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Advancing digital transformation in higher education teaching: evidence from Zhejiang Province, China

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Abstract: With the rapid development of educational digitalization and artificial intelligence, the digital reform of higher education teaching has become an important path toward educational modernization. Zhejiang Province takes the lead in China's digital economy. It boasts favorable policy conditions, a solid digital foundation, and active reform experience. Based on the theory of educational digital transformation, this paper examines the digital reform of higher education teaching in Zhejiang Province by adopting the methods of literature research, policy analysis, case study, and synthetic analysis. It is found that Zhejiang universities have made progress in digital infrastructure construction, online courses development, blended teaching application , and smart teaching platform building. Yet several challenges remain, including uneven infrastructure allocation, insufficient teacher digital competence, weak sharing of high-quality digital course resources, insufficient application of artificial intelligence in teaching, inadequate utilization of learning data, and imperfect digital governance system. The study argues that universities should improve digital infrastructure construction, strengthen teacher development, redesign digital courses, promote standardized and responsible AI-enabled teaching, improve data-based evaluation, and establish a sound governance system. Digital reform should not be merely equated with the application of platforms and tools. Instead, it should facilitate teaching restructuring, boost learning outcomes, and advance high-quality talent cultivation.

Keywords: educational digitalization; higher education; digital teaching reform; artificial intelligence; teacher digital competence; digital governance

1 Introduction

Higher education is undergoing a deep digital transformation. Artificial intelligence, big data, cloud computing, virtual reality, and learning analytics are reshaping teaching organization modes and students' learning patterns. Digital reform is no longer only about using new tools. It is now linked to teaching quality, talent cultivation, educational equity, and university governance. Studies on higher education digital transformation have shown that digital technology is reshaping teaching modes, curriculum resources, and quality assurance systems [1-3].

China has provided robust policy support for educational digitalization. From "Internet Plus Education" to Education Informatization 2.0 and further to the national strategy of educational digitalization, digital technology has become an important part of education reform. Scholars have argued that digital transformation is now closely related to the construction of a strong education system and the modernization of higher education [4][5]. In this context, the digital

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reform of higher education teaching has become a key task for universities.

Zhejiang Province takes a leading position in China's digital economy. It boasts solid industrial support, rich technology application scenarios, and advanced digital governance experience. These advantages provide a favorable environment for universities in Zhejiang to promote digital teaching reform. In recent years, universities in the province have made progress in smart campus construction, online course development, blended teaching practice, digital resource sharing, and the building of smart teaching platforms. However, the reform is still uneven. Some institutions prioritize platform development over instructional restructuring. Some courses merely place teaching materials online without optimizing learning support services. Some teachers adopt digital tools yet fail to restructure learning activities accordingly.

This study focuses on three questions. First, what is the current developmental foundation of digital teaching reform in Zhejiang Province? Second, what are the main challenges? Third, how can universities in Zhejiang formulate more efficient pathways to advance digital teaching reform?

2 Theoretical basis and research design

Educational digital transformation refers to the use of digital technology to promote structural change in education. Compared with traditional educational informatization, it places more emphasis on data, intelligence, openness, sharing, and system-level governance. In higher education, digital transformation is reflected in smart teaching environments, online course platforms, digital textbooks, virtual simulation systems, learning analytics, and data-based quality monitoring [6].

Technology-enabled teaching constitutes another key foundation of this study. Its purpose is not to add digital tools to the classroom, but to improve teaching design, learning processes, and evaluation methods. Digital technology can enrich learning resources and support more flexible learning. It can also help teachers understand students' learning progress and provide more timely feedback. The rise of artificial intelligence further expands this process. Generative AI, intelligent tutoring systems, automated feedback tools, and learning analytics are reshaping lesson preparation, classroom interaction, student support services, and academic assessment.

At the same time, digital reform requires modern educational governance. Without clear rules, stable systems, and cross-department cooperation, technology use may remain fragmented. Universities ought to strengthen coordination among academic affairs divisions, teacher development centers, information technology departments, quality monitoring offices, secondary colleges, and teaching teams. Such collaboration facilitates the integration of teaching reform, technology support, data governance, and quality assurance systems.

This study adopts literature research, policy analysis, case study, and synthetic analysis. Literature research is used to review studies on digital transformation, higher education teaching reform, and teacher digital competence. Policy analysis is used to understand national and provincial reform directions. Case study is used to examine common practices such as online courses, smart classrooms, blended teaching, and AI-supported teaching. Synthetic analysis is adopted to formulate practical strategies for universities in Zhejiang Province.

3 Current foundation of digital teaching reform in Zhejiang higher education

First, Zhejiang enjoys a supportive policy environment. Relevant national and provincial policies have prompted local universities to incorporate digital teaching reform into development strategies, curriculum construction, professional development, and teaching quality assurance systems. This has created a clear reform direction. It also supports the development of online courses, smart classrooms, blended teaching, virtual simulation training, and digital textbooks.

Second, digital infrastructure has improved. Most universities have built campus networks, teaching management systems, online learning platforms, smart classrooms, digital libraries, and course resource platforms. Online teaching

during the COVID-19 period also helped teachers and students become more familiar with digital platforms. This experience laid a foundation for blended teaching, classroom interaction, teaching data collection, and learning analytics.

Third, teaching reform practice has deepened. Some universities have developed online open courses, blended courses, virtual simulation courses, and project-based learning platforms. Teachers widely adopt online platforms and AI tools for lesson preparation, classroom interaction, homework feedback, and learning evaluation. Students also gain knowledge via digital resource repositories, discussion forums, intelligent tools, and online tasks. Learning is no longer limited to physical classrooms, but has expanded to cover pre-class, in-class, and after-class phases.

Fourth, teachers' awareness of digital competence has improved. Teachers serve as core participants in the advancement of digital teaching reform. More teachers now pay attention to online course construction, blended teaching, AI-assisted preparation, digital resource development, and evaluation reform. Similar research has also noted that teacher digital competence has become a key factor in educational digital transformation [7]. However, awareness does not always lead to deep competence. While many teachers are proficient in operating platforms, they still need support in digital instructional design, learning analytics, AI technology application, and personalized learning support.

4 Main challenges

The first challenge lies in unbalanced infrastructure development. Though Zhejiang boasts a solid digital foundation, distinct gaps still exist across different universities. Some institutions have advanced smart campuses and smart teaching platforms. Others still need improvement in smart classroom coverage, platform stability, storage capacity, and technical support. Inside universities, various management systems suffer from severe fragmentation. Academic affairs systems, learning platforms, student management systems, quality evaluation systems, and teacher development platforms may lack effective data interconnection. This creates data silos and weakens data-informed governance.

The second challenge is insufficient teacher digital competence. Some teachers still regard digital teaching merely as the application of technical tools. They may upload slides, assign homework online, adopt digital attendance checking, or play videos. Yet genuine digital teaching demands capabilities in teaching design, resource integration, data analysis, targeted learning support, as well as ethical awareness. The rapid development of AI has made these requirements more urgent. AI can help teachers design cases, generate materials, provide feedback, and analyze learning outcomes. However, it can also bring potential risks concerning academic integrity, personal privacy, algorithmic bias and subject accountability. Many teachers still lack systematic training in these areas.

The third challenge is the weak quality and poor sharing efficiency of digital course resources. The number of digital resources has increased, but their quality is uneven. Some digital courses are only electronic versions of slides or recorded lectures. They are not closely connected with learning objectives, learning activities, and assessment tasks. Inter-university and interdisciplinary resource sharing is also limited. Repeated construction of similar resources increases teachers' workload and reduces the efficiency of reform. This problem has also been discussed in studies on teaching mode reform and digital resource construction [8].

The fourth challenge is limited teaching mode innovation. The core of digital educational reform lies not in the adoption of online platforms, but in the restructuring of teaching practice. In some courses, blended teaching is only a simple extension of traditional teaching. Online learning tasks lack clear orientation, while offline are deficient in interactive discussion, inquiry exploration and problem-solving activities. In addition, after-class feedback fails to achieve personalization. Digital teaching should support a shift from teacher-centered teaching to student-centered learning, and from knowledge delivery to ability development.

The fifth challenge is the limited adoption of evaluation data. Online platforms can record learners' learning duration,

resource usage, task completion status, discussion engagement and quiz performance. However, many universities still rely mainly on final exams, course grades, and student surveys. They pay less attention to learning processes and ability development. In many cases, data are collected but not transformed into teaching decisions. Learning analytics remains a data presentation rather than a tool for improvement.

The sixth challenge is incomplete digital governance. Digital teaching involves large amounts of data. These data need clear rules for collection, access, sharing, storage, analysis, and protection. AI also brings new ethical issues. Students may use generative AI to complete assignments. Teachers may use AI to assess students. Platforms may collect detailed learning data. Without clear rules, digital reform may create privacy, fairness, and accountability risks.

5 Improvement strategies

First, universities should optimize digital infrastructure. They should advance the coordinated development of smart campuses, intelligent classrooms, online teaching platforms, virtual simulation platforms, and teaching quality monitoring systems. Infrastructure construction should not focus only on hardware deployment. It should also improve platform integration, data interconnection, and service capacity. Academic affairs systems, learning platforms, course resource libraries, student development systems, and quality evaluation systems ought to adopt unified basic standards and open interfaces to realize effective linkage.

Second, universities should build a long-term system for teacher digital competence. Teacher training should move from temporary training to continuous professional development. Training should be designed according to teachers' roles and development stages. New teachers need training in platform use, digital resources, and basic blended teaching. Experienced teachers need training in instructional design, learning analytics, AI tools, and course innovation. Teaching managers need training in data governance, quality monitoring, and digital decision-making. Teacher digital competence should also be included in teacher development and teaching evaluation.

Third, universities should enhance digital course development. Digital courses should not simply place resources online. They ought to restructure the course centering on learning objectives, learning tasks, teaching activities, and evaluation mechanisms. High-quality digital courses should cover videos, slides, learning guides, practical cases, interactive discussions, online quizzes, learning feedback, and extended learning resources. Zhejiang universities can build courses linked to regional strengths, such as the digital economy, intelligent manufacturing, modern service industry, rural revitalization, and green development.

Fourth, universities should promote responsible AI-empowered teaching. AI can support lesson preparation, classroom teaching, personalized tutoring, academic evaluation, and educational administration management. Teachers can leverage AI develop teaching cases, design learning scenarios, analyze learning data, and provide feedback. Students can utilize AI for self-study, question answering, language practice, and reflection. Nevertheless, AI shall function merely as an auxiliary tool. It should not substitute teachers' role in value guidance, emotional support, or educational responsibility. Universities should define clear boundaries for AI use in classroom instruction, homework arrangement, examinations and academic writing.

Fifth, universities should improve evaluation through data. Digital teaching reform should promote a shift from result-based evaluation to process-based, comprehensive, and developmental evaluation. Learning data should be used to understand students' learning processes, identify learning difficulties, and improve teaching. Yet data need educational interpretation. Platform activity does not always mean effective learning. Teachers should interpret data together with course goals, learning tasks, student work, and classroom performance.

Sixth, universities should build a sound digital governance system. Clear rules are needed for teaching data collection,

use, sharing, storage, and protection. For student learning data, universities should follow the principle of necessity and limit data access. They should also strengthen AI ethics governance. When AI is used in learning analytics or teaching evaluation, transparency and explainability are important. Universities should avoid algorithmic bias and protect students' rights.

6 Implementation pathways

Digital teaching reform should start with top-level design. Universities should incorporate digital reform into development strategies and talent cultivation systems. Reform goals, key tasks, and implementation steps should be clearly defined. The design should avoid a purely technical orientation and focus on improving teaching quality.

Course reform should be the basic unit of implementation. Universities can build model courses, blended courses, AI-supported courses, and virtual simulation courses. These courses can become practical examples for wider reform. Teacher development should be supported by continuous assistance. Universities should provide training, resources, platforms, and incentives so that teachers can progress from "being able to use technology" to "using technology well to enhance teaching quality".

Data governance should enhance management. Teaching data centers can integrate course data, students' learning data, teachers' teaching data, and quality evaluation data. These data can support teaching management and quality assurance. However, data use must serve educational purposes. Universities should avoid excessive quantification and mechanical evaluation.

Regional cooperation can also expand reform benefits. Universities in Zhejiang differ in type, level, and discipline. They can build digital course alliances, teacher development communities, and teaching reform networks. Through cooperation, high-quality resources can be accessible to more teachers and students.

7 Conclusion

The digital reform of higher education teaching is an important task in the context of educational modernization and digital China. Zhejiang Province has strong advantages in the digital economy and has laid a solid foundation for the digital reform of higher education. Universities in the province have made positive progress in policy support, infrastructure construction, digital course resources, and teaching innovation.

However, challenges remain. These include uneven infrastructure allocation, insufficient teacher digital competence, weak course resource quality, limited AI application, underutilized teaching data, and incomplete governance. Future reform should be systematic. Universities should improve infrastructure construction, strengthen teacher competence, develop better courses, promote responsible AI use, improve evaluation, and build sound governance systems.

The core of digital reform is not to replace education with technology. Its purpose is to renew educational concepts, redesign teaching models, and enhance the quality of talent cultivation. Zhejiang universities should leverage their regional advantages to explore a digital teaching reform path with local, institutional, and disciplinary characteristics.

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Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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