

Digital Transformation of Open Online Courses in the Age of Smart Education: Connotation, Dilemma and Breakthrough

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Abstract: In the era of smart education, digital technology has enabled higher education, enabling online open courses to move towards student-centred, personalized, intelligent and experiential. How to implement the digital transformation of open online courses is a current topic for governments, universities, societies and enterprises. The digital transformation of open online courses requires government, industry, universities and society to play the role of multi-subject cooperation and joint construction. The digital transformation framework for open online courses needs to be constructed from a set of system norms, six key technologies, one platform, four domains, and multi-subject co-construction. To this end, this study proposes practical paths to effectively promote and realize the digital transformation of open online courses in terms of top-level design, multiple co-construction, technical empowerment, platform construction and service guidance.

Keywords: Smart education, Online open course, Digital transformation.

1. Introduction

From the digital economy to new infrastructure and industrial transformation, leveraging digital technology to enable intelligent transformation in various industries and promoting digital economy has become a new growth driver post-pandemic. As the strategic game among major countries intensifies, the digital transformation of the global economy and society has brought about the digital transformation of the higher education system. Teaching and learning are gradually "migrating" and "integrating"[1] from the real world to the virtual world, and are continuously transforming to the student-centered, personalized, intelligent and experiential smart education. This research provides insights into the digital transformation of online open courses by analyzing its connotations and practical challenges. It aligns with the strategic goal of accelerating digital development and building a digital China, offering valuable references for digital transformation efforts.

2. Research Design

2.1. Connotations of digital transformation in online open courses

EDUCAUSE defines digital transformation as "the process of optimizing and transforming an institution's operations, strategic direction, and value proposition through deep and coordinated transformation of culture, workforce, and technology." [2] Therefore, the digital transformation of open online courses is not a simple superposition and stacking of digital technologies in courses, but a profound transformation of teachers' teaching thinking and the use of digital technologies to transform online course design and teaching mode, so as to achieve a fundamental transformation of course culture and education concept. The transformation of online open courses involves a series of interrelated and coordinated elements. At the macro level, it encompasses national policy planning, strategic positioning of higher education institutions, organizational culture, infrastructure,

educational administrators, stakeholders, online open course platforms, and more. At the micro level, it involves course objectives, teaching resources, instructional models, teaching structures, teaching methods, teachers and students, and learning evaluation and feedback. The connotations and relationships of these elements undergo profound changes during the digital transformation process.

2.2. Challenges in the Digital Transformation of Online Open Courses

Enabling technology-driven development in higher education and creating a digital, intelligent, personalized, and lifelong learning environment has become a global consensus. However, the current understanding of the implementation path for the digital transformation of online open courses is still in the developmental stage within China. The theoretical research on digital transformation is still ongoing, and specific policies, measures, digital infrastructure construction, digital literacy enhancement, and other related aspects are relatively scattered. The specific steps and promotion experiences of digital transformation in course digitization are not yet mature. Challenges in the digital transformation of online open courses include the absence of organizational development in policy agendas and unclear transformation plans, insufficient investment in digital infrastructure requiring digital technology support, lack of digital literacy among teachers with room for improvement in innovative curriculum design, inadequate funding for digital transformation resulting in reduced motivation, low concentration in online course learning and incomplete support for personalized learning services. These factors contribute to the increased difficulty in achieving the digital transformation of online open courses.

2.3. The construction of digital transformation framework for online open courses in the era of smart education

The digital transformation of online open courses requires closer collaboration between universities and stakeholders to

create a new form of digitalization. Therefore, this research proposes a framework for the digital transformation of online open courses in the era of smart education, encompassing system standardization, key technologies, platform construction, four major fields, multiple entities, and more.

2.3.1. A set of system specifications: Establishing system specifications for digital transformation of open online courses

As the basis and carrier for teaching activities in higher education, curriculum is the core element of digital transformation of higher education. Digital technology-enabled online open courses will bring learners a richer immersive online learning experience, diversified and comprehensive online learning scenarios and intelligent learning analysis, enhance the sense of intelligent learning experience and stimulate learning interest. The digital transformation of open online courses should establish clear and unified guidance and system specifications, and promote the adoption of policies and specifications by universities to reflect the value proposition and digital strategic direction of the transformation and upgrading of their online open courses.

2.3.2. Six key technologies: Providing efficient and accurate digital base support

As a new direction for the development of open online courses, the six technologies of metaverse, blockchain, big data, artificial intelligence, cloud computing and XR have broken the barrier of separation of time and space between teaching and learning, and will reshape the current form of "co-existence" of time and space in online learning in the era of smart education. These six technologies will profoundly reshape course resources, teaching methods, learning support services, and certification mechanisms in online education, providing realistic learning scenarios and creating immersive courses for learners that transcend normal life. At the same time, they provide intelligent services for carrying out online learning assessment, strengthening learner identity authentication, quickly extracting and analyzing learning data, creating a learning model with individualized "identification characteristics", and presenting and analyzing the overall picture of learning information of user groups and individuals [3].

2.3.3. A platform: Building a "five-all" intelligent course learning platform with open and shared data

Personalized learning cannot be separated from the construction of smart course learning platform and hybrid learning space. The result is the impact and change of "all airspace, all process, all scene, all analysis and all value" [4]. The platform is driven by human intelligence to achieve optimized operation. The environment for learning is gradually transformed from traditional real-classroom recording and platform-connected learning to a hybrid learning space that integrates virtuality and reality, supports cross-temporal learning experiences and learning interactions with embodied learning, creates appropriate embodied learning scenarios, and creates multi-scenario, physical and mental experiences. The platform collects, deduces and analyzes all the information about learning behaviors through technology.

2.3.4. Four fields: Identify the key fields for the transformation and change of open online courses

In the infrastructure field, the use of 5G, big data, blockchain and other infrastructures to empower curriculum platform systems, increase computing power, algorithms for

automated data authentication on blockchain, curriculum scenarios, immersive experiences, and physical interaction infrastructure construction; In the teaching field, the use of digital technologies to innovate online open course teaching methods, including the transformation of course content design, the transformation of online teaching methods, the transformation of course organization models, and the transformation of online teaching support services, carry out the construction of digital resources for online open course teaching and learning; In the management field, the use of digital technology to empower course teaching management, improve course backstage management technology, and provide personalized learning support services. In the field of course teaching and research and training objectives, innovative digital teaching and research of courses, cross-border cooperation, integration of digital technology, and enhancement of students' digital skills.

2.3.5. Multiple subjects: Innovate the way of course organization, and create a digital "cross-border cooperation" operation mode

In Finite and Infinite Games, James Cass shows that there are two types of "games" in the world: "One can be called a finite game and the other an infinite game." "Finite games aim to win, while infinite games aim to perpetuate the game by bringing more people into the game itself, thus perpetuating the game"[5]. Colleges and universities need to establish closer ties with their stakeholders such as governments, industries and enterprises, carry out the development mechanism of collaborative planning and construction between universities and governments, universities and enterprises, universities and platforms, and universities and course alliances, build a digital "cross-border collaboration" operation mode, and realize the collaborative development of high-quality online course resources.

3. Research Results

3.1. The path for digital transformation of online open courses in the smart education era

3.1.1. Top-level design: multi-level overall layout and policy guarantee

The first is to carry out long-term planning and layout at the government level, formulate development planning and construction norms for the application of open online courses for digital transformation, and stipulate general requirements such as infrastructure, digital resources, digital literacy, application services, network security and security systems. Driving the integration of new-generation digital technologies such as 5G/6G, WIFI6, artificial intelligence, big data, cloud computing, Internet of Things, blockchain, VR/AR/MR into online course development. Formulate a series of policy documents to promote the digital transformation of courses, encourage universities and scientific research institutions to set up special meta-cosmic education and research institutes, and guide the field of open online courses to make the first attempt. Special funds will be set up to strengthen financial security, and a number of pilot demonstration universities and programs for digital transformation and the application of open online courses will be selected and nurtured. Secondly, universities should develop goals and system specifications for the digital transformation of open online courses that meet their strategic

positioning and actual needs, covering complex resources, intelligent tools, imagery activities, whole-person evaluation, precision teaching, embodied learning, learning partners and teaching groups [6]. Finally, it should refine the typical and demonstratively carry out the cross-border "digital + online open course" customized construction plan and the research and development of digital online course demonstration products among enterprises, governments and institutions of higher learning.

3.1.2. Multiple co-construction: digital co-construction and operation and promotion of online open courses for sustainable development

Practical evidence shows that a certain degree of marketization plays a vital role in optimizing curriculum resource allocation, promoting curriculum resource sharing, and improving teaching quality. Explore and attract the external social environment to actively participate in the investment of course digital transformation, use digital technology to empower courses, application model and service innovation, and create a different form of open online courses, which will become an essential direction for the sustainable development and marketization of open online courses in the future. For example, the construction of digital textbooks based on online open courses has been carried out with a focus on intellectual property protection; We should strengthen joint research and development among scientific and technological enterprises, research institutions and colleges and universities, and explore the application model of meta-universe open online courses, which are in wide demand. It will develop extremely immersive learning experiences and high-quality online open course services, carry out research and development, co-construction and rental models of university-enterprise and alliance meta-universe learning platforms, and provide course content, course organization, course guidance, and experimental operation activities for the online open course teaching of relevant schools [7]. Form a batch of metacomp open-course product projects with market-promoting value, expand market demand and meet learners' personalized experience services. Innovate the form of online course service, carry out project-based and order-based training based on online open courses, such as exploring the cooperation between enterprises and institutions of higher learning to carry out micro-degree, micro-course, micro-certificate and micro-certification projects [8]. Explore operational channels based on the collaborative development of online open courses and digital technology educational products and derivative tools.

3.1.3. Technology empowerment: Constructing online teaching scenarios, promoting immersive and physical interactive experiences in online open courses, and reshaping the virtual-reality cohesive intelligent learning environment

As media tools connecting online learners and learning environments, digital technologies play a crucial role in helping learners reduce cognitive load, enhance the sense of engagement and experience of smart learning environments, and assist learners in omnidirectional online interactions. With the development of web3.0, AR, VR, MR, artificial intelligence, 5G, metaverse, etc., the virtual world and the physical world will accelerate their integration. Creating a blended learning experience that combines the virtual and physical worlds is an urgent need for the digital transformation of online open courses. Universities should work with technology companies, research institutions and

course production companies to redesign the components and teaching activities of open online courses, strengthen the construction of blended learning spaces, and expand and enrich online learning resources. For example, XR augmented reality technology is used to integrate virtual and real worlds in various combinations to create an interconnected and immersive online learning space. For example, when teaching a major course in literature and history, students can step into the palace of poetic literature and the battlefield of tense history. With the help of immersive online learning experiences, students can grasp the development of events in real time. Watch the actions of characters, and deepen the memory of knowledge content [9]. Based on students' online learning experiences, diverse online learning activities should be carried out, ensuring students' full participation and experiential engagement in pre-class, in-class, and post-class teaching and learning activities. By leveraging the sensory features brought by XR technology, it provides the learner with concrete simulations of abstract knowledge, making both abstract and obscure knowledge points more understandable and digestible. For example, VR technology allows students to see 3D imaging inside patients' veins during online anatomy learning, helping students thoroughly understand everything from anatomy to surgery, so as to learn more intuitively [10]. Analyzing the academic levels of different learners and providing tailored online open course learning resources of varying depths. Exploring diverse and comprehensive online educational scenarios, constructing targeted learning environments for online open courses, presenting knowledge in diverse ways, and providing interdisciplinary knowledge construction. Explore the process of designing immersive online education, create immersive online open course learning theater and extremely simulated learning scenes, and shape a new online open course education scene with VR course resources, VR course design and "5G+ VR" as the basic characteristics with the help of AR technology. Digital twins, brain-computer interfaces, Internet of Things, big data and wearable technologies are used to provide a deeply immersive experience for the online course learning process. Enhancing the concentration and learning interest of online course learning, exploring the design and implementation of gamified learning, and giving students a strong sense of immersion and playability are conducive to promoting active learning and building their own knowledge systems.

3.1.4. Platform construction: Build an open wisdom course learning platform, and explore the development of online and offline integrated teaching mode

Build a wisdom course learning platform of "whole airspace, whole process, whole scene, full analysis and full value". Employing XR technology to promote personalized education, providing learners with knowledge education, situational perception, skills training, and learning activity support. Enhancing the intelligence of the platform, give full play to the advantages of non-sensory collection of network data, outline learner profiles based on the data of the learning environment and the physiological data generated by the learners themselves, and realize the digitalization, intelligence and personalization of individual learning needs and effectiveness based on the data projections. Provide immersive teaching space to meet the needs of online teaching, provide students with more current practical operation cases and information resource support services,

and continually generate questions consistent with real scenarios, so that digital resources can be shared in an interactive form close to real resources, and rely on the learning platform to provide students with a large number of skills operation opportunities to strengthen the immersive experience of skills operation. In order to change the phenomenon of dispersed knowledge in the learning process of online open courses, the platform should be able to provide students with knowledge construction functions and guide students to strengthen the formation of knowledge construction and transferability in technical learning. The platform should support learners in independent exploration, explore learning activities in a dynamic omnidirectional interactive manner, and provide the possibility to help students in dialogue, interactive behavior, and team communication and collaboration. In the construction of the platform, attention should be paid to the realization of unified and trusted certification and intelligent control, so as to facilitate education departments and universities to carry out big data detection on the online teaching process, realize the sharing of information and data resources among different platforms, and promote educational equity with open course learning resources. Through an open platform architecture, it supports the aggregation of various online course teaching platforms and educational resource platforms, thus avoiding the phenomenon of universities using different platforms. At the same time, by interconnecting data, learners are recognized as participating in the learning outcomes of online courses in digital form of different platforms, thus avoiding difficulties in credit recognition when learners switch learning platforms. Lastly, platforms should focus on promoting the normalized integration of online and offline education, advancing the development of the online-merge-offline (OMO) teaching model in higher education. Building connections between virtual learning spaces and various structures, levels, and types of data in physical learning environments to form a new ecological education scenario that integrates online and offline learning [11].

3.1.5. Service leadership: expanding the application of teacher research and training, and promoting intelligent course management and evaluation

Promote teachers' proficiency in the use of digital technology to carry out diagnosis and analysis of online open course learning conditions, so that they can become capable of using digital technology for online teaching. This should include: digitizing professional learning for teachers, boosting teacher team building, helping to improve teaching capacity, optimizing teacher management, and developing teacher training applications. Building a framework for teacher digital competency and enhancing teacher digital competency to meet the needs of the online open-course transition. Establish professional digital competency incentive measures, such as formulating system design on salary and promotion, setting up teacher digital ability development projects, relying on famous teachers to build "online master teacher studios", "online virtual teaching and research offices" and other digital training communities for teachers, and creating digital skills level assessments. Create a digital skills assessment and certification system to help teachers develop their digital training skills, and incorporated the assessment into teachers' professional development and title appraisal systems. Efforts should be

made to reduce the technological barriers for teachers caused by digitization, enhance their ability to use digital technology for innovative teaching practices, and improve curriculum resource design. Providing digital learning spaces and practical training environments to enhance teachers' digital teaching capabilities. Training should be primarily focused on frontline teachers, teaching assistants, and online teaching management personnel involved in the construction of online open courses.

4. Conclusion

The curriculum teaching in the age of intelligent education will move towards the development process of multidimensional teaching space and organizational form, so as to realize the free and comprehensive development of mankind. The digital transformation of open online courses is not only an internal reform of higher education to realize personalized learning, improve individual learning experiences and achieve learning freedom, but also an actual demand to actively adapt to the transformation, development and adjustment of the digital society.

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