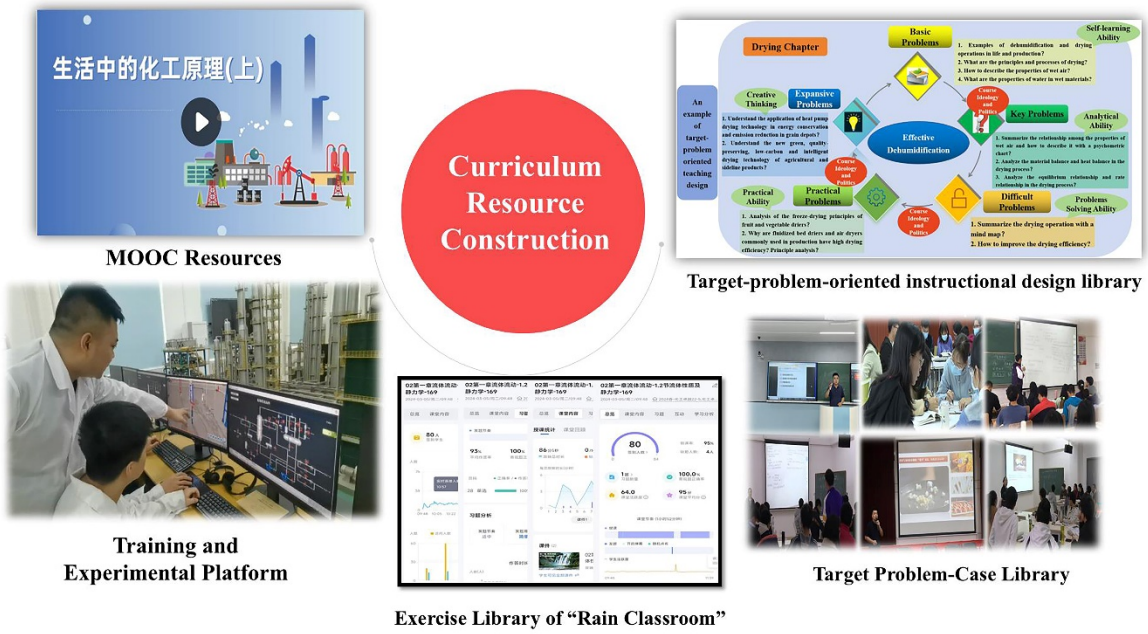

Figure 5. Course resource construction of principles of Chemical Engineering.

5. Innovative Points of Teaching Reform

5.1. Innovation of Educational Concept

The teaching design is closely carried out around the teaching objectives, and the ideological and political education of the course, life examples, production scenes and cutting-edge cases of scientific and technological development are integrated to the classroom, making it a high-level classroom, an open classroom, a dialogic classroom, a speculative classroom, a knowledge-action-integrated classroom, and a wisdom-evaluation classroom (as shown in Figure 6).

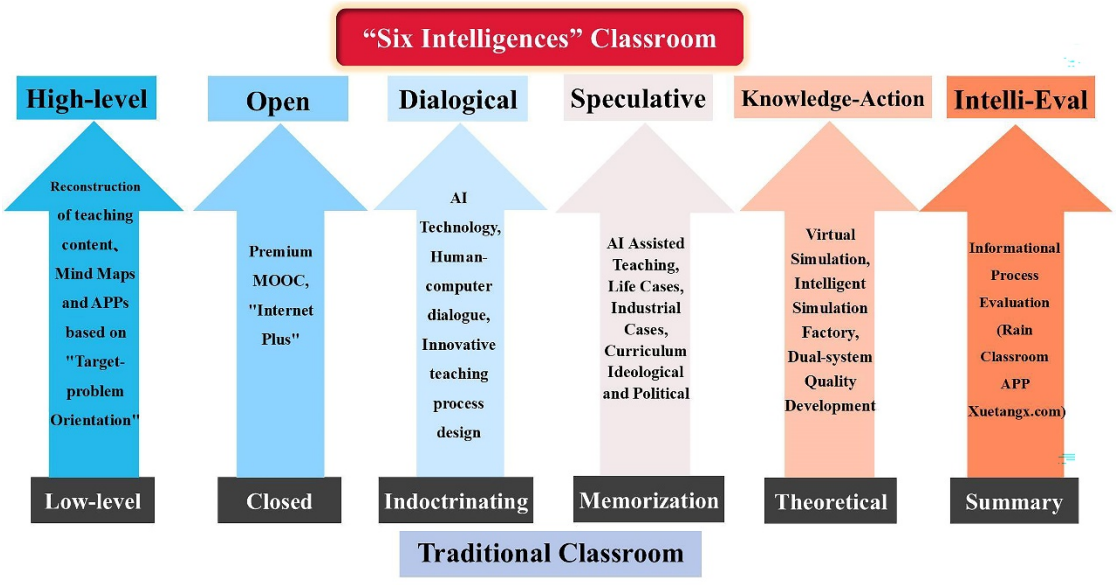

Figure 6. Innovation and reform of educational concept.

5.2. Innovation of Teaching Mode

Actively transform teaching thinking and promote the transformation from traditional mode to intelligent mode. Innovatively integrate the "target-problem oriented" into the blended teaching, reshape the content, reconstruct the

process, and organically integrate value guidance and capacity cultivation into knowledge point teaching.

(1) Highlight the "target-problem oriented", clarify the overall guidelines, make the teaching design objectives clearer, and significantly improve the classroom efficiency;

(2) Pay attention to the "problem knowledge chain", and build a knowledge chain that is progressive and enlightening by solving the "five problems";

(3) Strengthen the "interaction". The "target-problem oriented" mode improves the intelligent teaching mode, transforming the traditional classroom into a high-level, dialogic, speculative, open, knowledge-action-integrated and wisdom-evaluation combined classroom;

(4) Adhere to the "student-centered" principle, highlight the main position of students in the classroom through the design of teaching links, and achieve value shaping and capacity cultivation through the interpretation of the "five major problems";

(5) Attach importance to "instructional design", make "addition and subtraction" for the overall course chapters, the two depend on each other and work together to make teaching more effective.

6. Promotion and Application Effect of Achievements

The teaching design is closely centered around the objectives, and through the long-chain learning of knowledge points, the comprehensive effectiveness of student cultivation is fully demonstrated, and the "painful" problems are effectively solved and improved.

The practical innovation ability of students has been significantly improved, and the teaching achievements are remarkable.

● In 2024, the cultivated students have won the first prize in the National College Students' Chemical Engineering Design Competition for 12 consecutive years. In recent years, they have successively won more than ten projects and awards such as provincial college students' innovation and entrepreneurship projects, the Challenge Cup and the Material Innovation Competition.

● Five years after graduation, the students we trained grew rapidly into advanced workers, technical experts, industry experts and other advanced models in enterprise workshops.

● In 2024, with the "target-problem oriented + intelligent integration" blended teaching mode, they won the third prize in the National College Teachers' Teaching Innovation Competition and the first prize (special award) in the Guangdong Province College Teachers' Teaching Innovation Competition.

● In 2023, "Chemical Engineering Principles" was rated as a national first-class undergraduate course.

● In 2022, the teaching achievements related to "Chemical Engineering Principles" won the first prize of Guangdong Province Education and Teaching Achievements Award.

● In 2021, "Chemical Engineering Principles" was awarded as a provincial curriculum ideological and political demonstration course.

● In 2020, the chemical engineering and technology major was approved as a national first-class undergraduate major.

● In 2019, the chemical engineering and technology major passed the professional certification of China Engineering Education twice successfully.

Students' interests and autonomous learning abilities have been significantly enhanced.

(1) Comparison of academic performance within the same class. With the deepening implementation of the target-problem oriented teaching method, the learning outcomes of students have become more prominent. The proportion of high-scoring areas in both the regular academic performance and final exam scores in the second semester has significantly increased compared to the first semester, indicating a noticeable improvement in the "pain points".

(2) Comparison of final exam scores between parallel classes. The average final exam score of Class Chemical Engineering 21-5, which implemented the target-problem oriented teaching method, was 6 points higher than that of the Chemical Engineering Excellence Class and more than 12 points higher than that of the ordinary Chemical Engineering Class. This also verifies the effectiveness of this intelligent teaching mode and indicates a significant improvement in the "pain points", making it suitable for wider application.

(3) Enhanced learning interest of students. The online teaching of Chemical Engineering Principles has provided a learning platform for students preparing for postgraduate entrance examinations. The number of students who were admitted to graduate schools in 2024 doubled compared to that in 2022.

(4) Enhanced autonomous learning ability of students. The chapter summaries created by students are unique, such as short videos, mind maps and summary notes, reflecting students' thinking and refinement of the content as well as their perseverance and love for the course.

7. Promotion of Achievements

Participate in the construction of other provincial online open courses, and promote our teaching method to other institutions. The relevant teaching mode and educational effects have been recognized by industry experts including educator Huang Daren. The team teachers have given more than 30 keynote reports at domestic and foreign teaching forums, among which there are 7 international reports. A total of 15 institutions came to our school for exchange and learning, benefiting more than 2000 teachers. The educational achievements of this mode have been reported by national and provincial mainstream media such as "China Education Daily", "Southern Daily", "Southern Plus" and "Xuexi.cn".

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The authors have no competing interests to declare that are relevant to the content of this article.

References

1 Adera N. Innovative Learning Spaces and Blended Learning: Quest for 21st Century Competency Teaching and Learning Approaches. *Creating Dynamic Space in Higher Education: Modern Shifts in Policy, Competencies, and Governance* 2025: 139–174.

2 Li M, Han X, Cheng J. *Handbook of Educational Reform Through Blended Learning*; Springer Nature: Berlin/Heidelberg, Germany, 2024.

3 Nagaraja N, Davidson BGJ. Challenges and Transformation of Pedagogy Towards Blended Learning: A Sequential Mixed-Method Study in Higher Education. In *Global Higher Education Practices in Times of Crisis: Questions for Sustainability and Digitalization*; Emerald Publishing Limited: Leeds, UK, 2024; pp. 151–168.

4 Deng X. Research on Strengthening Quality Education and Training Mode of Innovative Talents in Petroleum Universities. *Journal of Education and Educational Research* 2024; **7**(**3**): 348–350.

5 Aithal PS, Maiya AK. Innovations in Higher Education Industry–Shaping the Future. *International Journal of Case Studies in Business, IT, and Education (IJCSBE)* 2023; **7**(**4**): 283–311.

6 Zhao X, Wang X. The Influence of College Entrepreneurship Education System on the Cultivation of Applied Innovative Talents. *Frontiers in Psychology* 2022; **13**: 844234.