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Digital transformation in top Chinese universities: An analysis of their 14th five-year development plans (2021-2025)

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Abstract: Digital transformation (DT) is a global trend in higher education. This study set out to examine the way DT is conceptualized in the 14th five-year development plans (2021-2025) of 56 top Chinese universities. Findings from the study show that Chinese universities have embarked on the DT journey with goals mostly similar to those pursued by their foreign counterparts but with distinctive Chinese characteristics in some dimensions. Compared with the findings of an earlier study on DT in their 13th five-year development plans (2016-2020), significant progress has been made both in terms of quantity and quality. More achievements have been reported and more goals have been set in the 14th plans. Nevertheless, the discourses of instrumentality and modernization continue to feature prominently in the 14th plans. A more balanced vision of DT is needed to give full play to its affordances for transforming individual universities as well as the entire higher education sector.

Keywords: digital transformation, higher education, institutional strategy, Chinese university, policy study

Highlights

What is already known about this topic:

- Digital transformation is a global trend in higher education.
- Digital transformation has been part of the long-term strategy of Chinese universities since the 1990s.
- The goals of Chinese universities' digital transformation are somewhat similar to those pursued in other countries.

What this paper contributes:

- Achievements in digital transformation have been made by Chinese universities since 2020.
- Themes which are unique to the Chinese context may enrich the connotation and denotation of digital transformation.
- Digital transformation in Chinese higher education is getting closer to the transformation end of the digitization→digitalization→digital transformation continuum.

Implications for theory, practice and/or policy:

- A more balanced vision of digital transformation is needed to give full play to its affordances.
- Efforts should be made to facilitate deep and coordinated cultural and organizational changes.
- Digital transformation is a contextualized process, hence no one-size-fits-all model.

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Introduction

Digital transformation (DT) is a trend in the global higher education sector. It "is a natural and necessary process" for those higher education institutions (HEIs) which aspire to "to be leaders of change and be highly competitive in their domain" (Benavides et al., 2020). The future of higher education "will undoubtedly be digital" (Kopp et al., 2019, p. 1448). Therefore, many countries have developed national or macro-level DT strategies for higher education (Dung et al., 2021; Marín et al., 2022; OECD, 2021) and some even promote DT in their (higher) education laws, for example, China (Xiao, 2019) and Turkey (Bozkurt et al., 2022). Important as these attempts are, institutional or meso-level strategies are critical to successful DT of individual HEIs and eventually of the entire sector.

DT requires institutional adaptation, adjustment, and even reinvention (Abad-Segura et al., 2020) because it is "deliberately challenging and disruptive of conventional practice" (ACT Government, 2016, p. 3). How DT is conceptualized in institutional strategies determines its implementation, hence shaping the digital landscape of an institution. Given the critical role that institutional strategies play in this process, a study was conducted to investigate how DT was framed in the 13th five-year development plans (2016-2020) (hereafter the 13th plan) of 75 top Chinese universities (Xiao, 2019). China has entered the 14th five-year development period (hereafter the 14th period). Is there any change in the way DT is conceptualized in the 14th five-year development plans (hereafter the 14th plan) of these top Chinese universities? A follow-up study will shed light on the DT status of Chinese HEIs and contribute to the global knowledge base of this field of study.

The terms *digitization*, *digitalization*, and *digital transformation* (DT) are used in the literature, sometimes interchangeably, especially the last two (Kopp et al., 2019). Nevertheless, distinctions are often made between them (Kraus et al., 2021), with *digitization* referring to "changing from analogue or physical to digital form" and *digitalization* involving the use of "digital technologies and information to transform individual institutional operations" (Brooks & McCormack, 2020, p. 5), hence more than "the technological transformation from analogue to digital" (Kopp et al., 2019, p. 1449). As for DT, this study adopts the definition of EDUCAUSE according to which it is "a series of deep and coordinated culture, workforce, and technology shifts that enable new educational and operating models and transform an institution's business model, strategic directions, and value proposition" (Brown et al., 2019). Nevertheless, digitalization is used to refer to digital transformation in literal translation of quotations from Chinese documents in which they are often used as synonyms. The same applies to *informatization* which is also a "standard" umbrella term in the Chinese context although it is being replaced by digitalization in recent years. Given that this article targets international audience, digitalization will be substituted for informatization in literal translation.

Dimensions of Digital Transformation in HEIs: a Literature Review

A survey of Australian HEIs' DT strategies show that this concept covers such areas as learning, teaching, research, profile-building, infrastructure, capacity-building and support for both students and staff, administration and management, open educational resources (OER), inter-institutional cooperation, industry partnership, wider community service, and internationalization (Bond, 2022), echoing the results of a German study (Gilch et al., 2019). Similar though somewhat different dimensions are identified by Germany's Standing Conference of the Ministers of Education and Cultural Affairs (Kultusminister Konferenz, 2016) as areas of action and development, including teaching, teachers, students, curriculum, OER, quality assurance, support for teachers, infrastructure, profile-building, and cooperation.

According to Benavides et al. (2020), DT research focuses on the following 11 themes - teaching, infrastructure, curriculum, administration, research, business process, human resource, extension, DT governance, information, and marketing, in descending order of research interest. Some of these dimensions are corroborated by official documents related to DT of a Spanish public university (Almaraz-

Menendez et al., 2016), including, in descending order of importance attached, teaching, marketing, research and knowledge transfer, administration, communication, IT infrastructure, and university campus.

A roadmap is proposed for DT in Spanish universities which is underpinned by six pillars, namely using digital technologies to help and bring value to HEIs (vision), change business processes (university process), provide flexible modes of interaction and communication with students (contact), design and offer new services and products (services and products), change from analogue to digital model (new model of university), and transform leadership and institutional ethos (organizational culture) (Cabrero et al., 2017). In comparison, the *Construction Specifications for HEI Digital Campus (provisional)* published by the Chinese Ministry of Education (MOE) (2021a) is composed of five dimensions: infrastructure (campus network, data centre, teaching environment and so on), resources (data generated and digital teaching, research, and cultural resources), information literacy, applications and services (teaching, research, management, logistics, and so on), and cybersecurity.

Overall, despite lack of consensus on the contents of DT and differences in labelling dimensions, DT is generally intended to bring an all-round change to HEIs, "more about people, culture and organizational change than technical implementations" (Lustosa Rosario et al., 2021).

Digital Transformation in Chinese Higher Education: a Macro Perspective

National policies, strategies and plans influence the formulation of their counterparts at the institutional/meso level. China is a typical case in point whose higher education is a highly centralized system with public HEIs constituting 75% of the sector (MOE, 2021b). Major macro-level documents related to DT in (higher) education which had been released before 2016 and were likely to affect DT goals in the 13th plans (2016-2020) were reviewed in Xiao (2019). This section centres on those published since 2016.

To ensure the accomplishment of the development goals set in the *Outline of China's National Plan for Medium and Long-term Educational Reform and Development (2010–2020)* (Central Committee of the Communist Party of China & State Council, 2010) and the *Ten-Year Development Plan for Educational Digitalization (2011–2020)* (MOE, 2012), MOE (2016) announced its *13th Five-Year Plan for Educational Digitalization* while the State Council's (2017) *Development Plan for the New Generation Artificial Intelligence* lists AI-driven smart education as a key task. In 2018, MOE (2018) published its *Action Plan for Educational Digitalization 2.0*, which can be regarded as an overarching response to the calls for accelerating DT by the Central Committee of the Communist Party of China and the State Council in preceding years, with the aim of accelerating the entry of Chinese (higher) education into a more advanced stage of DT through "re-conceptualization of education, transformation of educational model and restructuring of the educational system to support education modernization" (Xiao, 2019, p. 528). Other documents that may have influenced DT goals in the 14th plans of Chinese HEIs include: *Guidelines on Construction and Application of the Digital Educational Resources Public Service System* (MOE, 2017), *China's Education Modernization 2035 Initiative* and its corresponding *Five-Year Implementation Plan for Speeding up Education Modernization (2018–2022)* (Central Committee of the Communist Party of China & State Council, 2019a, b), and *Guidelines on Promoting Healthy Development of Online Education* (MOE et al., 2019). The common message conveyed explicitly or implicitly in these documents is the shift from favouring hardware construction and somewhat independent operation of different systems/platforms to an integrated and overall approach to DT as defined by EDUCAUSE (Brown et al., 2019).

Methodology

The Sample

This study was conducted using a directed approach to qualitative content analysis (Hsieh & Shannon, 2005). It is a follow-up to Xiao (2019) which investigated the roles of DT as conceptualized in the 13th plans (2016-2020) of 75 top Chinese universities. Of the 3012 HEIs in China (MOE, 2021b), only these 75 are directly under MOE, hence generously funded by the Central Government. The institutional websites of these universities were accessed and their 14th plans were downloaded from July 1 to July 7, 2022. Unfortunately, only 56 universities' 14th plans are available in full text while the remaining 19 are either published in the form of outline or denied to the public.

Research Question

This study set out to answer the following questions:

- How is DT conceptualized in the 14th plans (2021–2025) of top Chinese universities?
- Is there any change in the way DT is framed in the 14th plans as compared to their 13th counterparts?

Data Analysis

Given its follow-up nature, the thematic framework of the previous study (Author, 2019) was used to process the sample with new themes and categories added. In this paper, a category refers to a group of themes having some common features. The original framework is comprised of 18 themes grouped under five categories. The researcher and an associate who was also a coder for the earlier study used the original framework to code 10 texts line by line manually and independently, and noted down related contents including those which did not fall into any of the existing themes. Afterwards, they compared their coding results, including uncategorized contents, exchanged views on the coding of these contents, and settled disagreements by re-reading and discussing relevant contents together. Three new themes were identified and added to the original framework at this stage.

The revised framework was then used to analyze the remaining 46 plans by following a directed approach (Hsieh & Shannon, 2005). Both coders hand searched for and critiqued contents about DT in these documents independently, at least twice. A chart was created for each theme in the new framework and extracts specific to particular themes were collated in charts. Formal coding results were highly identical with an agreement rate of 93.2%. Consensus was reached by rereading, reanalyzing and discussing in depth these controversial contents together. New themes were added and new categories were created if they did not fall into existing categories. Two more themes were identified with each constituting a category: international cooperation/internationalization and cybersecurity. The theme international exchanges of education and culture was originally under the category of serving a wider community, mainly referring to Chinese language and culture teaching and dissemination. Therefore, a new theme and category, international cooperation/internationalization, was added to cover international activities other than those of the exchange theme. As for cybersecurity, it was categorized into the theme of digital infrastructure construction in the original framework but is treated as an independent theme and formed a category of its own now in alignment with the DT dimensions specified in the Construction Specifications for HEI Digital Campus (provisional) (MOE, 2021a).

To further reduce possible researcher bias and ensure coding reliability and validity, a third coder was invited to conduct a content analysis of 18 documents of his own random choice using the same coding framework. This researcher's coding results were then compared with the first two coders' results pertaining to the same documents. The agreement rate was 90.8% with disagreements resolved through

negotiation. Altogether, 23 themes are identified in the 14th plans which are grouped into seven categories (see Figure 1).

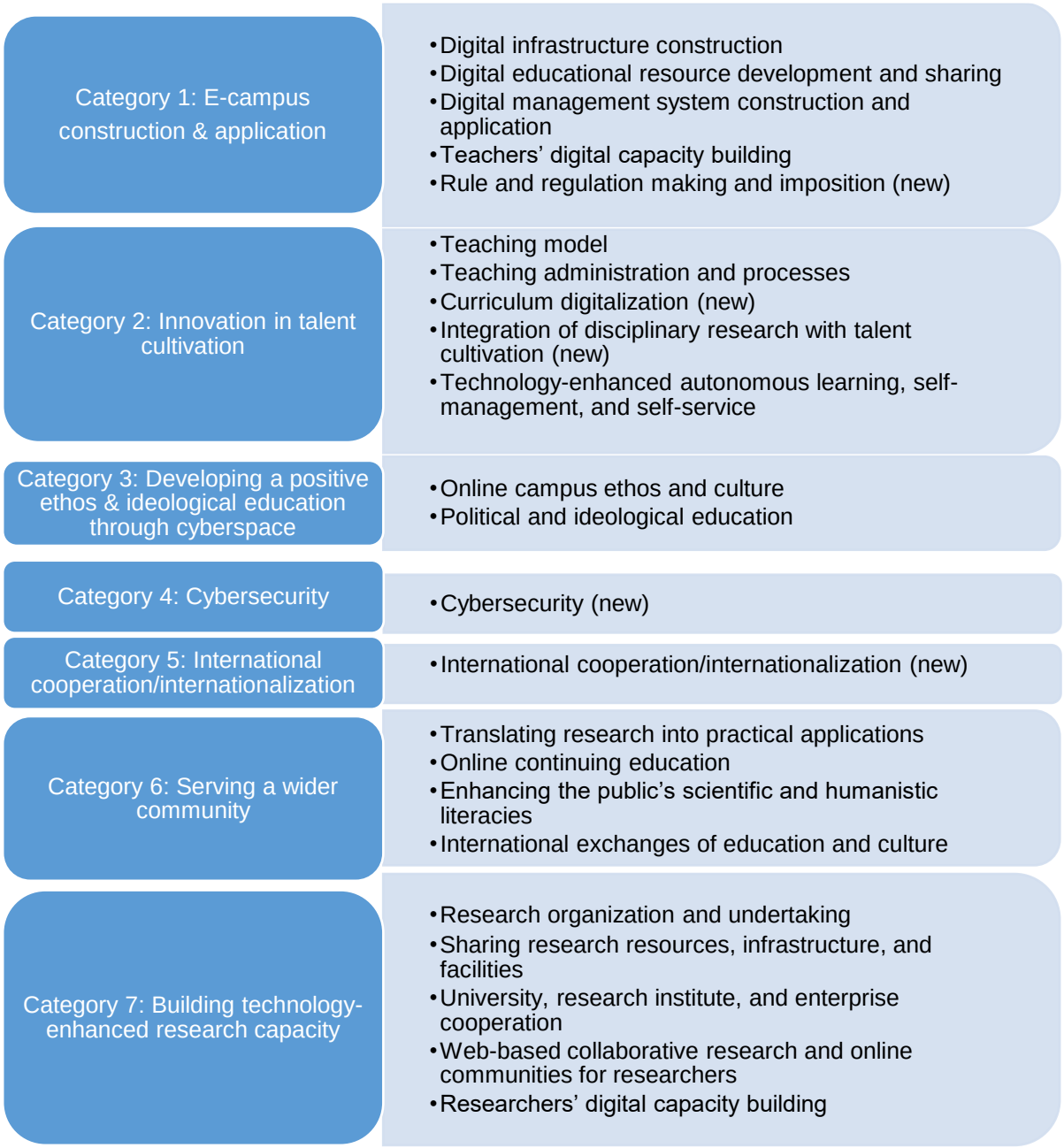

Figure 1: Categories and themes

Findings

Achievements, Opportunities and Challenges

All the plans start with achievements made in the 13th period (2016-2020) together with opportunities and challenges the universities identify as likely to emerge in the 14th period (2021-2025). Nearly 90% (n=50 out of 56) of the 14th plans include achievements in DT while the percentage was lower for the 13th plans at roughly 75% (n=56 out of 75). It is the same case with opportunities (44.6% vs 21.3%) and challenges (41% vs 26.6%) associated with DT. As for the reported achievements, six new themes have arisen, bringing the total number to 12 (Table 1). Compared with the 12th period (13th plan), the 13th period (14th plan) has witnessed greater progress in DT especially in terms of dimensions covered.

Table 1. Digital achievements (n=50 for 14th plan; n=56 for 13th plan)

Theme	14th plan	13th plan
Digital infrastructure construction	68%	89.3%
Digital educational resource development and sharing	68%	67.8%
Digital management system construction and application	44%	26.8%
Teaching model	20%	3.5%
Online campus ethos and culture	18%	25%
Political and ideological education (new)	16%	
Research organization and undertaking (new)	12%	
Rule and regulation making and imposition(new)	10%	
Online continuing education	8%	3.5%
University, research institute, and enterprise cooperation(new)	8%	
International cooperation/internationalization(new)	6%	
Curriculum digitalization(new)	2%	

Goals of Digital Transformation in the 14th Plans

E-campus Construction and Application

There are five themes under this category (Table 2). All the universities set their goals in digital infrastructure construction, digital educational resource development and sharing, and digital management system construction and application in their 14th plans while teachers' digital capacity building is included in only 41% of the plans. These four themes are more prominent in the 14th plans than in their 13th counterparts. The least popular theme (37.5%), rule and regulation making and imposition, is newly added. For example, China University of Mining and Technology-Beijing (2021) intends to formulate and impose related rules and regulations to enable DT in the way teaching, research, resource allocation, decision-making, and management are carried out.

Table 2. E-campus construction and application (n=56 for 14th plan; n=75 for 13th plan)

Theme	Digital infrastructure construction	Digital educational resource development and sharing	Digital management system construction and application	Teachers' digital capacity building	Rule and regulation making and imposition (new)
14th plan	100%	100%	100%	41%	37.5%
13th plan	85.3%	94.6%	88%	14.6%	

Although infrastructure, educational resources, and management are highly valued in both the 13th and 14th plans, expectations are higher now than in the 13th period. For example, Beijing Language and Culture University (BLCU) (2021) plans to utilize cutting-edge technologies such as 5G and WIFI 6 to:

- ensure high-speed network coverage and multi-access to the campus network, building an advanced, secure, campus-wide, and convenient online infrastructure;
- enhance the performance of the campus cloud computing platform, optimizing the computing environment and providing secure and stable computing and storage services for all the operation systems of the university;
- build a smart teaching and innovative environment, turning all classrooms into smart teaching stations, developing and using resources fit for online learning and mobile learning, and encouraging individualized and interactive teaching, for example, flipped classroom, inquiry-based, and project-based;
- adopt an integrated approach to designing the university's operation systems (teaching, research, human resources, student affairs, finance, logistics, university assets, and so on), optimizing and synthesizing their functions to construct a synergistic model of service; and

- strengthen data governance, promoting inter-department and cross-level data sharing, providing intelligent services, and informing the management's decision-making.

Innovation in Talent Cultivation

A significantly higher proportion of 14th plans mention innovation in teaching model (91% vs 66.7%) and transformation of teaching administration and processes (51.7% vs 33.3%) than the 13th plans (Table 3) while the opposite is true for promoting technology-enhanced autonomous learning, self-management, and self-service (9% vs 28%). It is worth noting that open, flexible, distributed, and/or disaggregated learning was hardly mentioned in the 13th plans while this goal appears in 39% (n=22) of the 14th plans in relation to teaching model (n=51). On the other hand, transformation of teaching administration and processes is no longer limited to assessment, credit recognition and transfer, and course selection and enrolment, either university-wide or across domestic universities. For example, Communication University of China (2021) proposes to build a credit recognition system to facilitate MOOC credit transfer across universities, both domestic and international.

Table 3. Innovation in talent cultivation (n=56 for 14th plan; n=75 for 13th plan)

Theme	Teaching model	Curriculum digitalization (new)	Teaching administration and processes	Integration of disciplinary research with talent cultivation (new)	Technology-enhanced autonomous learning, self-management, and self-service
14th plan	91%	66%	51.7%	16%	9%
13th plan	66.7%		33.3%		28%

The second most popular theme in this category in the 14th plans is curriculum digitalization, a new theme referring to digitally modernizing curricula in terms of learning objective, content, and delivery to meet the needs of contemporary socio-economic development. For example, Xiamen University (2021) vows to promote full integration of the Internet, big data, and artificial intelligence with humanities and social sciences while China Agricultural University (2021) plans to adapt and upgrade its agricultural curricula using digital technologies. Another new theme is integration of disciplinary research with talent cultivation, with the purpose of integrating new research outcomes into teaching resources and encouraging learning by research in a digital environment.

Developing a Positive Ethos and Ideological Education Through Cyberspace

Both themes (online campus ethos and culture, and political and ideological education) in this category are more popular in the 14th plans than in their 13th counterparts. Due to the increasing emphasis on fostering all-round development, socialist core values, and patriotism in students, many universities outline their plans to strengthen political and ideological education in a digital manner which is arguably familiar and acceptable to students, with a 22 % increase in the 14th plans as compared to the 13th plans (78.5% vs 56%). It should be borne in mind that this theme refers to extracurricular political and ideological education, in other words, occurring informally (or formally) in extracurricular activities, not as a single course which is put under the theme of teaching model. Similarly, as the society is more and more digital, the great majority of universities detail their goal to harness the affordances of digital technologies in, among other things, disseminating and indoctrinating positive values, increasing awareness of university missions, taking responsibility for community outreach, preserving cultural artefacts of historical value to the university, and building a striking profile. This theme also receives more attention in the 14th plan (87.5%), albeit its relative popularity in the 13th plans (74.5%). For example, Beijing Jiaotong University (2021) sets the goal of speeding up the construction of online culture to build a brand-new image of the university. Put specifically, it is to implement political and ideological education through integrated media, including producing online mini-lessons to cultivate humanistic values, political and ideological education, and morality, launching a select series of online

cultural products, and building online studios for political and ideological education and an integrated media centre, among other measures.

Cybersecurity

Cybersecurity becomes an independent theme now and forms a category of its own. The identification of cybersecurity as a dimension of digital transformation by 64.2% of the 14th plans (n=36 out of 56) shows that more and more Chinese universities are conscious of potential threats posed by digital technologies and digital applications. Anti-hacking, data security, privacy protection, network robustness, content monitoring and filtering, and capacity building are covered under this theme.

International Cooperation/Internationalization

Enhancing international cooperation/internationalization through DT is a goal in 57.1% (n=32) of the 14th plans. This is a reaction to the State Council's (2015) Double World-class Project (world-class universities and world-class disciplines) and the implementation measures proposed by MOE and other ministries (2017). For example, BLCU (2021) sets the goal to harness cloud-based and intelligent technologies to extend its campus not only beyond Beijing but also outside China, and to make the best use of both domestic and international educational resources by turning the globe into its campus.

Serving a Wider Community

All the four themes in this category appear both in the 13th and 14th plans (Table 4). Three of them find greater favour in the 14th plans. In recent years, the Chinese government has offered many incentives to encourage researchers to step out of the ivory tower and contribute to the wider community's socio-economic development by translating their research into practical applications. Consequently, the 14th plans that recognize the affordances of digital means for facilitating this translation far outnumber the 13th plans (53.5% vs 8%). For example, Southwest University (2021) plans on leveraging its strengths in research to build a world-class Internet of Things to monitor the fragile ecosystem of the Three Gorges Reservoir Region with a space-air-ground integrated approach, automatically collecting and intelligently analysing and processing data to inform the restoration and re-construction of the ecosystem as well as policy-making.

There are also a higher proportion of universities that plans on developing online continuing education in the 14th period than in the 13th period (50% vs 34.6%) although MOE has tightened the policy on degree and diploma programs in online continuing education recently. Instead of focusing on degree and diploma online continuing education as they used to, more universities have formulated their plans to offer workforce training, professional development, and personal enrichment courses in an attempt to cater to the learning needs of a learning society. This sense of social responsibility also leads to a rise in the proportion of universities that aim to play an active part in enhancing the public's scientific and humanistic literacies (25% vs 10.6%) by organizing and holding non-profit events. International exchanges of education and culture, referring to teaching the Chinese language and disseminating Chinese culture via digital means, is the only theme that has seen a slight decrease (7.1% vs 8%).

Table 4. Serving a wider community (n=56 for 14th plan; n=75 for 13th plan)

Theme	Translating research into practical applications	Online continuing education	Enhancing the public's scientific and humanistic literacies	International exchanges of education and culture
14th plan	53.5%	50%	25%	7.1%
13th plan	8%	34.6%	10.6%	8%

Building Technology-Enhanced Research Capacity

All the five themes in this category emerge more prominently in the 14th plans than in the 13th plans, especially utilizing digital technologies to optimize research organization and undertaking, enhancing efficiency and quality (48.2% vs 5.3%); share research resources, infrastructure and facilities university-wide as well as between university, research institute and enterprise (32.1 vs 25.3%); promote cooperation in research between university, research institute and enterprise, driving research innovation and transfer (17.8% vs 4%); and facilitate Web-based collaborative research and establish online communities for researchers (16% vs 9.3%)(Table 5). Although these four themes are less valued than the themes in the preceding categories, their increase in percentage is still more substantial than improving researchers' competencies to conduct research in a digital environment, which is set as a goal only occasionally both in the 14th and 13th plans (5.3% vs 4%). Take Sun Yat-sen University, one of its DT-related goals is to establish a public digital platform for humanities to facilitate innovations in the research paradigm of humanities while another goal is to establish a public digital platform for social science to provide researchers with research data.

Table 5. Building technology-enhanced research capacity (n=56 for 14th plan; n=75 for 13th plan)

Theme	Research organization and undertaking	Sharing research resources, infrastructure, and facilities	University, research institute, and enterprise cooperation	Web-based collaborative research and online communities for researchers	Researchers' digital capacity building
14th plan	48.2%	32.1%	17.8%	16%	5.3%
13th plan	5.3%	25.3%	4%	9.3%	4%

Discussion

Digital Transformation in the 14th Plans

Overall, Chinese HEIs have achieved a higher degree and wider range of DT in the 13th period. Achievements in this period have doubled those in the 12th period in terms of themes (12 vs 6). Of the six new themes, political and ideological education, research organization and undertaking, and university, research institute, and enterprise cooperation were set as goals in the 13th plans (Xiao, 2019) while the remaining three can be regarded as reactions to new demands put forward in related national documents (for example, Central Committee of the Communist Party of China & State Council, 2019a, b; MOE, 2016, 2017, 2018). Of the six "old" themes, digital infrastructure construction drops from 89.3% in the 13th plans to 68% in the 14th plans. Chinese HEIs started to construct digital infrastructure in the 1990s, which has become part of university routine ever since (people.cn, 2019). Some HEIs may take this work for granted and do not count progress in this aspect as achievements in their 14th plans, hence the drop in proportion. This may also explain the decline from 25% to 18% in reported achievements in online campus ethos and culture which has become increasingly emphasized and normalized in recent years. The remaining four "old" themes all record a rise in prominence in the 13th period.

As for goals of DT, 23 themes emerge in the 14th period. These themes overlap, to a considerable but varying extent, with findings from research in other contexts (for example, Benavides et al., 2020; Bond, 2022; Cabrero et al., 2017; Gilch et al., 2019), albeit with some discrepancies. For example, marketing is set as a goal in Almaraz-Menendez et al. (2016) but not specifically mentioned in the 14th plans while political and ideological education is specific to the Chinese context.

Three themes related to e-campus construction and application appear in all the 14th plans (see Table 2), corroborating Fisher's (2006) arguments about the affordances of digital technologies for enhancing cost efficiency and effectiveness and echoing findings that investment in hardware infrastructure is top

on many universities' agenda (Bozkurt et al., 2022; Gilch et al., 2019; Kovari, 2022; OECD, 2021). In contrast, teachers' digital capacity building is mentioned in only 41% of the 14th plans, hence the need for Chinese HEIs to pay more attention to this work whose importance cannot be underestimated (European Commission, 2020; Hesse et al., 2021; Hungarian Government, 2016; Norwegian Ministry of Education and Research, 2018; Lustosa Rosario et al., 2021). Concrete actions are required to address deficiencies in digital capacity building for teachers (Selwyn, 2007). As for rule and regulation making and imposition, despite its relatively less popularity (37.5%), its emergence is definitely a good sign since one of the greatest barriers to DT is culture change (Brooks & McCormack, 2020; Lustosa Rosario et al., 2021) which can hardly be effected without setting and implementing related rules and regulations. Appointment of a CIO may be conducive to this work. Only one university plans to appoint a CIO (Jiangnan University, 2021) while over 60% of HEIs in Germany and the United States have a CIO (Gilch et al., 2020).

When it comes to innovation in talent cultivation, reform in teaching model is the fourth popular theme (91%) in the 14th plans, a finding which aligns with other studies (for example, Gilch et al., 2020). Its importance is also reinforced in Benavides et al. (2020). Furthermore, about 40% of the 14th plans which include this theme also aim to normalize open, flexible, distributed, and/or disaggregated learning into campus-based education. This should be one of the prime objectives of DT (Benavides et al., 2020; European Commission, 2020). Therefore, more radical change is needed to drive DT in this direction. Of the remaining four themes, popularity varies considerably. Curriculum digitalization and innovation in teaching administration and processes are among the targets of DT (Benavides et al., 2020; Strods et al., 2018; Hungarian Government, 2016) which are included only in two-thirds and slightly over 50% of the 14th plans respectively. Integration of disciplinary research with talent cultivation (16%) and technology-enhanced autonomous learning, self-management, and self-service (9%) are even less favoured. Innovation in teaching model alone, even with a focus on openness and flexibility of learning, is far from sufficient to ensure that university graduates possess the knowledge, skills and qualities that the digital society requires (European Commission, 2020; Hungarian Government, 2016). All the themes in this category work in synergy to ensure that higher education keeps up with contemporary demand.

Developing a positive ethos and ideological education through cyberspace is highly characteristic of Chinese (higher) education, especially the ideological part which is essential to education in China. Hence, the two themes in this category rank 4th (87.5%) and 5th (78.5%) in popularity in the 14th plans. Education is value-loaded; what values are to be advocated depends on the social system of a country and the means by which the values are inculcated and promoted may differ from one country to another. That said, some elements of online campus ethos and culture are similar across countries, for example, equality, equity, and justice; social responsibilities; university cultural heritage; and profile-building.

Cybersecurity is set as a goal by nearly two-thirds of the 14th plans. Given that cyberspace is indispensable to HEIs today, any threat or possible breach in this aspect should be taken seriously in that they may eventually lead to tremendous damage, loss, and even disaster. Therefore, proactive security assurance measures should be in place for all digitalized institutions (Grosseck et al., 2020; Rodrigues, 2017); no Chinese HEI should be an exception.

Digital technologies can contribute to international cooperation and internationalization of higher education (Kondakci & Erberk, 2021), enabling HEIs "to gain a strategic positioning in the global education industry" (Mohamed Hashim et al., 2022, p. 3176; Taşlıbeyaz & Taşcı2021). However, a considerable number of Chinese HEIs have yet to realize that digital technologies can play a part in their ambition to join the ranks of world-class universities and world-class disciplines (MOE et al., 2017; State Council, 2015). Similarly, public HEIs have the obligation to give back to society in other ways rather than merely produce graduates. Digital technologies can make a difference in this aspect (European Commission, 2020). The four themes in the category of serving a wider community range from 53.5% to 7.1% in popularity. Obviously, Chinese HEIs need to raise their "digital" awareness in these areas. It is the same case with the category of building technology-enhanced research capacity. Digital

technologies can be used to improve the way research is organized and conducted; facilitate the sharing of research facilities such as equipment, instrument and laboratory; promote cooperation between university, research institute and enterprise; encourage collaborative research online; and build online research communities (Gilch et al.,2019; Multisilta & Mattila, 2022; Norwegian Ministry of Education and Research, 2018; Zemsky & Massy, 2004). In a sense, to what extent these goals can be achieved is determined by how well researchers are able to do research in a digital environment. Unfortunately, researchers' digital capacity building is the least popular theme (5.3%) in the 14th plans. Popularity of the other four themes in this category is not optimistic either, ranging from 48.2% to 16%.

Changes in the 14th Plans as Compared to the 13th Plans

Compared with the 13th plans, there is an increase in the number of dimension/category/theme set as goals of DT in the 14th plans. There are 18 themes which are categorized into five categories in the 13th plans while 23 themes, five of which are new, emerge in the 14th plans and are classified into seven categories, two of which are new. There is also an increase in popularity that specific themes enjoy in the 14th plans. Of the 18 themes mentioned both in the 13th and 14th plans, only two suffer from a decline in popularity, namely technology-enhanced autonomous learning, self-management, and self-service (28% vs 9%), and international exchanges of education and culture (7.1% vs 8%). The popularity of the other 16 themes increases by an average of 17.5%, with translating research into practical applications (by 45.5%) and research organization and undertaking (by 42.9%) topping the list.

In addition to changes in quantity, there are also qualitative changes. First, the addition of new themes and categories is also evidence that DT covers a wider range of dimensions in the 14th plans, hence richer in connotation and denotation. Secondly, a particular theme may imply higher expectations in the 14th plans, for example, the themes regarding infrastructure, educational resources, management, teaching model, teaching administration and processes, and online continuing education (see the Findings section).

Conclusion

Judging from the most popular themes identified, instrumentality (highlighting the utilitarian purpose of DT) and modernization (transforming higher education to keep up with the times) continue to feature prominently in the 14th plans of top Chinese universities despite the fact that, compared with the 13th period, DT in the 14th plans is coming closer to the transformation end of the digitization→digitalization→digital transformation continuum. Chinese universities have already embarked on the DT journey. Nevertheless, there is still a long way to go before changes of a disruptive nature occur at all levels across an HEI, "with changes to views of learning and to the nature and operation of the tertiary institutions and the tertiary system" (Brown et al., 2007, p. 76).

DT "is enabled, supported and guided by technological, human, organizational and pedagogical drivers" (Oliveira & de Souza, 2022, p. 286). Deep and coordinated cultural and organizational changes have yet to gain due emphasis in the 14th plans. For example, all Chinese universities have an office in charge of DT. However, this department alone cannot effect the cultural or organizational changes needed (including leadership and institutional ethos). To this end, both academic and administrative governance hierarchy may need re-structuring in ways conducive to cultural and organizational changes so that DT can give full play to its affordances. On the other hand, capacity building needs strengthening not only for teachers and researchers but also for students, managing staff, and administrators. This is a dimension included in MOE's (2021a) *Construction Specifications for HEI Digital Campus (provisional)*. If this document had been published one year earlier, the capacity building theme might have featured more prominently in the 14th plans. As for pedagogical practices, student-centeredness needs further highlighting to realize transformation of learning, reaching the final destination of the three-stage e-learning framework (Brown et al., 2007).

DT "is a journey with multiple paths" (Brooks & McCormack, 2020, p. 3). DT in Chinese HEIs is justifiably progressing in a direction similar to the global trend but to some extent also with Chinese characteristics. Of the 23 themes identified as goals for the 14th period, only five appear in over 80% of the 14th plans which focus on instrumentality and modernization. Therefore, university policy-makers need to have a more balanced vision of DT rather than merely concentrate on the "material" benefits of DT. Globally, university leaders are not adequately ready digitally. A survey by EDUCAUSE shows that HEI management's awareness and understanding of DT needs significantly enhancing (Brooks & McCormack, 2020). In the case of Chinese HEIs, university executives and administrators have to be digitally ready because DT is a national strategy; what they need to do is embrace a more inclusive vision of DT rather than overemphasize the instrumentality and modernization discourses.

It should be pointed out that as a policy analysis, this study cannot be completely free from researcher bias despite efforts to ensure its reliability and validity. Findings from this type of research tend to represent the researcher's perspective on the issue under investigation. Future research may involve inputs from insiders' perspective, for example, interviewing policy-makers to triangulate the researcher's interpretations and gain deeper insights into their true intentions.

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