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Research on the Strategies for Cultivating College Students' Digital Innovation Abilities in the Context of the Digital Intelligence Era

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Abstract

In the era of digital intelligence, developing the workforce's digital innovation capabilities is essential for enhancing corporate digital prowess, fostering business transformation, and ensuring high-quality enterprise growth. College students, as future contributors to the labor market, must therefore be equipped with robust digital innovation skills. Currently, however, these skills among students in domestic institutions are broadly deficient, and both theoretical and practical research in this area remain underdeveloped. This gap threatens the sustainable progress of domestic businesses and necessitates urgent development of effective training strategies. Extensive review of international literature and current practices reveals that college students' digital innovation skill development is hindered by inadequate theoretical underpinnings, ambiguous training objectives, a scarcity of collaborative educational mechanisms, limited resources, and imperfect instructional systems. Addressing these issues requires a redefinition of digital innovation competencies tailored to college students, aligned with labor market demands. This paper advocates for the establishment of joint training ecosystems, the broadening of resource integration channels, the enhancement of dynamic interdisciplinary systems, and the reform of flexible pedagogical and assessment methods. These recommendations aim to fortify the framework for nurturing digital innovation capabilities among college students in China.

Keywords: Digital Intelligence Era, College Students, Digital Innovation Ability, Cultivation Countermeasures

1. Introduction

In the digital era, the swift emergence and expansive integration of digital technologies — notably "big intelligence, material, mobile, and cloud" — have catalyzed the creation of substantial new industries, business models, and practices, thereby invigorating China's economic expansion. The 2021 White Paper on China's Digital Economy Development indicates that in 2020, the digital economy's volume reached 39.2 trillion yuan, constituting 38.6% of China's gross domestic product (GDP) (China Academy of Information and Communications Technology, 2021). Consequently, the digital economy has emerged as China's fourth major economic phase, succeeding the agricultural, industrial, and information service economies (Sun & Ding, 2022).

However, the evolution of the digital economy has elevated data to a principal factor of production, ranking alongside land, labor, capital, and technology. This elevation necessitates comprehensive digital transformation across industries, encompassing the digitization of conventional products, operations, and managerial decisions (Xu et al., 2022). The "2021 China Enterprise Digital Transformation Index Research Report" reveals that a mere 16% of Chinese enterprises have significantly advanced in their digital transformation, with the majority encountering challenges. The fundamental issue is the lack of robust digital innovation capabilities, which entails leveraging digital technology for product development, organizational restructuring, and business model refinement, fundamentally requiring the synthesis of digital resources (Liu et al., 2020; Svahn et al., 2017). Enterprises such as Alibaba and Gree have successfully reconfigured digital resources to innovate their products, processes, organizations, and business models, thereby securing a competitive industry edge (Svahn et al., 2017; Tan et al., 2015; Yang et al., 2022). As a pivotal driver of digital innovation (Xu et al., 2022), fostering digital innovation competence is vital for corporate digital transformation.

In March 2022, the Central Internet Information Office, among other agencies, promulgated the "Key Points for Enhancing the Digital Literacy and Skills of the Entire Population in 2022," prioritizing the improvement of "workers' digital innovation, entrepreneurship, and creativity" (Ministry of Education, 2022). The document also sets forth objectives for developing elite digital professionals and fostering top-tier digital talent. As the epicenter of talent development in China, higher education institutions bear the critical responsibility of nurturing digital innovators aligned with contemporary societal needs. Thus, strategizing the enhancement of digital innovation skills among university students is an imperative and timely endeavor.

2. Literature review

2.1. Definition and dimensions of digital innovation capabilities

The concept of digital innovation capability varies across disciplines, leading to a lack of consensus within the academic community regarding its definition. The debate primarily revolves around two frameworks: the attributes of digital technology and the innovation ecosystem. From the digital technology attribute standpoint, Liu et al. (2020) contend that digital innovation capability is an organization's capacity to employ and allocate digital resources for innovation across various domains, including products, organizational structures, and business models. This capability is delineated into primary capabilities—digital connectivity, data aggregation, and intelligent analysis—and advanced capabilities—digital agility and restructuring innovation (p.198). Yang and Li (2023) through the development of an evaluative index and case studies, argue that for manufacturing enterprises, digital innovation capability involves the strategic allocation of digital resources to meet specific innovation objectives, such as business model enhancement. They identify five distinct capabilities: intelligent connection, digital integration, data analysis, digital operation, and value creation (p.4).

From the innovation ecosystem perspective, Shang and Yang (2020), Yang et al. (2022) posited that digital innovation capability is a symbiotic blend of innovation acumen and digital literacy, which is characterized by the proficient application of digital technology, products, and tools in specialized fields to fulfill the advanced requirements of industrial digitalization. This encompasses a broad and intricate knowledge base, data-driven innovation thinking, and digital-era entrepreneurship. Wu et al. (2022) noted that define digital innovation capability as the utilization of digital resources to devise new products, offer novel services, and generate fresh user value (p.10).

2.2. Factors influencing digital innovation capabilities

Digital innovation capability is shaped by a myriad of factors. Wang et al. (2023) through the construction of a "motivation-behavior/capability-output" model pertaining to data orientation and digital innovation capability reveals that data orientation substantially enhances the development and refinement of corporate digital innovation capabilities (p.20). Liu et al. (2021), Wei and Liu (2020) asserted that policy frameworks and market demands directly influence digital technology's evolution, while technological environment shifts serve as a catalyst for corporate digital innovation capability construction. Following the development of a corporate digital innovation

capability evaluation index, Li et al. (2022) through empirical research, deduce that human resources in digital innovation exert the most significant impact, with financial resources also being critical, whereas the effects of resource integration and economic infrastructure appear marginal (p.1). Other researchers suggested that digital technologies, devices, and other infrastructure form the foundational elements for nurturing corporate digital innovation capabilities (Gregory et al., 2020; Haefner et al., 2021). Wang and Velamuri (2020) posited that innovation awareness and behavior manifest when individuals perceive an environment conducive to innovation, and an open, inclusive culture fosters innovation drive and dynamism, essential for digital innovation capability (p.12).

In summary, while research on digital innovation capability has progressed, two critical gaps persist: First, the domestic theoretical underpinnings of digital innovation capability are not yet comprehensive. Homegrown scholarship primarily fixates on defining and identifying influential factors and, when benchmarked against more established international frameworks, lacks breadth and depth. Second, the scholarly lens remains focused at the organizational level, neglecting more granular inquiries. Contemporary studies on digital innovation capability are predominantly enterprise-centric, with limited recognition of the workforce's pivotal role—the primary agent of corporate innovation. Research on the digital innovation prowess of the workforce, particularly college students as the nascent labor force, remains scarce within academic institutions. This paper aims to advance the theoretical base and research perspectives, contributing novel insights to the field.

3. Interpretation of the current situation and problem analysis of the cultivation of college students' digital innovation ability

3.1. The theoretical foundation is not yet solid, and the orientation of cultivation remains unclear.

A foundational step in fostering digital innovation skills among college students is to establish a robust and scientific theoretical base for their digital innovation capabilities. This requires formulating a comprehensive and precise definition of these capabilities. There has been notable progress in this area by scholars such as Yang et al. (2022), Zhen (2023) and Adner et al. (2019), who have offered definitions from various disciplinary perspectives. Nevertheless, the research predominantly focuses on enterprises, with scant attention to defining digital innovation capabilities from the vantage point of higher education institutions. Moreover, these studies often take a narrow disciplinary approach, such as Zhen (2023)'s work in the realm of new business science, which may limit their applicability and generalizability.

Furthermore, there is a discernible absence of industry-wide standards for digital innovation expertise, resulting in an ambiguous talent cultivation orientation within the job market. This ambiguity hinders higher education institutions from effectively developing students' digital innovation skills. The deficiency in both theoretical structure and industry benchmarks contributes to a limited recognition of the value of digital innovation capabilities among university leaders and students alike, consequently diminishing the drive to enhance these skills in the digital age.

3.2. Lack of diversified collaborative education and insufficient conditions for training resources

Comprehensive training resources are crucial for the enhancement of college students' digital innovation skills. However, Chinese higher education institutions currently face a scarcity of such resources, primarily due to the absence of a multifaceted collaborative educational framework. The development of these skills is an intricate endeavor that necessitates cooperation and collective effort from various university departments and external entities (Wang, 2022). Yet, there are misalignments in value orientation among stakeholders and ambiguities in responsibility definitions, often leading to the misconception that universities alone should shoulder the responsibility for nurturing digital innovation. This misperception results in a lack of engagement from other participants and diminishes the potential collective impact, leaving universities to contend with minimal outcomes from their isolated efforts.

From an industry standpoint, the corporate pursuit of profit maximization impedes the intrinsic motivation for investing in talent development, viewed as non-lucrative. Consequently, there is insufficient collaboration between businesses and educational institutions, limiting the integration of advanced digital technologies and practical training resources in student education. Regarding governmental involvement, there is a notable deficiency in orchestrating a cohesive multidimensional education system, resulting in uncoordinated stakeholder functions and interests and inadequate policy and fiscal incentives to support student innovation capabilities. This gap intensifies the financial burden on universities and undermines the practical implementation of digital innovation training.

Furthermore, higher education institutions themselves grapple with the high demands of personalized and elite training programs, which elevate the barriers to developing digital innovation competencies. The current academic workforce is predominantly single-discipline oriented, leading to a shortfall in 'professional + digital' educators. The dearth of faculty capable of imparting a blend of professional expertise, digital literacy, and innovative aptitude — a tripartite skill set essential for contemporary digital innovation education — severely constrains the advancement of such programs within universities.

3.3. The training mechanism is not yet perfect, and the supply and demand of talent training are decoupled.

Current mechanisms for nurturing digital innovation skills in college students encounter several challenges. Primarily, there is a disconnect between the educational and industrial sectors, leading to outdated curricula. With the rapid evolution of digital technology driving fundamental changes in industry, work, and production, there is a shift in talent requirements—from traditional labor and technical proficiency to a composite skill set encompassing professional expertise, digital literacy, and innovative capacity. Universities, however, have been sluggish in adapting their talent development programs to these shifts, resulting in a curriculum that fails to address the market's growing demand for multidisciplinary and cross-functional competencies, exacerbating the misalignment between talent cultivation and industry needs.

Moreover, the prevalent teaching and assessment methods lack adaptability. Predominant instructional models remain heavily theoretical, with insufficient emphasis on inspiring and exploratory practical learning, hindering the stimulation of students' enthusiasm for digital innovation. Furthermore, the assessment practices in higher education often overlook the diverse nature of course content, typically relying on theoretical evaluations and written examinations, which inadequately gauge students' digital innovation capabilities.

4. Countermeasures for the Cultivation of the Digital Innovation Ability of College Students

4.1. Compacting the theoretical foundation of digital innovation ability and clarifying the cultivation orientation of the employment market

The first task of researching the cultivation of college students' digital innovation ability is to clarify a reasonable and perfect definition of college students' digital innovation ability. On the basis of organizing and analyzing the existing results, this paper chooses the perspective of an innovation ecosystem that is more in line with the characteristics of individual ability and organically combines with the definition of college students' innovation ability to make the following innovations in the definition of college students' digital innovation ability: college students' digital innovation ability is the organic integration of high-level digital literacy and innovation ability, and it is the ability to give full play to innovative thinking based on existing knowledge and experience and to skillfully use modern digital technology in the field of specialization to produce new products with new value for society or industry. It is the ability to give full play to innovative thinking on the basis of existing knowledge and experience and skillfully utilize modern digital technology in the field of specialization to produce new products with new value for society or industry. Students should have a high level of digital literacy and innovation ability, conscious digital innovation awareness, meticulous digital innovation thinking and high modern industrial adaptability. Second, form a national research network of college students' digital innovation ability and clarify the standard of digital innovation talent demand in each industry. The government will play a leading role in organizing and decentralizing the project of exploring the standards of digital innovation talent in industries and will link the research teams of digital innovation ability of college students majoring in each university, the corresponding industries and the corresponding scientific research institutes to form a research team of the

standards of the needs of digital innovation talent in the industries. With the help of the cloud platform for scientific research results exchange, a regular exchange mechanism is established for the teams, and academic exchange meetings are held regularly for results sharing. At the same time, the government allocates funds to support the practical testing of excellent research results by building a pilot application mechanism for excellent theories. Finally, the awareness of colleges and universities and students should be cultivated to improve their digital innovation ability. At the university level, establish an external supervision and evaluation mechanism, build an evaluation index system for the cultivation of college students' digital innovation ability, supervise and evaluate the cultivation practice of college students' digital innovation ability based on it, and implement certain incentives for universities or cooperative enterprises based on the evaluation results; at the student level, set up a scholarship for outstanding talent in digital innovation to reward students with excellent overall evaluation of digital innovation ability cultivation courses or actively participate in digital innovation-related projects and competitions and achieve certain results. innovation-related projects and competitions and achieve certain results to stimulate students' awareness and subjective initiative to improve their digital innovation ability. The details are shown in Figure 1.

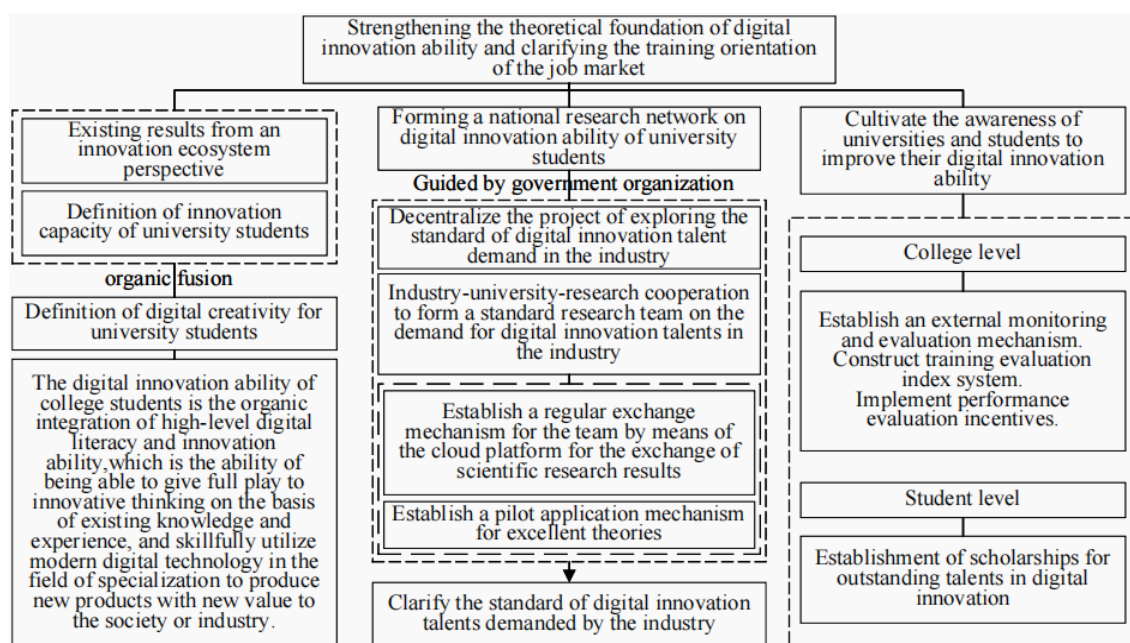


Figure 1: Strengthening the theoretical foundation of digital innovation ability and clarifying the cultivation orientation of the job market

4.2. Build a diversified and integrated cultivation ecosystem and expand multidirectional resource merging channels

The cultivation of college students' digital innovation ability requires the participation of multiple subjects from government, industry, academia, research and society to jointly cultivate high-quality digital innovation talent. In this regard, this paper proposes the following suggestions. First, improve the policy and system of collaborative education to realize the linkage and coupling of multiple subjects. The fundamental reason why the current collaborative education mechanism cannot have a good effect is that the value orientation of the main body of education is not the same and the responsibility of education is not clear. In this regard, the government needs to play a coordinating role, set up a special fund for the cultivation of students' digital innovation ability, encourage the active participation of social organizations through policy incentives and other measures, and build a multidimensional financial support system mainly based on financial allocations and social donations. At the same time, it should establish perfect policies for the collaborative cultivation of digital innovation talent, such as the preferential system of performance appraisal for cultivation subjects, the financial support system for related scientific research projects, and the reward system for excellent pilot projects, to encourage the cultivation subjects to participate actively. Improve the top-level planning of college students' digital innovation ability, clarify the boundaries of the responsibilities of each cultivation subject, guarantee that the cultivation subjects have their own

duties, and promote orderly cultivation. Second, open up the enterprise-school cooperation cultivation system and build a bridge for the mutual transfer of talent and resources. The government provides policy support, scientific research institutions provide intellectual support, promote universities and enterprises to build a cloud platform for the training of digital innovation talent, formulate digital innovation talent training courses mainly by university research teams, supplemented by enterprise research departments and scientific research institutions, share platform resources between enterprises and schools, and set universities and enterprises as theoretical training bases and practical training bases, respectively, to promote the talent of enterprises' advanced training personnel and university students. Enterprises and schools share platform resources and set universities and enterprises as theoretical training bases and practical training bases, respectively, to promote the complementary training of enterprise trainees and university students and help improve the digital innovation ability of the current labor force. Moreover, enterprises can set up "excellent digital innovation talent" through training for cooperating universities to realize the accurate delivery of digital innovation talent. Finally, to create an "endogenous and exogenous" talent mechanism to realize the construction of a three-pronged teaching team. Currently, teachers in colleges and universities mostly specialize in professional theory, lack practical experience in enterprises, have low digital literacy, and have weak innovation ability. First, due to the lack of practical experience, we can adopt the "endogenous and exogenous" talent mechanism, introduce enterprise engineers with a certain degree of digital innovation ability as practice tutors, set up a system of periodic enterprise practice and further training for on-campus teachers, and cultivate the "dual-capability" characteristics of on-campus teachers. Second, we will provide "digital innovation" courses. Second, the "Digital+" teacher training courses are set up to realize the deep integration of teachers' "professional dual competence" and "digital literacy". Third, to form a mechanism to improve the ability of the teacher team, enterprise and university cooperation to implement a typical project embedded learning system, teachers should be guided to actively participate in industrial frontier forums, digital innovation research projects and tournaments to bring teachers into contact with the international frontiers of the discipline and to promote the integration of the teacher's ability and teaching innovation. The details are shown in Figure 2.

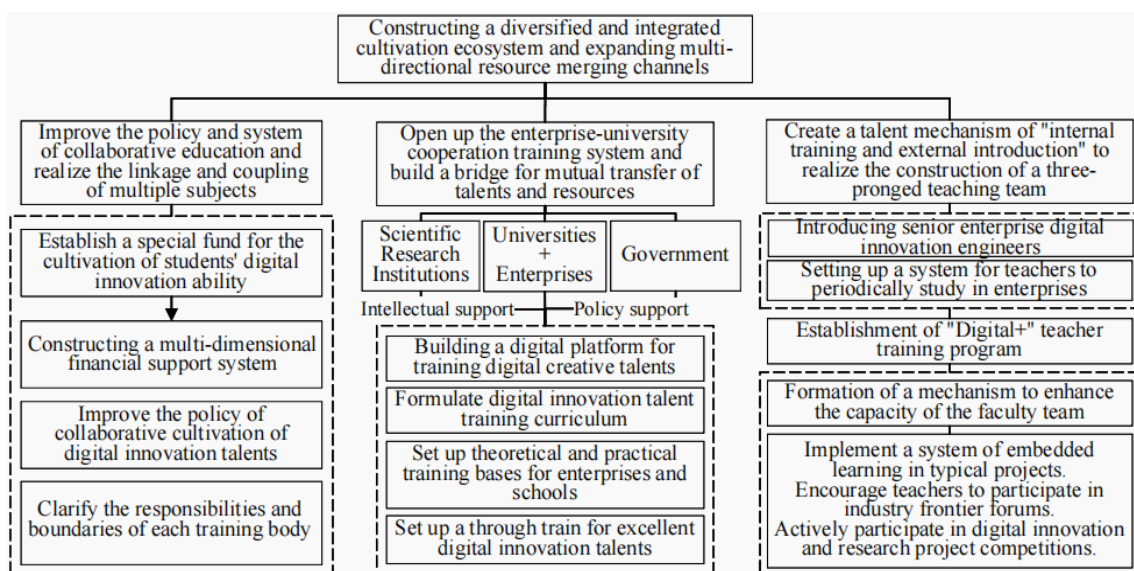


Figure 2: Building a diversified and integrated cultivation ecosystem and expanding multidirectional resource merging channels

4.3. Improve the construction of a dynamic digital creation course system and innovate the flexible teaching and assessment mode.

Based on the existing problems of the cultivation mechanism, this paper proposes the following suggestions in a targeted manner. First, to promote the construction of the three-pointed talent curriculum system, the digital innovation talent training program should be updated. Colleges and universities should actively explore the construction of a "professional + digital + innovation" integrated curriculum system, digital technology, and innovative thinking in traditional professional courses. For example, Hangzhou University of Electronic Science

and Technology School of Management organized the preparation of a "management + digital + innovation" series of teaching materials to explore the cross-fertilization of curriculum construction. For example, the School of Management of Hangzhou University of Electronic Science and Technology has organized the preparation of a series of textbooks on "Management + Digital + Innovation," which discusses the construction of cross-fertilization courses. Through the theory and practice base of enterprises and schools, it realizes the training of "dual-capability" talent. At the same time, digital innovation talent training courses on the digital innovation talent training cloud platform are regarded as online courses, and digital technology is utilized to strengthen backstage supervision and incorporate learning and assessment into the assessment indexes of students. Second, to build a feedback and adjustment mechanism for cultivation effect, the research team of digital innovation talent demand standard of each industry regularly tracks and studies the satisfaction and opinions of on-the-job graduates and interns who are engaged in professional counterparts within a certain number of years on the current professional curriculum system and updates the industry's digital innovation talent demand standard on the basis of it, promotes the iteration of the professional triple-talent curriculum system and digital innovation talent cultivation curriculum, and guarantees that the It also promotes the iteration of the professional triple-talent curriculum system and digital innovation talent cultivation courses, and guarantees the dynamics and advancement of the college students' digital innovation ability cultivation courses. Finally, innovate the teaching and examination mode of "scientific research leading, competition promoting learning," flip the teaching form of theory-based and practice-supplemented teaching, increase the proportion of heuristic and exploratory practical teaching, adopt the cross-fertilization teaching mode of "one class, many teachers, many teachers in the same classroom," and set up a reasonable proportion of teaching content and assignments for the students. A reasonable proportion of the teaching content and assignments are docked with disciplinary competitions and scientific research projects to create a teaching mode that utilizes scientific research to feed the teaching and truly focuses on the students. The assessment is based on the students' performance and final results in the process of disciplinary competitions and scientific research projects, supplemented by theoretical assessment. The details are shown in Figure 3.

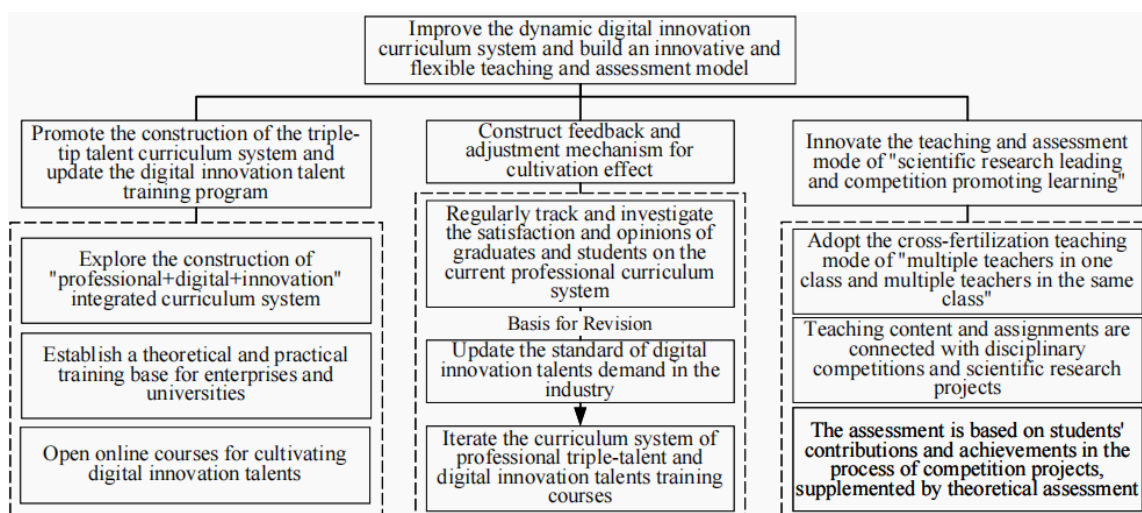


Figure 3: Improve the construction of a dynamic digital creation course system and innovate flexible teaching and assessment modes

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