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Research on the Impact Mechanism of Teaching Reform on the Cultivation of Students' Innovative Ability

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ABSTRACT

In recent years,with the rapid development of globalization and technology,innovation ability has become a core element of competition in various industries.For a long time,the traditional model of education has focused on imparting knowledge while neglecting the cultivation of students' innovative abilities.For this reason,teaching reform in colleges and universities is imperative.This paper first presents the current situation and trends of teaching reform in colleges and universities at home and abroad,then analyzes the impact of teaching reform on the cultivation of students' innovation ability,and finally explores the cultivation approaches of students' innovation ability under teaching reform,in the hope of providing reference for related teaching work in the future.

1.Teaching reform in universities

Teaching reform in colleges and universities is one of the core tasks for the development of higher education,aiming to meet the demands of talent cultivation in the new era,improve the quality of education,and enhance students' innovation ability,practical ability and social adaptability.In recent years,with the rapid development of digitalization and intelligence,teaching reform in colleges and universities has shown trends[1]such as informatization,personalization,cross-disciplinary and practicalization.The Ministry of Education of China has emphasized deepening teaching reform and promoting the connotative development of higher education in documents such as the Education Informatization 2.0 Action Plan and the Opinions on Accelerating the Construction of High-level Undergraduate Education and Comprehensively Improving the Capacity for Talent Cultivation.In addition to the current industrial upgrading,such as artificial intelligence and the digital economy,which put forward new requirements for talent capabilities,the traditional teaching model has become difficult to meet.In addition,technologies such as artificial intelligence (AI),big data,and virtual reality (VR)are driving innovations in teaching models,such as smart classrooms,online education,and virtual simulation experiments.In this context,colleges and universities urgently need to reform teaching in order to enhance students' innovative thinking and practical abilities.

2.Innovation ability

Innovation is the ability of an individual or group to come up with novel and valuable ideas, methods, or products in a particular field through knowledge integration, critical thinking, and practical exploration. It covers three levels of thinking innovation, method innovation, and practice innovation, and is one of the core goals of contemporary talent cultivation. The key components of innovation ability: (1) Critical Thinking, that is, the ability to question existing theories or methods and propose improvement plans. Einstein's critical thinking about Newtonian mechanics contributed to the birth[2] of the theory of relativity. (2) Divergent Thinking, that is, exploring problems from multiple perspectives and proposing multiple possible solutions. Such as Design Thinking, which emphasizes brainstorming to stimulate creativity. (3) The ability to Transfer Knowledge, that is, to apply knowledge or skills in a particular field to a new situation. Such as bionics, designing drones based on the flight principles of birds. (4) Practical Implementation, that is, the ability to turn innovative ideas into viable products or solutions. As Musk turned the electric vehicle (Tesla) and the recyclable rocket (SpaceX) from concept to reality. (5) Collaborative Innovation, that is, the ability to integrate different perspectives in an interdisciplinary team to drive innovation. For example, Apple combined design, engineering, and marketing teams to create the iPhone.

2. The current situation and trends of teaching reform in universities at Home and abroad

1. Domestic teaching reform

In 2025, the Ministry of Education of China issued the "Notice on Digital Empowerment for Teachers' Development Action", requiring a comprehensive improvement in teachers' digital literacy within 3 to 5 years, integrating technologies such as AI and big data into the entire teaching process, and establishing a teacher digital literacy assessment system. For instance, Nanjing University of Aeronautics and Astronautics initiated the construction of smart courses for graduate students, reconstructing teaching content based on knowledge graphs and large AI models, and promoting intelligent evaluation and digital profiling. Xuchang University builds a "four-dimensional integration" (courses, competitions, research, clubs) engineering education model, and cultivates innovation ability through the "dual-wheel drive" of the science and technology innovation center and the Future Engineers Association, with a student achievement conversion rate of 12.5%[3]. Starting from the class of 2025, Fudan University will use "projects" instead of "majors" as the training unit to support the acquisition of interdisciplinary degrees. The University of Electronic Science and Technology of China's "Pillar Program" lasts for four years. Students participate in real engineering problems, such as the design of temperature control systems, from the beginning of their freshman year to develop systems thinking and stress resistance. Beijing Institute of Technology's "Yanhe No. 1" project breaks down professional barriers and forms multidisciplinary teams to solve complex engineering problems, with process evaluation accounting for 80%.

2. Teaching reform abroad

Teaching reforms abroad have developed much faster than in China. For example, the University of California system in the United States plans to spend 370 million US dollars to return from the Quarter system to the Semester system in order to optimize cross-campus cooperation and internship connection; British universities have shifted their curriculum from subject-oriented to skills-oriented, increasing practical tasks such as business plans and prototyping, reducing the proportion of exams, and emphasizing cross-disciplinary collaboration. The University of Toronto has established the Centre for Critical Qualitative Research in Healthcare, which aims to develop interdisciplinary research capabilities for graduate students in a social critical paradigm, covering multiple fields[4] such as public health and nursing. Some European universities have shortened their doctoral programs to three years, but are facing the squeeze of quantitative evaluation on qualitative research, highlighting the conflict between innovation and tradition. Stanford University in the US and others are using generative AI to assist in instructional design, while British universities are promoting tools like Trello to manage team projects.

3. Commonalities and challenges of teaching reforms at home and abroad

Both at home and abroad, there is an emphasis on the deep integration of intelligent technologies, such as virtual simulation

experiments, intelligent learning situation analysis, and the reshaping of teaching scenarios[5] by AI, VR, etc. It also attaches great importance to cultivating students' critical thinking, complex problem-solving skills, breaking down departmental barriers, and promoting school-enterprise collaboration. However, there are still significant challenges in teaching reform in our country. Traditional teaching still dominates, the evaluation tools for innovation ability need to be improved, digital literacy is seriously lacking, and the approaches for cultivating innovation ability need to be improved.

3. The impact of teaching reform on the development of students' innovation ability

1. Curriculum System Reconstruction: Providing a "knowledge foundation" and "Exploration Direction" for innovation ability

On the one hand, from disciplinary fragmentation to interdisciplinary integration. The traditional curriculum system often centers on the systematicness of disciplinary knowledge, with fixed content and clear boundaries (such as learning only texts in Chinese and only formulas in physics), which, while enabling students to master the basic knowledge, tends to limit the cross-border application of knowledge-innovation often relies on the integration of knowledge from different fields. Breakthroughs in artificial intelligence rely on the intersection of computer science, mathematics, and neuroscience. After the teaching reform, the curriculum is no longer confined to a single disciplinary framework, but rather connects knowledge from different fields through thematic courses and project-based modules. For example, the "New Engineering" program at Zhejiang University requires students to take cross-disciplinary courses, and its student teams have won numerous innovation awards in international robotics competitions. For example, the "Urban Water Resources Conservation" course, which integrates biology (ecological cycling), chemistry (water quality testing), engineering (water-saving technology), and sociology (public advocacy program) (as shown in Figure 1 below); Offer innovative design thinking courses that combine psychology (user needs analysis), aesthetics (product form design), and management (implementation feasibility assessment)[6]. This integration makes students realize that knowledge is not an isolated fragment but a tool for solving problems, and that the awareness of using knowledge to solve real problems is the starting point of innovation.

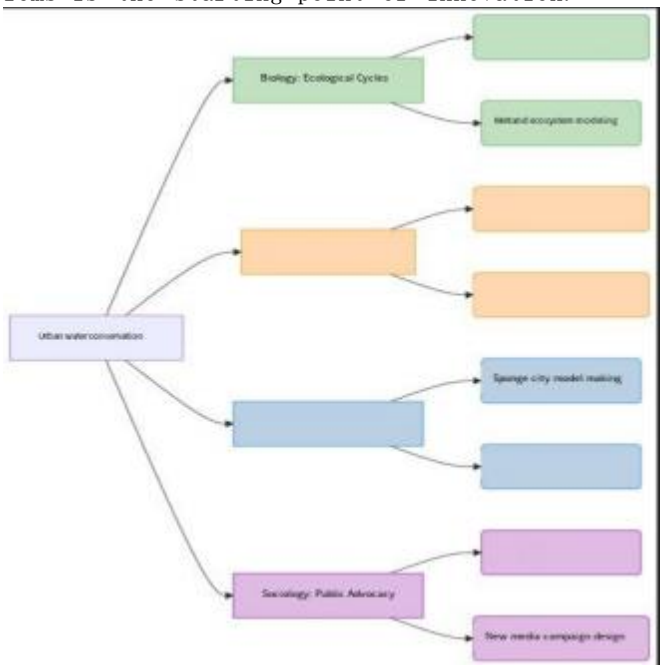

Figure 1 Urban Water Resources Conservation"course

On the other hand, from knowledge coverage to blank space exploration. Traditional courses aim for no omissions in knowledge points, while reformed courses will actively "leave room", not by not presenting all conclusions directly, but by retaining open-ended questions. For example, history classes are no longer just about the timeline of historical events, but instead pose the question, "Would the modernization process have changed if the Qing Dynasty had opened up trade before the Opium War?" Hypothetical questions; After the math class on "triangle stability", guide students to think about "why do chairs in life have four legs but can stand firm?" This kind of "blank space" essentially leaves room for students to think independently. The core of innovation is not memorizing standard answers, but daring to pose new questions and allowing students to actively explore and seek personalized answers.

2 Transform teaching methods: from "passive acceptance" to "active exploration" to cultivate innovative thinking methods

The core of innovation is not a flash of inspiration, but cultivable thinking methods and behavioral habits. The lecture-style approach in traditional teaching, where the teacher speaks and the student takes notes, essentially puts the student in a passive receptive state, where the student's attention is focused on how to remember

the conclusion rather than how to deduce the conclusion or whether there are other conclusions. After the teaching reform, the teaching method needs to be adjusted from teacher-led to student-led in[7] the past. The starting point of teaching has shifted from knowledge points to real problems, such as when a teacher asks "How to design an age-friendly smart bracelet for a nursing home," and then asks students to break down the problem on their own, that is, what functions do the elderly need? Is it technically feasible? How can costs be controlled? Guide students to search for materials and team up to discuss solutions. During this process, students must think proactively: "What are the shortcomings of the existing plan? Is there a better solution?" This is the teaching process

Classroom types	Core Features	Typical Form
First Classroom	Knowledge system construction	Specialized courses, general education, laboratory courses
Second Classroom	Capacity building and interest development	Clubs, competitions, research projects, lectures
The Third Classroom	Practical application and social connection	Internships, volunteer services, school-enterprise cooperation, field research

Training in critical thinking and divergent thinking. Even if the final solution is not mature enough, it can still make students understand that innovation is not a one-time success, but a process[8] of continuous optimization. For example, after the Innovation Design course at Huazhong University of Science and Technology adopted this model, the number of student patent applications increased by 40 percent year-on-year. In the "Pillar Program" of University of Electronic Science and Technology of China, students jointly participated in satellite design projects and incubated 12 innovative enterprises in the past three years.

3. Evaluation Criteria Innovation: Providing "positive feedback" and "continuous impetus" for innovation capabilities

If teaching evaluation is based solely on test scores, students will naturally focus on doing practice questions to improve their scores; Students will be willing to spend time exploring the unknown if the evaluation recognizes innovative attempts and unique thinking. The reform of the evaluation system mainly incentivezes innovation in two ways: on the one hand, from result-oriented to the emphasis on process and result. Traditional evaluation focuses only on test scores and homework answers, while the reformed evaluation incorporates process-oriented performance[9]. For example, in the evaluation of university innovation and entrepreneurship courses, only 40 percent of the business plan is ultimately feasible, while 60 percent is whether user needs have been investigated, whether the plan has been revised more than three times, and whether unique ideas have been proposed in the team. This kind of evaluation makes students realize that even if they don't succeed in the end, the exploration and growth in the process of innovation are valuable, thereby reducing the fear of failure. On the other hand, expand from a single criterion to multiple dimensions. Evaluation after teaching reform no longer measures all students with a uniform scale, but rather recognizes different types of innovation. For example, universities treat patent applications, shortlisted entrepreneurial projects, creative awards in subject competitions, and academic performance equally in the process of recommending students for postgraduate studies and awarding prizes. This multi-faceted evaluation makes students understand that innovation is not the gift of a few people, and that everyone can find space for innovation in their own areas of expertise, thereby stimulating the motivation[10] to keep exploring.

Table 1 Functional Positioning of the Three types of Classrooms

2 Reform teaching methods to enhance core competencies

On the one hand, the reform of teaching methods in colleges and universities should aim at cultivating students' core competencies, and achieve the transformation from knowledge imparting to ability building through innovative teaching models, reconfiguring the roles of teachers and students, strengthening practical interaction and digital empowerment. As shown in Table 2 below: Cultivate students' core

competencies through corresponding teaching methods.

Table 2 Core Competencies of Students and Appropriate Teaching Methods

Core Competencies	Adaptive teaching methods	Typical cases
Critical thinking	Socratic questioning, debating teaching	Debate session of the Harvard Justice course
Interdisciplinary integration skills	Project-based learning (PBL), case teaching	MIT's "New Engineering Education" interdisciplinary project-based course
Innovative practical skills	Design thinking, maker education	Stanford d.school Innovation Workshop
Digital literacy	Virtual simulation, AI-assisted instruction	Zhejiang University's "Zhiyun Classroom" Metaverse experiment
Global Competence	International virtual classroom, scenario simulation	Hai New York University Global Online Collaboration Project

universities should take the path of industry-university-research cooperation and implement the "dual-subject, dual-mentor, dual-cooperation" teaching model, where schools and enterprises jointly lead talent cultivation. First of all, enterprises and schools should clarify the rights and responsibilities of both sides, establish a joint management committee of enterprises and schools, and jointly formulate talent cultivation plans, curriculum systems, and evaluation standards. Schools can set up special funds, and enterprises can participate through donations, equipment investment, and the establishment of scholarships. Enterprise representatives enter the professional construction committees of colleges and universities to participate in professional planning and curriculum development; University teachers participate in enterprise technology research[15] and development. Secondly, integrate teaching resources. Corporate mentors teach in collaboration with university teachers, and companies provide real cases, such as Huawei's ICT Academy and Bosch's Smart Manufacturing course. Embed enterprise technical standards such as AWS cloud certification and SAP ERP courses into the professional curriculum system. Again, implement a dual-mentor system. On-campus tutors help students develop study plans, are responsible for theoretical teaching, and solve professional learning and employment problems; Business mentors guide students in business operations and extracurricular research projects, and assist students in employment[16]. Enterprise internship credit transfer, such as the "3+1" model, that is, three years of on-campus study and one year of enterprise practice. Engineering training and on-the-job internships, research projects and graduation projects are carried out under the guidance of dual mentors, thereby enhancing students' innovation and practical abilities. Finally, achieve dual cooperation. Resource sharing among universities, governments and enterprises is key to promoting regional economic development and facilitating collaborative innovation among industry, academia and research. Local governments build industry-university-research service clouds and publish enterprise demands, university achievements, and policy lists. It also introduced the "Regulations on Promoting Industry-Education Integration", clarifying the rights and responsibilities of the three parties and setting up assessment indicators, such as converting enterprise resource input into social responsibility points. Enterprises provide industry data, such as e-commerce platform consumption data, for research purposes; Share production equipment, such as car manufacturers providing training production lines. Colleges and universities can open up laboratory equipment to transform research results; Adopt a flexible credit system to recognize students' practical experience in enterprises. Universities, governments and enterprises can form a virtuous cycle of complementary resources and value creation that feeds back to the ecosystem, thereby enhancing regional innovation capacity and economic competitiveness.

3 Improve the evaluation system and establish a long-term mechanism

With the increasing autonomy and participation of students, a new evaluation mechanism should be established on the basis of ensuring teaching quality to promote teaching reform and innovation and improve teaching

quality. First, change the evaluation concept. Make innovation as the core indicator of evaluation, rather than focusing only on test scores or memorization of knowledge[17]. Set the goal of cultivating innovation ability in the talent development program and incorporate it into institutional documents such as course evaluation and graduation requirements. Secondly, set up diversified evaluation criteria. This includes subject differentiation, ability stratification, and process growth evaluation. For students in science and engineering, the focus should be on experimental design ability, technological invention, and data analysis ability, which can be evaluated through patents, prototypes, and interdisciplinary project solutions. For art students, the focus should be on the originality of the work, cultural expression, and the integration of technology, which can be evaluated in the form of curatorial plans and cross-media creation portfolios. For students in the humanities and social sciences, the focus is on the depth of social research, theoretical innovation, and policy recommendations, which can be evaluated through field research reports and the construction of original theoretical frameworks. For example, in the case of students' research and innovation ability, at the basic level, they need to be able to reproduce classic experiments/theories and propose solutions to conventional problems; At the advanced level, it is required to improve existing methods/theories and design interdisciplinary research plans; At the excellence level, original theories and techniques are required, and the results are recognized by the industry, such as published papers, competition awards, and technology transfer[18]. The evaluation tools are shown in Table 3 below: Through this multi-dimensional, dynamic and traceable evaluation standard design, universities can ensure basic academic norms and provide personalized growth space for innovative talents. In addition, a variety of incentives such as special scholarships, innovation funds, entrepreneurship funds, credit transfer, bonus points for postgraduate recommendation, and honors and commendations can be established.

Table 3 Multimodal Evaluation Tools

Metrics	Weights	5 points (excellence) standard	3 points (reach) standard
Problem Findings	20%	Raise key unresolved issues within the domain	Identify the limitations of existing research
Methodological innovation	30%	Develop entirely new experimental/analytical methods	Optimize by combining two existing methods
Social value	15%	The outcome has clear potential for industrialization/policy impact	Address specific problems in limited scenarios

4 Build a practice platform to foster an innovative mindset

Cultivating students' innovation ability in colleges and universities is a systematic project that requires the integration of resources both inside and outside the school, the innovation of management models, and the integration into the entire process of talent cultivation. Colleges and universities are required to provide students with a real practical environment, stimulate their curiosity and spirit of exploration, cultivate problem-solving, interdisciplinary collaboration, hands-on practice, resilience, and create an innovative culture that is open, inclusive, and encourages trial and error and cross-border communication. First, build basic experimental and practical training platforms. Break down departmental barriers and establish interdisciplinary, university-wide open public experimental platforms such as maker Spaces, basic manufacturing workshops, and public testing platforms, providing basic equipment, tools, and technical support such as 3D printing, laser cutting, basic electronics, basic biology, etc. Upgrade traditional laboratories, reduce verification experiments, and increase the comprehensiveness, design, and inquiry of experiments. Secondly, build specialized practice platforms. Build specialized laboratories that integrate multi-disciplinary resources around artificial intelligence, biomedicine, new energy, new materials, smart agriculture, etc., support frontier exploration and in-depth research, and deeply build with enterprises and research institutions, introduce real industrial problems, technical demands and

R&D projects, and provide opportunities[19] to access the frontiers of the industry. Again, build an integrated innovation and practice platform. Integrate the school's innovation and entrepreneurship education resources and provide one-stop services including courses, mentors, project incubation, competition organization, and investment and financing matching. Provide free and open physical Spaces, basic tools, small equipment and technical community support, and encourage students to initiate projects independently, make hands-on works and exchange ideas. Support students to form interest-driven, project-driven societies such as robotics clubs, programming clubs, smart car studios, social innovation groups, etc., and provide space, small funding and guidance. The school system organizes and supports students to participate in influential subject competitions at home and abroad, such as Challenge Cup, Internet Plus, ACM Programming, Mathematical Modeling, Robotics Competition, etc., to promote learning and innovation through competition. Use technologies such as VR/AR, cloud computing, and big data to create virtual practice environments that simulate complex systems, expensive equipment operations, or high-risk environments. Finally, build a platform for social practice and technology transfer. Colleges and universities work with communities, rural areas, enterprises and public welfare organizations to establish stable social practice bases and guide students to apply their professional knowledge to solve practical social problems. Provide entrepreneurship guidance, office space, legal advice, seed funding and industrial resource connection for student innovation projects with market potential to facilitate the transformation and application of results. Regularly organize innovation achievement exhibitions, roadshow days, technology trade fairs, etc. to facilitate the connection of student projects with social capital and market demand. Organize activities such as innovation lectures, workshops, hackathons, innovation carnivals, and failure experience sharing sessions to foster an atmosphere[20] of daring to take risks, tolerating failures, and being willing to share. In summary, building a practical platform to cultivate students' innovation ability is by no means simply building a few laboratories or maker Spaces. It requires ideas first, systematic design, mechanism guarantee, resource input and cultural immersion, and in combination with its own disciplinary characteristics, resource endowments and development orientation, student-centered and ability-oriented, To build an open, collaborative and sustainable innovation practice ecosystem, we can truly ignite students' innovative sparks and cultivate future-oriented innovative talents.

V. Closing Remarks

Teaching reform in colleges and universities is the key engine for cultivating students' innovation ability. It is necessary to break through the traditional knowledge-imparting model and build a new teaching system centered on students and oriented towards ability. By reforming the curriculum system and establishing core courses; Reform teaching methods to enhance core competencies; Improve the evaluation system and establish a long-term mechanism; Build practical platforms, cultivate innovative consciousness and other measures to develop students' innovative ability, and ultimately provide society with compound talents.

References:

[1]Lv P. Exploring the Reform and Innovation Path of Physical Education in Colleges and Universities under the Background of the Internet[J]. Applied Mathematics and Nonlinear Sciences, 2024, 9 (1): 56-57.

[2]Ma X. The Contribution of Vocal Music Education in Colleges and Universities to Cultural Inheritance and Innovation[J]. Journal of Contemporary Educational Research, 2024, 8 (8): 154-160.

[3]Luan J. Research on the Reform of Translation Teaching for English Majors by TBLT under the Background of AI[J]. English Language Teaching, 2023, 16 (9): 8.

[4]Music-guided imagination activity combined with multimodal movement on college students with autism[J]. CNS Spectrums, 2023, 28 (S2): 100-101.

[5]Ledrew E, Ryerson R. The Evolution of Remote Sensing Education in Canada's Universities and Colleges: Decades of Innovation and Expansion[J]. Canadian Journal of Remote Sensing, 2023, 49 (1): 18.

[6]Yang S. Innovation of Physical Education and Health Curriculum Teaching Models in Colleges and Universities in the Digital Era and Its Contribution to Students' Core Literacy[J]. Applied Mathematics and Nonlinear Sciences, 2024, 9 (1): 78-79.

[7]Sun Y. Research and Innovation of Physical Education Teaching in Colleges and Universities in the Context of Big Data[J]. Applied Mathematics and Nonlinear Sciences, 2024, 9 (1): 145-146.

[8]Shi G. Construction and Management of Innovation and Entrepreneurship Laboratories in Colleges and Universities[J]. Engineering Advances, 2023, 4 (11): 15-16.

[9]KAI ZHANG. Research on the Reform Path of Music Teaching in Colleges and Universities in the Era of Artificial Intelligence[J]. Applied Mathematics and Nonlinear Sciences, 24, 9 (1): 89-90.

[10]YANCHENG TAO,FANG HAN.Research on the Implementation Strategy of the Integration of Students'Civic and Political Education and Information Technology in Innovation and Entrepreneurship Education in Colleges and Universities[J].Applied Mathematics and Nonlinear Sciences,25,10(1):407-408.

[11]Wang,X.,&Cheng,M__Curriculum reform in Chinese universities:Youdaoplaceholder0 innovation through interdisciplinary programs.Higher Education Policy,2021,34(3):567-585.

[12]Li,Y.,Wang,K.,Xiao,Y&Froyd,J.E.Research and trends in STEM education:A systematic review of journal publications.International Journal of STEM Education,2020,7(1),1-16.

[13]Wang,C.,Shi,Y&Jiang,S.The early bird catches the flywheel:Pedagogical components of entrepreneurship education in American higher education institutions.Education+Training,2024,66(5):789-805.

[14]Li,L.,Chen,Z.&Tang,C.Exploring innovations in the undergraduate tutorial system paradigm in the era of mega science.Journal of Higher Vocational Education,24,1(1):34-48.

[15]Wang,P.Strategic research on English teaching reform in colleges and universities supported by artificial intelligence technology.Applied Mathematics and Nonlinear Sciences,24,9(1):11-12.

[16]Nevhudoli,N.D.Decolonizing universities pedagogy in creating space for an engaged teaching and learning.South African Journal of Higher Education,2025,39(2):45-62.

[17]Fuentes,M.A.,Zelaya,D.G.,&Madsen,J.W.Rethinking the course syllabus:Considerations for promoting equity,diversity,and inclusion.Teaching of Psychology,2021,48(1):69-79.

[18]Echeverri-Sucerquia,P.,&Sierra-Piedrahita,A.The journey towards English syllabi unification:The case of a private Colombian university.Colombian Applied Linguistics Journal,24,26(1):89-90.

[19]Yang,H,etal."Mentorship+Competition Empowerment+Growth Portfolio":A tripartite model for innovative talent cultivation.Journal of Educational Innovation,25,18(3):112-130.

[20]Gao,J.Exploration of the reform path of English classification teaching in applied undergraduate colleges.Journal of Educational Development,2024,45(7):19-23.