Research on Construction and Application of Digital Ecosystem for Innovation and Entrepreneurship Education—The Case of National Vocational Education Innovation and Entrepreneurship Repository

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Abstract: Digital transformation is reshaping the society, the labor market and the future of work. Accelerating the digital transformation of education has become a consensus of the international education community. This paper takes the national vocational education innovation and entrepreneurship education repository as an entry point, to carry out research on the construction and application of education digital ecosystem. Targeting the pain points of the digital ecosystem construction of innovation and entrepreneurship education now, the author proposes solutions in five dimensions, including the construction concept, top-level design, institutional support, platform application, and teachers development. The aspiration is that the construction of digital education ecology can help serve people's lifelong growth and sustainable development.

1. Research Background

Today's world is witnessing a new round of technological revolution and industrial transformation in an accelerating pace. Driven by innovation and technological progress, digital transformation is reshaping our society, the labor market and future ways of work. In this process, education is becoming increasingly important. Increasing interconnectivity, widespread application of various devices and digital softwares, and a growing demand for digital skills continue to drive the digital transformation of education.

The United Nations Transforming Education Summit held in September 2022, has listed high-quality digital learning as one of its five major areas of action. In its National Statement of Commitment, China was also committed to further implementing the national education digitalization strategy action, which includes enriching the supply of digital education resources, building a broad and open learning environment, accelerating the sharing of resources on learning platforms of different types and levels, promoting the integration of new technologies with education and learning, and accelerating the digital transformation of education.

There are changes to work scenarios in the digital era: expanded work scope, flattened organization, innovative content, and collaborative approaches, which are collectively asking for more comprehensive competencies and more transferable skills from the talents. UNESCO adopted a Strategy for Technical and Vocational Education and Training for 2022-2029, stating that future vocational and technical talents should possess 3 prioritized skills - skills for all individuals to learn, work and live, skills for inclusive and sustainable economies, and skills for inclusive and peaceful societies. Among them, the skills for inclusive and sustainable economics are addressed with the specific need to "enhance STEM skills, green skilling, sustainability related competencies, entrepreneurial and 21st century skills; and to support TVET teachers and institutions to foster quality, innovation and excellence;"[1].

Therefore, entrepreneurship skills are core skills for future vocational and technical talents in the era of digital economy. In the process of economic restructuring and power dynamics change, the society needs a large number of high-quality technical and skillful talents that can meet the needs of national innovation-driven strategy and industrial upgrading[2]. An improved innovation and entrepreneurship education system shall be able to cultivate students' innovation mindset, entrepreneurship awareness and innovation and entrepreneurship ability. The creation of a digitalized innovation and entrepreneurship education ecology will be able to guarantee an efficient use of high-quality resources, thus providing high-quality human resources to support the delivery of the national innovation-driven strategy.

2. Dimensions of Research

2.1. An ecologic perspective

With the rise of the knowledge economy, the traditional university education model can no longer meet the strong demand for talent cultivation in the new era of economic and social development. Therefore, innovation and entrepreneurship education aiming at cultivating higher quality talents has emerged. China's innovation and entrepreneurship education started relatively late, but has made certain achievements with an approach of introducing and following foreign best practices in teaching concepts and mature teaching modes. However, problems such as unsound support system and lack of evaluation mechanism are also obvious. On the other hand, the external environment faced by universities has been undergoing changes from static to dynamic, propelling universities to strengthen partnerships with governments and enterprises, and partnerships among schools, to jointly promote scientific research and innovation, technology transfer, and entrepreneurship by creating a more open and balanced innovation and entrepreneurship education ecosystem. Similar to the natural ecosystems, the innovation and entrepreneurship education system also has a quasi-food-chain mechanism, where a variety of stakeholders inter-play and maintain the routine operation of the whole system through the material cycle and energy flow.

After the 1970s, the research on entrepreneurship education ecosystems gradually emerged in foreign countries. Initially, researchers mainly applied ecological theories to study the connection between entrepreneurial environment and entrepreneurship education. In 2005, Catherine Dunn proposed the concept of entrepreneurial ecosystem, indicating the start of attention drawn to the field. At present, the general definition of entrepreneurship education ecosystem in the academic world is: a self-regulating and sustainable education system that aims to cultivate innovative and entrepreneurial talents, and is composed of multiple subjects such as colleges and universities, governments and enterprises, as well as various elements such as curricula, programs, resources and policies. The nature this ecosystem are reflected as nurturing, coupling and endogenous. Nurturing refers to the ecosystem's goal of cultivating innovative and entrepreneurial talents, focusing on cultivating the spirit of innovation and entrepreneurial competencies; coupling refers to the fact that each element of the entrepreneurship education ecosystem does not exist in isolation, but are interdependent, mutually influential and interrelated to maintain a dynamic balance; endogenous refers to the fact that each element in the

entrepreneurship education ecosystem will flow in an orderly manner under the guidance of endogenous dynamics, and eventually generate a stable cyclic structure [3].

2.2. Perspectives on Digital Education based Repository

In the 1990s, with the development and application of computer network technology, Internet-based online learning emerged. This mode of learning provides conditions for personalized learning, independent learning, collaborative learning and exploratory learning. The informatization of teaching repository also joined the momentum. So far, there are many mature commercially available teaching repository products worldwide, as well as ones developed by educational institutions. Some of the more famous teaching repositories include: GEM (The Gateway to Educational Materials), CSILE Database, CODILESS Learning Support System; EDNA Education Network, CAREO Educational Resource Repository and EASEL (Educator Access to Services in the Electronic Landscape).

With the continuous maturity of the information-based teaching repository market and the increasing variety of available products, countries around the world have come to realize that the shareability of teaching resources and the interoperability of the system are of decisive significance for the use of internet-based learning and its cost-effectiveness. Foreign research in this area started in 1997. Some main achievements in the informationization of teaching respiratory in foreign countries include: LOM (Learning Object Metadata), LRM (Learning Resource Mefadata), DCMS (Dublin Core Metadata Set), etc.

Since the launch of China Vocational Education Professional Teaching Repository in 2010, it has gained wide attention and in-depth participation from vocational colleges and universities, the industry, and government departments at all levels, making great contribution to progress of vocational education informatization. In order to clarify the direction, priorities and reporting requirements of the project, the Ministry of Education has been issuing the Professional Education Repository Construction Manual every year since 2010, providing guidance for the management of the resources and improvement of the quality and outcomes of their application. Previous years' publications have reflected the trajectories of repository development. The functional orientation of teaching repository has been shifted from "teaching" to "learning", the logic from simple "classification" to a "tier-based approach", and content from "construction" to "use". The Chinese academia community in general have shown a positive attitude towards the teaching repository of vocational education, acknowledging that such teaching repository is playing three roles: 1) it helps to stimulate the learners' interest and facilitate learning to happen in a more effective way; 2) it helps to improve the quality of teaching and the role of education in serving the society, raising the efficiency and quality of talent cultivation; and 3), it helps to adapt education to the development of the times, and provides a basic foundation for the construction of the lifelong education system and a learning society [4].

3. Current Situation Analysis

3.1. Ecological research on innovation and entrepreneurship education tends to focus on the driving force of the three core chains, i.e., government, universities and enterprises, but ignores the inter-play of internal elements

The current research on the ecology of innovation and entrepreneurship is mostly based on the "triple helix", i.e., the relationship model in which universities, enterprises and the government cooperate closely and interact with one another, to jointly promote innovative activities, but also maintaining their independent identities. However, such research fails to address the fact that the innovation and entrepreneurship ecosystem is a dynamic and open system composed of individuals, organizations and the environment, and that all the elements are interacting and communicating with one another for the

shared goal of innovation, thus having some core features such as "mobility" and "symbiotic evolution". Moreover, since each institution may have different resources at its disposal, and there is asymmetry of information between individuals and organizations, low utilization of resources, insufficient integration usually occurs, leading to a lack of effective information flow among the elements of the system, and the failure to form a synergy.

3.2. The research on digital teaching repository tends to focus on the construction period, with insufficient research on how to effectively operate and maintain it after its completion to realize long-term sustainable development

The construction period of a national-level teaching repository project is generally two years. However, after the acceptance check, the system shall be able to maintain long-term sustainable online operation and service, with continuous updating and improvement, which requires the hosting unit to have preparations for an enduring period to come. At present, there is a lack of effective long-term working mechanism and resource guarantees, leading to the stagnation of some projects after acceptance. There have been a large number of digital repositories in "idle" state after acceptance.

3.3. There is a lack of high-quality teaching resources and shortage of teachers

An team of teachers with an adequate number, a reasonable structure and outstanding competencies serves as a powerful support for higher vocational colleges to carry out innovation and entrepreneurship education. At present, faculty of Chinese higher vocational colleges are facing the following problems: firstly, the talent structure is unreasonable. Teachers of innovation and entrepreneurship education in higher vocational colleges are mostly served part-time by class counselors or administrators. Most professional teachers lack understanding and awareness of innovation and entrepreneurship education. They are unwilling to change the traditional education and teaching methods, and tend to resist the integration of innovation and entrepreneurship to specialized course teaching. Although some higher vocational colleges have hired innovation and entrepreneurship lecturers, who are only available during lectures or assessments, with randomness in teaching frequency and effectiveness; secondly, the quality of teachers needs to be improved. Most of the teachers of innovation and entrepreneurship education in higher vocational colleges lack working experience in the industry or hands-on experience in innovation and entrepreneurship, which makes it impossible for them to provide relevant guidance to students.

4. Solutions

4.1. Construction concept: building a digital innovation and entrepreneurship education ecology as a life-long course, to achieve the nurturing and endogenous nature of resources

It's important for all stakeholders to consider innovation and entrepreneurship education teaching repository as a "living pursuit with soul", whereas the students growth are impact made during one's professional life. In the process of repository construction, key aspects such as new findings of course contents, teachers' inspirational mission and the exploratory teaching methods shall be addressed. The construction of the repository shall always adopt a user-centered approach, considering the characteristics of innovation and entrepreneurship education and teaching, and mobilize the construction of related resources, the overall design of the platform, and cross-regional efforts in co-construction, to build a sharing mechanism, that offers good accessibility, wide-spread roll-outs, creative extension. Teachers shall analyze the demand for course content according to the positioning of the curriculum and talent training requirements, and carry out overall design and tier-based development of material resources in a planned and purposeful manner at four levels: curriculum, modules, building blocks and

materials. On the other hand, users can retrieve resources according to their needs, learn and extract resources quickly, and build their individualized microstructures freely to meet personalized needs. The resource repository thus becomes a living pursuit, able to facilitate co-construction, co-creation and coexistence. It possesses the benign mechanism of self-selection, self-growth and self-circulation, full of vitality. In this way, the resource repository is no longer a pile of teaching resources, but a teaching ecosystem with inner life texture.

4.2. Top-level design: designing the digital ecological architecture of innovation and entrepreneurship education, to form innovation synergy with an open-minded, open source approach

The digital ecosystem of innovation and entrepreneurship requires the in-depth participation of industrial players, associations and enterprises, right from the formulation of the construction plan, to the participatory steps in the construction process, until the application and promotion. It also seeks to realize co-construction and sharing of the results. Therefore, at the beginning of the construction of the innovation and entrepreneurship repository, 30 vocational colleges and 11 industrial enterprises were invited to pool their resources. During the construction process, a sound accountability system, a sub-project-level reporting mechanism, full-process monitoring system, resource updating system, project mentor designations and other infrastructures were established to ensure tasks delivered to a high standard. Furthermore, sub-tiered projects are encouraged to be launched on the basis of the repository. In management, a project management approach has been adopted to ensure progress, which facilitated the integration and participation of the industrial players, associations and enterprises.

The goal of digital eco-design is to reduce the flow cost of factors such as human, logistics, capital and information, to promote the cross-regional interaction of innovation factors and innovation subjects, and provide more opportunities and conditions for college students' innovation and entrepreneurship efforts. The platform of innovation and entrepreneurship repository digitally transforms innovation and entrepreneurship featured resources such as culture-building solutions, newsletters, mentor list, case studies, competition casebook, crowdsourcing space options, project promotion opportunities, financing platforms, innovation collection, etc., to forme an open-minded and open-source ecological structure, with sub-tiered repositories. With this as the foundation, efforts shall be made to improve the branding and marketing of product + enterprise, to build a digital innovation and entrepreneurship ecology that addresses innovation education, incubation, competition, exhibition and investment.

4.3. Institutional support: Improving the digital ecosystem construction mechanism of innovation and entrepreneurship education, to realize the sustainable momentum of co-creation and sharing

In order to guarantee the construction and application outcome of the innovation and entrepreneurship digital ecosystem, it is necessary to establish mechanisms to guarantee support for the construction of the repository, build discipline and assessment systems, the exchange of social resources and the repository-based resources, the certification system for the learning achievements, and a three-dimensional promotion mechanism suitable for both on-line and off-line scenarios. The goal is to realize the co-creation and sharing of high-quality resources among schools, between schools and enterprises, and to build a lifelong learning "Overpass". In order to guarantee the sustainable development of the repository and its continued use after project completion, it is necessary to establish an external circulation mechanism for sustainable development. Market mechanism can be leveraged to explore a results-driven paid sharing scheme and trading of material resources. The goal is to realize the sustainable construction, sharing and application of the repository, and a benign cycle of resource construction and application where the rights and obligation are unified.

4.4. Platform application: Improving the soundness of digital ecological grid of innovation and entrepreneurship education, to realize use-case optimization and intelligent matching

The repository platform shall be able to support teaching modes such as ubiquitous learning, research-based learning, exploratory learning, collaborative learning, etc., and provide an open, shared, collaborative, interactive teaching and learning online learning environment, through respective channels for student leaners, teachers, enterprises and public learners. It builds up interactive use cases as typical applications, such as entrepreneur self-assessment, project team ability assessment, project feasibility analysis, etc.. With a "Cloud + Internet + Terminal" infrastructure, the platform is able to gather high-quality material resources, intelligently push resources to match learners needs, use big data mining for education and teaching process to implement a smart classroom; It also develops large-scale collaborative teaching and learning, promotes the data-based decision-making of vocational teaching, intelligently pushes material resources, delivers three-dimensional classroom communication and interaction, and facilitates instantaneous learning evaluation and feedback.

4.5. Teachers development: a "Ripple Method" to address insufficient professional teachers

Currently, teachers of innovation and entrepreneurship education come from a variety of professional backgrounds, but tend to lack systematic knowledge or practical experience. They are in urgent need of updating the concept of innovation and entrepreneurship education and upgrading their ways of teaching and practical abilities. Considering the openness and flexibility of teaching and learning in innovation and entrepreneurship education, a "ripple method" has been created based on the concept, principles and contents of repository construction, i.e. from a point to a dimension, from the center to the periphery, from backbone teachers to the whole teaching team, from core schools to participating schools then to application organizations, from offline to online, from classroom to applications, from papers to teaching materials, from competitions to patents. In this way, the training for teachers expands and radiates like ripples, to efficiently cultivate a specialized teaching task-force for innovation and entrepreneurship education and teaching across the country. Meanwhile, the high-quality teaching resources in the repository also lay a good foundation for teachers' rapid learning, free class organization and practices of flipped classroom.

5. Future Prospects

Intelligent education is not only a concrete campaign concerning people's livelihood, but also a major strategy with relevance to the overall national priorities. Through technology-empowered and data-driven measures, the actions will catalyze educational change in all aspects, systematically construct a new ecology of education and social relations, provide personalized education for learners, and make the millennium dream of aptitude-based equitable teaching a reality [5-7].The digital transformation of education will break through boundaries of school-based education and promote the integration of various forms of education, resources, elements, etc., to build a high-quality personalized lifelong learning system, where everyone learns from everywhere at all time. By integrating physical space, social space, and digital space, and innovating the way of content presentation, we foresee a future when learning becomes a beautiful experience, and cultivates the learners' higher-order thinking ability, comprehensive innovative ability, and lifelong learning mindset.

The Innovation and Entrepreneurship Teaching Repository now has two 600,000 registered users, over 200 million clicks, and deployed over 4,300 organizations. In the future, with the rapid changes in technology, intelligent education will be centered around data governance as the core, and driven by numerical intelligence, to promote the reengineering of the education management and business process in an integrated way. With an emerging digital education ecology, people's lifelong growth and

sustainable development will be served in an purposeful way.

Acknowledgements

References

[1] UNESCO. Strategy for technical and vocational education and training (TVET)(2022-2029)[EB/OL].(2022-03-04)[2022-04-30]. https://unesdoc.unesco.org/ark:/48223/pf0000380775?35=null&queryId=692713ce-93fb-448c-ba15-130602c13ae5.html

[2] Miao Changwu. The coupling logic, strategy and pathways of high-quality development of higher vocational education driven by innovation and entrepreneurship education[J]. Vocational and Technical Education, 2020, 41(16): 18-23)

[3] Shao Zebin. Outline of Educational Ecological Modernization[J]. Research on Education Development, 2019, 39 (17):58-64.

[4] Han Ce, Jiang Chunyang. An overview of Research on Professional Teaching Repository in Vocational Education in China - based on bibliometrics and CiteSpace analysis [J]. Southern Journal of Vocational Education, 2019, (3):65-70.

[5] Gao Yizhe, Huang Lulu. Blue Book and Development Index Report on Intelligent Education Released, a Reference for Effective Promotion of Intelligent Education [N]. China Education News, February 14, 2023 (2nd ed.).

[6] Li Xiaowa, Mo Yuwan. Construction of Professional Repository: from Quality Sharing of Resources to Good Balance of Higher Vocational Colleges [J]. Vocational and Technical Education, 2017, (19):30-34

[7] Luo Bingjin. A Synergistic Discussion on Resource-Platform-Mechanism of National Professional Repository for Vocational Education[J]. Vocational Education Forum, 2019, (12): 47-51