Practical Path Research to Building Informatized Basic Teaching Environments in Higher Education Institutions

Lu Ren, Shiyong Huang*

Network Information Center, Wuhan University of Technology, Wuhan 430070, Hubei, China

*Corresponding author: hsy@whut.edu.cn

Abstract. Driven by the deep integration of information technology into educational reform as well as the national educational modernization strategy, building an efficient, intelligent, and ubiquitous informatized basic teaching environment has become essential for higher education institutions to improve their quality of personnel training. Within this context, higher education institutions in China have implemented extensive active exploration and practice, during which a myriad of challenges, encompassing construction fragmentation, data islands, unbalanced investment, and lack of experience, have been exposed. Taking the construction practice of W University, which aims at becoming a model of digital transformation, as an example, this research constructs a five-dimensional collaborative model covering technology, platform, resources, ability, and system, which is characterized by an informatized basic teaching environment that empowers teaching and learning. In short, the proposed model furnishes an operational blueprint for other universities to develop their teaching space transformation, platform integration and optimization, curriculum resource reconstruction, and ability improvement mechanism.

Keywords: Higher education institutions; Informatization; Teaching Environment; Empowerment; Practice

1 Introduction

Under the wave of digital transformation of global education, the deep integration of information technology and education has evolved into a core driving force for educational reform in higher education institutions. In this regard, General Secretary Xi Jinping explicitly proposed that the digitalization of education serves as an important breakthrough for China to open up a new track of educational development and shape novel advantages of educational development [1]. To achieve this objective, China has successively issued policies such as the Action Plan for Education Informatization 2.0 and China's Education Modernization 2035, which clearly put forward the idea of "smart education" to promote the innovation of teaching mode, thereby creating ubiquitous, flexible, and intelligent teaching environments [2]. Additionally, the Guiding Opinions of the Ministry of Education and Other Six Departments on Promoting the

N. B. Abdul Ghani et al. (eds.), *Proceedings of the 2025 6th International Conference on Big Data and Social Sciences (ICBDSS 2025)*, Advances in Computer Science Research 126,
https://doi.org/10.2991/978-94-6239-598-5_7

Construction of New Educational Infrastructure and Constructing High-quality Education Support System, coupled with the Code for the Construction of Digital Campus in Higher Education Institutions, provides technical top-level design and theoretical guidance for the construction of informatized teaching environment in higher education institutions. In this foundation, it is urgent for higher education institutions to explore practical paths of informatized teaching environment with prominent feasibility in order to address emerging challenges and opportunities during the process of educational reform.Taking the construction practice of W University, which aims at becoming a model of digital transformation, as an example, this research constructs a five-dimensional collaborative model covering technology, platform, resources, ability, and system, which is characterized by an informatized basic teaching environment that empowers teaching and learning. In short, the proposed model furnishes an operational blueprint for other universities to develop their teaching space transformation, platform integration and optimization, curriculum resource reconstruction, and ability improvement mechanism.

2 Research Status and Significance

The teaching environment in higher education institutions still faces numerous structural contradictions, which restrict the in-depth promotion of educational digital transformation.

(1) Limited Functionality of Teaching Spaces.the functions of teaching spaces are monotonous and difficult to support new teaching models such as blended and flipped classrooms. Baig M I et al. conducted a systematic review and research, pointing out that the promotion of flipped classrooms in higher education still faces the problem of "incompatibility between classroom space and tool functions", which limits the teaching effect and is mentioned multiple times in the research that "insufficient design of physical and virtual spaces affects teaching quality" [3].

(2) Fragmented Resources and Tools.Many educational technology researches and industry annual conference papers indicate that while universities operate on multiple platforms simultaneously, there are widespread problems such as scattered teaching resources, fragmented tools, and lack of effective integration among systems, resulting in insufficient data interconnection between different platforms, resource duplication, and management redundancy, which to some extent restricts the systematic support and efficiency of the information environment for the teaching process [4].

(3) Uneven Development of Faculty Digital Literacy.Multiple surveys on faculty digital teaching competence in universities reveal that about 40% of teachers can effectively integrate information technology into course design. A significant portion still primarily operates at a basic application level characterized by "slide presentations + resource uploading," with insufficient depth in integrating pedagogical design with digital tools [5].

(4) Weak Support for Personalized Student Learning.Most domestic universities have not established systematic learning behavior profiling or personalized early warning mechanisms. The dynamic support needed for "teaching students according to their

aptitude" (personalized learning) requires strengthening [5].Nevertheless, intelligent classrooms that practically realize the functions of behavior recognition and data feedback analysis of artificial intelligence (AI) are still in the pilot stage, the main issues are the insufficient spatial literacy of teachers and the mismatch between traditional assessment methods and new spaces[6].

(5) Lack of Data-Driven Teaching Management and Resource Allocation.Although many institutions have built teaching data platforms, their overall data governance capabilities and resource scheduling efficiency remain limited. Phenomena such as platforms being "built but unused" or "used but unevaluated" persist.

Also the current research on teaching informatization in higher education institutions generally focuses on theoretical research such as platform construction, application of single technology, or top-level design, rarely investigating the overall construction of teaching environment and its empowerment path from a systematic and practical perspective. To this end, this paper discusses the prominent issues related to the informatized teaching environment construction during the process of teaching reform in higher education institutions. Particularly, through the in-depth analysis of the exploration and practice of W University, which aims at becoming a model of digital transformation, this research sums up feasible paths for the construction of informatized teaching environment, providing a referable blueprint for other higher education institutions to develop their teaching space transformation, platform integration and optimization, curriculum resource reconstruction, and ability improvement mechanism.

3 Theoretical Basis and Analytical Framework of Practice Path

According to the research implemented by Zhu et al. (2021), the new infrastructure related to educational informatization should focus on six elements, including information network, platform system, digital resources, intelligent campus, innovative application, and credible security [7]. Simultaneously, Sun et al. (2019) proposed that the supporting environment system of informatized practice teaching covers five elements, encompassing informatized teaching infrastructure, informatized practice teaching resources, informatized practice teaching application system, informatized practice teaching management platform, and informatized practice teaching talent team [8]. Furthermore, Wu et al. (2025) argued that the intelligent learning environment can be defined as an architecture environment that integrates physical, informational, social, and psychological spaces and adaptively provides personalized learning support based on scenes, data, models, resources, tools, and services [9]. The UC Berkeley has taken the construction of instructional resilience as its theme, promoting the renovation of classroom facilities and the integration of teaching tools, and establishing a inclusive classrooms that supports online, offline, and hybrid teaching[10].Based on the existing research, this research combines the theory of educational informatization, the theory of intelligent teaching space construction, and the theory of digital transformation management, thus forming a theoretical basis and analytical framework of practical paths.

More specifically, from the ecological perspective, this research regards the informatized teaching environment as a teaching ecosystem composed of space, platform, resources, people, and system. All the elements are interrelated and work together to promote teaching activities and achieve teaching goals. Such a perspective breaks through the limitation of a single technology or platform, emphasizing the coordinated evolution and sustainable development of the whole system. On this basis, from the perspective of the whole-process empowerment logic, this research highlights the closed loop formed by teaching tasks, technical support, data flow, and behavior change in each stage before, during, and after class. Instead of being limited to a single link, the role of informatized environment runs through the whole teaching process. Through data collection, analysis, and feedback, the informatized environment further continuously optimizes teaching behavior, thus forming a virtuous circle.

The five-dimensional collaborative model is designed to offer specific practical guidance. In this connection, by constructing a five-dimensional collaborative system covering technical foundation, platform application, resource content, capacity building, and institutional guarantee, the proposed model highlights the key link with platform and data as the core, as demonstrated in Figure 1:

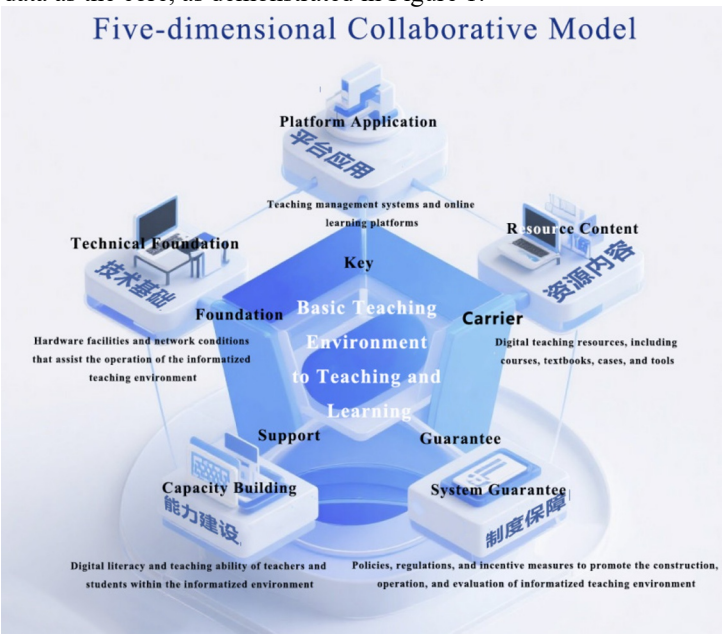

Fig. 1. Five-dimensional Collaborative Model of the Empowerment of Informatized Basic Teaching Environment to Teaching and Learning

As shown in Figure 1, first of all, the technical foundation refers to the hardware facilities and network conditions that assist the operation of the informatized teaching environment, such as intelligent classrooms and high-speed networks. Secondly, platform application, being a key support to realize the digitalization of teaching process, refers to all kinds of teaching management systems and online learning platforms.

Thirdly, resource content, serving as a core component of teaching activities, refers to digital teaching resources, including courses, textbooks, cases, and tools. Fourthly, capacity building, as a key factor to effectively implement informatized teaching, refers to the digital literacy and teaching ability of teachers and students within the informatized environment. Lastly, system guarantee, being a core element to ensure the sustainable development of an informatized teaching environment, refers to policies, regulations, and incentive measures to promote the construction, operation, and evaluation of an informatized teaching environment. As a whole, the above five dimensions depend on and promote each other to form a complete ecological pattern of the informatized teaching environment in higher education institutions. Through collaborative development, they finally realize the effective empowerment of the whole teaching process.

4 Practical Path of Empowering Teaching and Learning by Informatized Basic Teaching Environment: A Case Study of W University

Presently, the system construction of the informatized basic teaching environment has completed the transformation from the initial narrow classroom construction to the concept of online-offline dual-space construction with data as the core. In practice, however, this concept is still in the stage of continuous exploration and promotion. Meanwhile, the specific practice path must be combined with the school's professional characteristics and educational philosophy in order to effectively promote their high-quality development.

W University, administered directly by the Ministry of Education, is a nationally recognized key institution that emphasizes engineering while fostering the integrated development of multiple disciplines, including science, engineering, economics, management, arts, humanities, and law. In recent years, the university has actively responded to the educational digitalization policy, with the goal of building itself into a digital transformation benchmark university. To this end, the university released the "May 30" action plan in May 2022, which is dedicated to promoting the high-quality development of education and teaching with educational informationization as the engine. The plan focuses on building an informatized teaching environment and an intelligent teaching platform, and provides practical action guides for teaching and learning with digital empowerment as the driving force, thus shaping a new ecology of high-quality talent training and enrollment and employment.

4.1 Top-level Design: Systematic Planning and Phased Advancement

W University has elevated digital transformation to the level of a top-leadership project. To this end, during the process of building an information-based teaching environment, the university has formulated the *Implementation Outline of Educational Digitalization Strategy Action (2022-2025)* in combination with its actual demands and development goals. It is distinctly stated in the foregoing outline that the university will reconstruct

the traditional teaching mode through digital technology during the 14th Five-Year Plan period, gradually promoting the evolution of educational informatization to wisdom education. By 2025, its overall objective is to achieve a comprehensive digital upgrade in teaching content, teaching form, teaching management, and learning evaluation. Guided by this top-level design, the university can promote the coordinated development of technology, platform, resources, ability, and system as a whole, thereby establishing a strategic system aimed at comprehensively improving teaching quality.

4.2 Practical Path: Building a "Five-Dimensional Collaborative System"

Practices related to the empowerment of informatized teaching environments for teaching and learning primarily focus on five key dimensions, encompassing technical foundation, platform application, resource content, capacity building, and system guarantee. Taking these five dimensions as the core, a development path of educational informatization with the characteristics of W University is progressively formed. Concretely, the university strives to create an efficient, collaborative, and intelligent teaching environment by integrating technological advantages, building a teaching system, enriching teaching content, improving teachers' and students' quality, and strengthening institutional guarantee. The corresponding technical architecture is depicted in Figure 2.

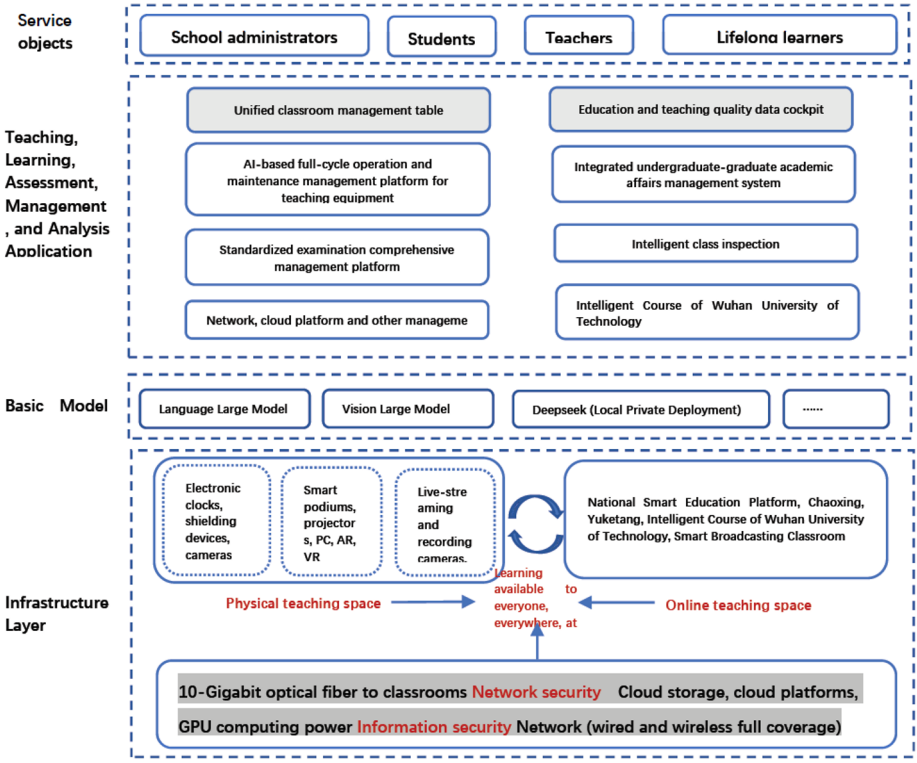

Fig. 2. Technical Architecture of the Empowerment of Informatized Basic Teaching Environment to Teaching and Learning

(1) In the dimension of technical foundation, the key point of construction is to create an efficient and stable intelligent physics teaching space. Such physical teaching places can not only meet the daily teaching needs but also provide practical support for the reform of various teaching models. Meanwhile, it serves as an important basis for teaching data collection. As Zhu et al. (2021) emphasized, educational informatization should pay attention to data value rather than external appearance (such as decoration effect or equipment complexity) [3]. Accordingly, the novel educational infrastructure should adhere to the principle of "light construction".

In August, 2022, W University set off the construction of a private educational network for 627 public multimedia classrooms. As a whole, the network adopts a three-layer architecture, including a core layer, a regional convergence layer, and a classroom access layer. The access of 10-Gigabit optical fiber ensures the smooth and safe operation of various applications in the physics teaching space. Based on this, the university expanded its cloud platform to provide a centralized and professional environment for live-streaming and recording platforms, curriculum platforms, and educational administration platforms. Simultaneously, the GPU computing platform was built to offer solid support for the analysis of diverse complex teaching data. Through the transformation for half a year, the university has upgraded more than 400 public multimedia classrooms across the whole school, ultimately achieving live-streaming and recording full coverage on the main campus.

Regarding the transformation of public multimedia classrooms, W University, guided by the practical demands of faculty and students as well as the principle of "lightweight" development in new educational infrastructure, prioritized limited funding to resolve five prominent issues, including inadequate visual clarity, insufficient auditory support, slow computer performance, overly complex central control systems, and the lack of mechanisms to retrospectively access classroom teaching resources. Based on this, the university mainly purchases high-lumen laser projectors, smart blackboards, conference-level audio, smart platforms, and high-definition live-streaming and recording systems, without introducing high-end complex intelligent equipment. In addition to the hardware transformation, the university has realized the combination of the entity intelligent teaching space and the online teaching platform through the full coverage of wired and wireless networks. By simplifying and upgrading, not only has the mixed teaching between teachers and students been effectively supported, but also the teaching data collection function in class has been further realized. In this connection, Figure 3 depicts the real scene of the transformation of public multimedia classrooms. Moreover, the university has implemented characteristic teaching environment construction in certain campuses, such as meta-universe classrooms, digital twin classrooms, and multi-screen interactive seminar classrooms, in an attempt to support the multi-mode teaching reform of teachers and students, finally forming a classroom construction pattern that is stratified by campus, specialty, and function.

Fig. 3. Real Scene of the Transformation of Public Multimedia Classrooms

(2) In the dimension of platform application, the key point of construction is to build an integrated and linked network teaching space. Firstly, W University integrates the network teaching space and intelligent physics teaching space to realize the lifelong education concept of "learning available to everyone, everywhere, at any time". Secondly, focusing on the driving force of teaching reform, W University established an intellectual teaching platform driven by "knowledge and data". The interconnection between platforms serves as the key link to break the isolated island of teaching data and realize the whole process empowerment. During concrete practices, W University has built the "Intelligent Course of Wuhan University of Technology" platform with the teaching platform as the breakthrough point, realizing the docking with the national wisdom education platform. In parallel, W University has aggregated over 600,000 high-quality resources through the establishment of inter-university, university-enterprise, university-local, and international cooperation platforms, and jointly launched more than 150 micro-courses with enterprises, thereby forming a comprehensive education resource supply system. Through these efforts, user activity has been rising continuously, with the proportion of online teaching reaching 78%, marking the normalization of online and offline integrated teaching mode. Lastly, with the real-time teaching behavior feedback function, the platform can automatically adjust the teaching progress and resource allocation based on the interactive data during the students' learning process. In short, the platform application further promotes the structural reconstruction of teaching and learning behavior, thus providing strong data support for digital decision-making.

(3) In the dimension of resource content, the key to construction lies in constructing a diversified and open digital teaching resource ecosystem. To this end, W University gives full play to its undergraduate engineering-related advantages, proactively promoting the construction of digital curriculum resources as well as the development of virtual simulation experiment teaching resources. Besides, the university has set up a digital teaching material co-construction fund to encourage teachers from all colleges to develop diversified teaching resources such as MOOC, SPOC, and micro-courses. These teaching resources are unified into the "teaching resources platform" for open sharing within the university. Meanwhile, the university enriches the types of resources by introducing enterprise resources and developing specialized courses jointly built by university and enterprise, thereby enhancing the timeliness and industry adaptability of

course content. In terms of mechanism construction, the university has established "incentive mechanism for curriculum resources construction" and a "feedback mechanism for teaching resources utilization", eventually forming a closed loop covering "construction, application, and evaluation".

(4) In the capacity-building dimension, the focus is on improving teachers' and students' information literacy and digital teaching ability. The improvement of the use efficiency of informatized teaching environment is inseparable from the excellent information literacy of teachers and students. To this end, W University continued to promote the construction of informatized teaching ability, implementing work from the perspectives of all-staff training, key incubation, and normal improvement, ultimately forming a multi-level digital teaching ability advanced system. In addition, the university set up digital teaching ability training courses for teachers, covering blended teaching design process, flipped classroom implementation strategy, teaching platform operation skills, and the auxiliary use of AI tools. On this foundation, a gradient training organization form encompassing basic general knowledge, special practice, and innovation competition has been constructed. On the other hand, the university encourages teachers to proactively explore the informatized teaching mode by holding teaching innovation competitions, micro-course production competitions, and other activities. Furthermore, the university set up courses focusing on digital literacy and innovation ability, aiming at cultivating students' digital tool use, autonomous learning, and innovation ability. By setting up Smart Academy and Digital Campus, students can not only acquire personalized learning support in the classroom but also interact with teachers after class with the help of the platform, enabling efficient after-school follow-up learning.

(5) In the dimension of system guarantee, the key point of construction is to build a sustainable informatized teaching operation mechanism. In this regard, W University establishes a relatively perfect system of institutional guarantee from four perspectives: organizational mechanism, financial support, performance appraisal, and data security. At first, the university set up a leading group for network security and informatization, which is co-chaired by the Secretary of the Party Committee and the President, and held regular meetings. Meanwhile, the university set up an information office, a quality evaluation center, and a big data center to promote the materialization of the school's Intelligent Operation Center (IOC). Moreover, the university established a work promotion mechanism featuring weekly promotion and monthly scheduling, thereby driving the development of digital transformation as a whole. With regard to funds, the university set up a special fund for informatized teaching as well as a teacher teaching innovation fund for project construction and teacher development. In the aspect of performance appraisal, the university integrated the implementation effect of informatized teaching, resource development, and platform usage data into the teacher title evaluation and teaching quality evaluation system to strengthen positive incentives. Lastly, in terms of data governance, the university formulated the *Regulations on the Use and Privacy Protection of Teaching Data* to ensure the security and compliance of platform data. Simply put, this whole set of mechanism guarantee system furnishes systematic synergy and stable support for the informatized teaching environment of the university,

achieving the objectives of being well-constructed, effectively utilized, clearly evaluated, and sustainably maintained.

4.3 Practical Effect

With regard to the upgraded intelligent physics teaching space, the university distributed a questionnaire on the utilization of the reformed classroom to all teachers, receiving 398 valid responses. The respondents came from 24 colleges. As can be seen from the discipline distribution diagram outlined in Figure 4, participation was higher among science and engineering faculty, suggesting that the university is dominated by science and engineering disciplines. Given the variety of question types and options, only the positive feedback options were statistically analyzed in this research. As illustrated in Figure 5, the satisfaction degree of all selected options is 70% or above. This result demonstrates that the transformation path of intelligent physics teaching space aligns with the operational needs science and engineering-oriented universities.

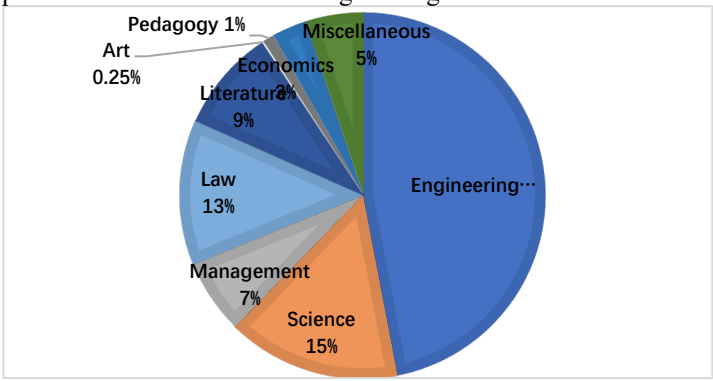

Fig. 4. Disciplinary Distribution of Respondents in the Questionnaire on the Utilization of the Reformed Classroom

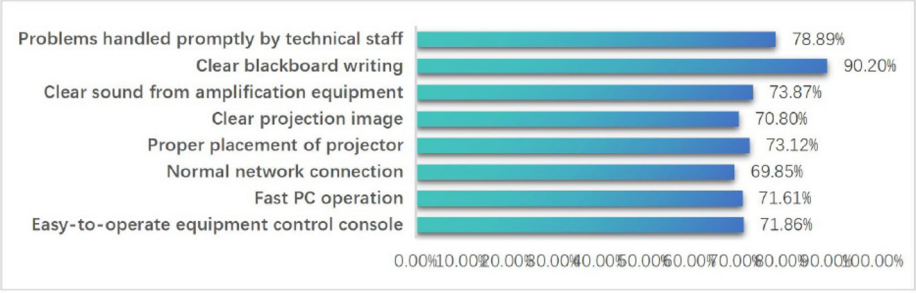

Fig. 5. Proportion of Positive Feedback Options in the Questionnaire

Through the integrated and linked construction of online teaching spaces, W University has built a new ecology of talent cultivation characterized by connection, openness, sharing, and personalization, achieving 81% and 22% of blended classroom and

flipped classroom respectively in the total classroom [11]. Based on this, the university combined the internal and external forces to conduct innovative classroom practices such as meta-universe classroom and digital twin classroom. Figure 6 presents various innovative teaching modes implemented by the university in the physical teaching space. Over the past three years, the university has received a total of more than 500 units for investigation and visit, successfully holding the National Education Digitalization On-site Promotion Conference. Concurrently, the university was designated as the first institution in China to conduct a fully off-campus undergraduate teaching and learning assessment, with its exemplary experience incorporated in the *World Higher Education Digital Development Report*.

Fig. 6. Innovative Teaching Reform Practice

Higher education institutions can provide excellent learning experience for learners during the process of building an informatized teaching environment. Yet, given that it is still in the stage of exploration and rapid development, the wide application of information technology has caused various issues of general concern, such as data management, network security, information dependence, and ethics. Informatized teaching environment construction is impossible to be done to perfection. Also, user demands and application scenarios are changing dynamically in actual use. As a result, apart from the necessary and sufficient technical planning and demonstration in the early stage, it is imperative to establish a multi-department collaborative guarantee mechanism and respond quickly to problems in the implementation and operation stages, thus ensuring the smooth operation of diverse businesses and processes.

5 Conclusions and Future Prospects

Taken together, it is an inevitable choice for higher education institutions to build a powerful informatized teaching environment and effectively empower teaching and learning-related practices to address the challenges of the times, improve the quality of personnel training, and realize quality-oriented development. As a whole, this research reveals the defects, key paths, concrete practices, achievements, and challenges existing in current practices, according to constructs a five-dimensional collaborative model covering technology, platform, resources, ability, and system,based on the specific implementation case of W University, providing a certain degree of reference for practices of constructing the informatized teaching environment in other higher education institutions. Future research will focus on frontier issues such as technology iteration, model innovation, data-driven, ethical security, etc., with a view to deepening the understanding of "how technology can better serve teachers and students as well as the essence of education" and constantly exploring and optimizing specific empowerment paths.

Acknowledgment

Fund Project:
Independent Innovation Research Fund Project of Wuhan University of Technology (2020IVB071).
Teaching and Research Project of Wuhan University of Technology(W2025190)

References

1. Xinhua News Agency. Xi Jinping Presided over the Fifth Collective Study Session of the Political Bureau of the CPC Central Committee and Delivered an Important Speech.Accessed: May.29, 2025. [Online]. Available:.https://www.gov.cn/yaowen/liebiao/202305/content_6883632.htm.
2. Ministry of Education of the People's Republic of China. Notice of the Ministry of Education on Printing and Distributing the *Action Plan for Education Informatization 2.0* .Accessed: May.28, 2025. [Online].Available:.hitp:/hwnw.moe.gov.cn/srcsite/A16/s3342/201804/t20180425 334188.html.
3. Baig M I, Yadegaridehkordi E. Flipped classroom in higher education: a systematic literature review and research challenges[J]. *International Journal of Educational Technology in Higher Education*, 2023, 20(1): 61.
4. China Association for Educational Technology. Proceedings of the China Educational Technology Annual Conference (2022) [C]. *Beijing: China Association for Educational Technology*, 2022.
5. Han Xibin, Ge Wenshuang. Investigation and Research on the Information-Based Teaching Ability of Chinese University Teachers [J]. *China Higher Education Research*, 2018, (07): 53-59.
6. Imms, W., & Byers, T. (2017). Impact of classroom design on teacher pedagogy and student engagement and performance in mathematics[J]. *Learning Environments Research,* 2017(20): 139-152.
7. Zhu Z. T., Xu Q. X., & Wu Y. H. Standard Requirements and Action Recommendations for New Infrastructure of Education Informatization[J]. Distance Education in China, 2021(10): 1-11.
8. Sun H. Z., Wang W., et al. Design and Construction of Practical Teaching Environment for Informatization of Traditional Chinese Medicine[J]. *Lishizhen Medicine and Materia Medica Research*, 2019(07): 1735-1738.
9. Wu F. T., Xia Z. W., & Gao S. R. Reshaping Smart Learning Environments with Generative Artificial Intelligence: From Elemental Improvement to Ecological Reconstruction[J]. *E-education Research*,2025(01): 54-63.
10. UC Berkeley:Building Inclusive Classrooms. Accessed: July. 9, 2025. [Online]. Available:https://rtl.berkeley.edu/rtl-learning-paths/building-inclusive-classrooms.
11. [Shuzhi Ligong] Recognizing Change: Opening a New Track for Educational Digital Transformation.Accessed: May.8, 2025. [Online].Available:https://news.whut.edu.cn/zhxw/202505/t20250508_1328325.shtml.