



Research on the Key Links of Blended Teaching in Applied Colleges under the Digitalization of Education

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Abstract. It has become a global consensus to accelerate the Digital transformation of education. Based on the characteristics of application-oriented undergraduate talent construction, this paper first analyzes the development direction of digital education and blended teaching, and draws on the OECD model framework to establish an analytical framework for blended teaching. Starting from the bottleneck problem of blended learning in the past, this paper proposes a learning and practical blended teaching system and method that gradually progresses from introducing basic knowledge to innovative ability. Explore teaching cases and design methods systematically, study the optimal configuration mode of blended teaching, propose a multi-dimensional teaching evaluation method, and provide useful reference for the research of applied undergraduate blended teaching under digital education.

Keywords: education digitization; application-oriented; blended teaching

1 Introduction

Digitalization of education has become a strategic support and necessary path for countries around the world to promote high-quality and sustainable development of education. The rise of Big data, block-chain, artificial intelligence and other technologies marks the arrival of the Industry 4.0 era. Throughout the entire history of human development, every technological innovation has had a profound impact on various fields of society. At present, human society is in a critical period of transition from industrialization to digitization and intelligence. The overall outbreak of COVID-19 has further catalyzed the digital process of education, and all links in the education system are facing the challenge of business restructuring^{[1][2]}.

In order to adapt to the development trend of education digitization, countries and regions have formulated corresponding education digitization strategies. The European Commission released the Digital Education Action Plan (2021-2027) in 2020, which clearly proposes a long-term strategic vision for high-quality, inclusive, and accessible digital education in Europe. In 2018, the Netherlands issued the Dutch Digitalization Strategy, which gives predictions and suggestions on the Digital transformation of education. In April 2022, Ireland released the Digital Strategy for

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Schools to 2027, aiming to ensure that all learners have the opportunity to acquire knowledge and skills that adapt to the constantly evolving digital world. In 2020, the State Council of China issued the "13th Five Year Plan for the Development of National Education", which clearly stated that "actively promote the integration and innovative development of information technology and education, and strive to build a networked, digital, personalized, and lifelong education system." This indicates that the construction of digital education resources in China has become an important component of the development of national education, which brings new opportunities for the construction and development of digital education resources^{[3][4]}.

To sum up, it has become a global consensus to accelerate the Digital transformation of education. At present, domestic and international research is usually limited to a certain region, with few comparative analyses conducted between different regions. Most research or reviews focus on professional fields, and few scholars focus on how to apply these achievements to blended teaching methods. Therefore, this paper aims at the key technologies of hybrid teaching, uses the life cycle system research method, and combines the empirical research status of Digital transformation of education at home and abroad in recent years, to explore the difficulties and pain points in hybrid teaching practice under the background of Digital transformation, and proposes key technologies for solutions to provide reference for similar research^[5].

2 Digitalization of Education and Blended Teaching

Digital transformation of education refers to the use of digital technology to promote all-round innovation and change in teaching paradigm, organizational structure, teaching process, evaluation methods, etc. The Digital transformation of education will help regional and school managers to break through the difficulties in the convergence and circulation of education data and the reform of governance methods, help teachers activate the value of education data, and enable the pain points of teaching practice. The Digital transformation of the education industry is different from the informatization transformation and digital upgrading of other industries. The inherent complexity of the education ecosystem, coupled with difficulties in data fusion, school governance, and digital intelligence decision-making, affects the effectiveness of the Digital transformation of education. With the digital process in the industrial field, the evolution of the four stages of manual production, mass production, Lean manufacturing and customized production has been realized. The Digital transformation of education is different from the industrial field, which focuses on the intelligent personalization of human development^[6]. The evolution diagram of Digital transformation in education and industry is shown in Figure 1.

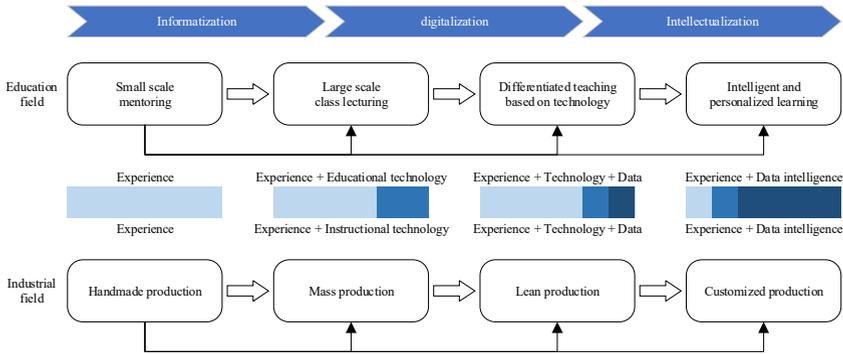


Fig. 1. Schematic Diagram of Digital transformation in Education and Industry

Blended learning is a "online" and "offline" teaching approach that combines the advantages of online and traditional teaching. The organic combination of two teaching organizational forms can lead learners' learning from shallow to deep to deep learning. Although there is a widely recognized and broad definition of blended learning as "the combination of online learning and face-to-face teaching," the concept of blended learning has undergone an increasingly clear evolution since the late 1990s. The evolution of the concept can be divided into three stages, as shown in Table 1.

Table 1. The Evolution Stage of the Concept of Blended Teaching

| | Technology application stage | Technology integration stage | "Internet plus" stage |
|----------------------|---|---|--|
| Physical dimension | The combination of online and face-to-face teaching | Clarify the proportion of online users | Combination of Mobile technology, online and face-to-face teaching |
| Teaching dimension | Application of technology | Blending of teaching strategies and methods | learning experience |
| Focus | information technology | interactive | Students-centered |
| Focus on perspective | Technical perspective | Teacher's perspective | Student's perspective |

The World Organization for Economic Cooperation (OECD) has proposed an e-commerce analysis framework when analyzing the level of industry adoption and use of information technology, which includes three dimensions of indicators: readiness, application, and impact. Blended teaching, as a way of educational transformation driven by information technology, can draw inspiration from the OECD framework, where "application" is manifested in the design and implementation of blended teaching. Following this approach, establish an analytical framework for blended learning, as shown in Figure 2.

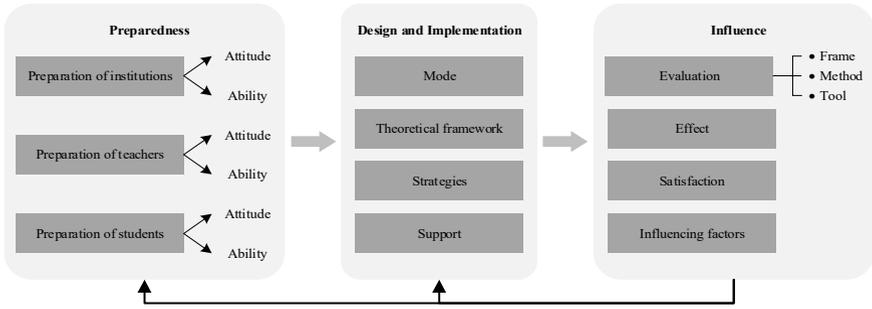


Fig. 2. Drawing inspiration from OECD's blended learning analysis framework

3 Characteristics and Existing Problems of Applied Undergraduate Education

Applied technology undergraduate refers to a general undergraduate institution that focuses on the type of applied technology rather than academic education. It is a relatively different type of undergraduate education from academic undergraduate education. Applied undergraduate education has played a positive role in meeting the needs of China's economic and social development, high-level applied talents, and promoting the popularization of higher education in China. Applied undergraduate education is a level of higher vocational education, which has distinct technical application characteristics compared to ordinary undergraduate education. In terms of training standards, applied undergraduate programs do not cultivate disciplinary, academic, or research-oriented talents, but rather cultivate higher technology applied talents who meet the needs of production, construction, management, and service frontline; In terms of training mode, applied undergraduate programs aim to adapt to social needs, with the main focus on cultivating students' technical application ability. They design a training plan for students' knowledge, ability, and quality structure, with "application" as the main theme and feature to construct a curriculum and teaching content system, and attach importance to the cultivation of students' technical application ability^[7].

Based on this positioning, the current practical problems that urgently need to be solved in the development of online and offline blended teaching in applied undergraduate education have been summarized. One is that traditional teaching content focuses on imparting and applying knowledge, which is difficult to meet the future requirements for talent abilities. At present, the teaching content of the course focuses on the teaching and application of knowledge points, ignoring what problems knowledge points are generated for and the methodology for solving problems, and also lacking the ability to cultivate students' independent thinking through Critical thinking. The second is that the learning atmosphere is weakening, the communication and interaction are insufficient, and the effect of E-learning is difficult to guarantee. The biggest advantage of face-to-face classroom teaching is that it can ensure timely communication of information, and teachers can quickly

grasp the effectiveness of knowledge transmission by observing students' expressions and eyes. However, the time and space between online education and learning are relatively separated, making it easy for students to form online "islands" when teaching abstract traditional knowledge points. Thirdly, the online and offline experimental teaching resources for applied undergraduate programs are not abundant enough, and personalized services are insufficient to stimulate students' interest. The source of course resources is single and mostly procurement resources. Video courses related to current events and new technologies cannot keep up with students' learning needs, making it difficult to flexibly adjust the difficulty based on their most direct needs and feelings during the learning process, and it is difficult to stimulate students' interest. Fourthly, the cultivation of students' abilities in blended teaching lacks objective evaluation methods. Assessing the effectiveness of conducting online and offline course teaching is a challenge in previous educational informationization reforms. The goal of online and offline course teaching should be to cultivate applied undergraduate talents with basic theoretical, practical abilities, and innovative spirit. Therefore, it is urgent to explore a scientific evaluation system to evaluate the effectiveness of integrating online and offline practice^[8].

4 Key links and methods of blended learning

In response to the above issues, by addressing the bottleneck issues of blended learning such as difficulty in ensuring learning outcomes, difficulty in stimulating students' interest, and difficulty in comprehensive evaluation, we fully pay attention to the characteristics of cultivating new engineering theory and applied undergraduate practical talents, deeply explore diversified online and offline teaching designs, and establish a ability evaluation strategy that emphasizes both theory and practice. The system is shown in Figure 3. The system aims to conduct research and exploration work on the key links of applied undergraduate blended teaching under the digitalization of education by comprehensively constructing a learning and practical blended teaching method that progresses from introducing basic knowledge to innovative abilities.

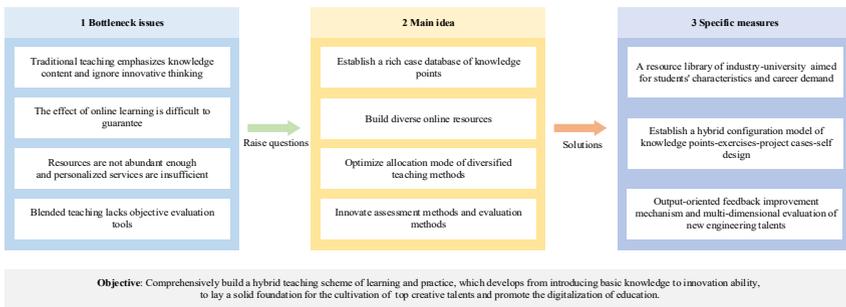


Fig. 3. A blended teaching system with gradually improving abilities

4.1 Building a knowledge point traceability case library.

Sort out the important knowledge points of the course, form the background and related technological development path through the knowledge points, summarize their academic ideas, and at the same time, explore the application boundaries and limited examples of the knowledge points, collect and write case libraries for these two aspects, solve the problem of "where" and "why" knowledge, inspire students to discuss and expand the case library.

4.2 Building diversified online teaching resources.

The new engineering curriculum needs to achieve the cultivation of innovation ability, engineering practice, and patriotism, including both theory and practice. The existing online resources have not yet organically integrated theory and practice, and the explanation of knowledge points is single. Therefore, it is necessary to fully utilize the flexibility and rich imagery of online teaching, integrate industry development with theoretical teaching content, and combine engineering practical problems and key core technologies with cutting-edge basic theories, principles, and methods to build a diversified online teaching resource.

4.3 Optimized configuration mode of mixed and diversified teaching methods.

Because online and offline teaching have various forms of content and have different advantages and disadvantages, this brings various possible forms of integrated online and offline teaching. How to better leverage the unique advantages of online and offline teaching, teach students according to their aptitude, more effectively achieve the "Five Education" and comprehensively improve the quality of education, is the value pursuit of integrated online and offline teaching. Deeply explore the configuration of different teaching methods and the impact of integrated online and offline teaching modes on improving courses, seek the optimal allocation and integration mode of online and offline teaching content, and explore new paths for the construction of new engineering courses in the new era.

4.4 Innovation of blended teaching assessment methods and evaluation methods

Exploring diversified assessment and evaluation methods for the teaching effectiveness of blended courses, combining theoretical exams with practical evaluations, and combining regular final exams with regular training, online discussions, and practice. Use the Big data analysis function of teaching tools to evaluate the effectiveness of hybrid teaching in multiple dimensions. The evaluation of effectiveness is evaluated using objective and non objective indicators, exploring a professional course assessment and evaluation method that is suitable for the characteristics and requirements of the new engineering discipline.

5 Research methods and specific measures

5.1 Strengthen the construction of online case resources based on student characteristics and professional needs

By conducting questionnaire surveys and interviews, we carefully investigate and analyze students' learning characteristics and needs, in order to gain a deeper understanding of their preparatory knowledge, age characteristics, and learning needs. When organizing teaching content, taking into account the learning characteristics of university students, the latest technology in their major, frontline engineering cases, and the real needs of enterprises, further strengthen the reform of teaching content and methods, scientifically and reasonably integrate teaching objectives with actual cases, and construct comprehensive online resources such as video explanation, code transparency, thinking expansion, and ideological and political integration. Diversified practical cases meet students' different needs such as interests, learning progress, and professional directions.

5.2 Establish a hybrid configuration model of knowledge points-exercises-cases-independent design

By discussing the knowledge point complementarity mode, exercise flipping mode, project case cooperation mode, and self-designed online teaching content configuration based on the teaching syllabus, and analyzing the data of teaching objects, teaching objectives, teaching content, and real-time feedback from students, the rationality of mixed configuration is deeply analyzed. Make full use of pocket laboratories and remote semi physical platforms to build a virtual experimental teaching platform from three levels: system construction, comprehensive design, and theoretical application. Integrate online teaching and virtual experimental platforms organically, promoting students to freely and independently connect and transform theoretical knowledge, design methods, and specific applications.

5.3 Based on an output oriented evaluation system for applied talents

The evaluation of theoretical teaching effect adopts the combination of objective test scores and non objective scale survey. The design of Final examination questions is divided into three categories: the content of knowledge points, the application of knowledge points, the synthesis of knowledge points, and non-standard examination questions. The two teaching modes are compared and statistically evaluated by the scores of classified examination questions. Design a scale to measure students' level of interest and achievement in the two teaching modes, and complete a non objective evaluation of the effectiveness of teaching reform through the collection of questionnaires.

6 Conclusion

Information technology, especially artificial intelligence, is profoundly affecting curriculum teaching. This impact involves two aspects, one is the target content and teaching methods of "teaching", and the other is the ability structure and knowledge acquisition channels of "learning". Based on sufficient research on students' learning situation and teaching data, an innovative hybrid teaching system with gradually improving abilities is proposed. Exploring new engineering online teaching cases and design methods that integrate school and enterprise systems, researching the optimal configuration mode of blended teaching knowledge points, exercises, cases, and independent design, proposing an evaluation method based on objective and non objective data for multi-dimensional educational reform effectiveness and student ability improvement, promoting the new construction of educational evaluation theory. This system can promote the reform of online and offline blended teaching in the context of new engineering disciplines, and can provide guidance and reference for similar research.

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