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Data-Driven Precision Training Model for Innovation and Entrepreneurship Talents in Universities: Theoretical Framework and Implementation Path

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Abstract: Against the backdrop of the national innovation strategy and the digital transformation of education, the traditional "extensive" training model for innovation and entrepreneurship talents struggles to meet the personalized development needs of students, making an urgent shift toward precision and intelligence necessary. This study constructs a four-dimensional integrated framework centered on data, "Goal-Data-Intervention-Evaluation", and proposes a data-driven training model for innovation and entrepreneurship talents in universities. By collecting multi-source data such as learning behaviors, competency assessments, and practical projects, the model conducts in-depth analysis of students' individual characteristics and development potential, enabling precise decision-making in goal setting, teaching intervention, and practical guidance. Based on data analysis, a supportive system for personalized teaching and practical activities is established. Combined with process-oriented and summative evaluations, a closed-loop feedback mechanism is formed to improve training effectiveness. This model provides a theoretical framework and practical path for the scientific, personalized, and intelligent development of innovation and entrepreneurship education in universities.

Keywords: Data-driven; AI; Innovation and entrepreneurship; Talent training

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1. Introduction

With the in-depth advancement of the national innovation strategy and the digitalization of education, cultivating high-quality talents with innovative spirit, entrepreneurial capabilities, and interdisciplinary literacy has become a core task of higher education reform. As the main front for innovation and entrepreneurship education, universities' training effectiveness directly affects the overall efficiency of the national innovation system. However, current

innovation and entrepreneurship education still generally adopts a standardized and large-scale "extensive" training model, which is difficult to adapt to differences in students' knowledge bases, interest tendencies, and development potentials. This leads to a significant structural imbalance between talent supply and personalized demands. This problem not only restricts the full release of students' innovative potential but also weakens universities' effectiveness in serving the innovation-driven development strategy.

In recent years, the rapid development of technologies such as big data and artificial intelligence has provided new possibilities for addressing the above dilemmas. The data-driven approach promotes the transformation of the educational paradigm from "experience empowerment" to "data empowerment" by comprehensively collecting, analyzing, and interpreting data throughout the teaching and learning process, injecting new momentum into enhancing the precision and effectiveness of innovation and entrepreneurship education. However, existing studies mostly focus on the application of learning analytics technology in online education scenarios or are limited to the optimization of single links such as curriculum systems and practical platforms. A systematic model driven by data and running through the entire talent training process has not yet been formed. Most current discussions regard data technology as an auxiliary tool, lacking an embedded design of the data-driven mechanism in the entire chain of goal setting, process intervention, and effect evaluation. Therefore, constructing a closed-loop and precise innovation and entrepreneurship training ecosystem based on data has become a key direction for theoretical innovation and practical breakthroughs.

2. Current application status of data-driven approaches and innovation and entrepreneurship education

2.1. Research on the application of data-driven approaches in the field of education

As an emerging methodology in education, data-driven approaches have demonstrated significant value in online education, learning analytics, and personalized teaching in recent years. Studies have shown that this method can provide a scientific basis for teaching decisions by real-time collection, in-depth analysis, and intelligent interpretation of data on teaching processes and learning behaviors, thereby effectively optimizing teaching outcomes [1]. For example, in online learning platforms, big data analytics can record students' learning trajectories, interaction frequencies, and homework completion status to construct personalized learning profiles, and recommend suitable learning resources and paths accordingly [2]. Learning analytics technology enables researchers to identify the inherent laws of students' learning patterns by mining massive educational data, dynamically adjust teaching strategies, and achieve precision teaching. However, existing research still has certain limitations in positioning data-driven approaches in education: most regard them as auxiliary tools rather than core driving elements throughout the entire educational process, resulting in their applications being confined to partial links and failing to fully exert systemic value.

2.2. Relevant research on the cultivation of innovation and entrepreneurship talents

As a key direction of higher education reform, the cultivation of innovation and entrepreneurship talents has made remarkable progress in curriculum system construction and practical platform development in recent years. The traditional training model is characterized by standardized courses and large-scale teaching, which, although conducive to systematic knowledge transmission, has obvious deficiencies in teaching students in accordance with their aptitude and personalized development [3]. For instance, innovation and entrepreneurship courses offered by some universities still focus on policy propaganda and theoretical teaching, with weak systematic cultivation

of students' practical abilities and innovative thinking [4]. In terms of practical platform construction, despite the continuous increase in resource investment, problems such as scattered resources, insufficient collaboration, and low utilization efficiency remain, making it difficult to provide comprehensive and effective support for students' innovative ability training.

In recent years, some studies have attempted to introduce big data technology to support the construction of dual-innovation (innovation and entrepreneurship) teaching platforms, but overall, they still focus on optimizing single elements such as courses, platforms, or evaluations, lacking systematic integration of the entire "goal-process-evaluation" chain. In addition, teachers' inadequacies in data literacy and information-based teaching capabilities have also become one of the key factors restricting the improvement of innovation and entrepreneurship education quality.

3. Construction of a data-driven framework model for cultivating innovation and entrepreneurship talents in universities

Based on existing research, this paper constructs an integrated framework model covering four dimensions, "goal-data-intervention-evaluation", to systematically explore the theoretical construction and practical paths of data-driven cultivation of innovation and entrepreneurship talents in universities, providing new ideas and methods for promoting the education model to a higher level of scientization, personalization, and intelligence [5].

3.1. Goal dimension

3.1.1. Principles for goal setting

In the data-driven cultivation of innovation and entrepreneurship talents in universities, goal setting must follow basic principles such as student-centeredness and alignment with market demands. Being student-centered means respecting students' individual differences and development needs; through data analysis technology, it can accurately capture students' learning behaviors, interest preferences, and ability levels, thereby formulating training programs that meet their personalized development goals [6]. Aligning with market demands requires closely connecting with the actual needs of social and economic development for innovation and entrepreneurship talents, ensuring that the cultivated talents can adapt to changes in the future professional environment [7].

3.1.2. Analysis of goal elements

The specific elements of innovation and entrepreneurship talent cultivation goals include innovative thinking, entrepreneurial ability, interdisciplinary literacy, and other aspects. The cultivation of innovative thinking aims to stimulate students' creative thinking and problem-solving abilities. Through data-driven methods, based on students' learning trajectories and thinking patterns, it can accurately locate the development stage of their innovative abilities and design targeted training tasks [8]. Entrepreneurial ability covers multiple skills such as resource integration, team management, and market insight. By collecting data on students' performance in practical activities, their entrepreneurial potential can be quantitatively evaluated, and hierarchical training goals can be formulated [9].

In addition, as an important characteristic of innovation and entrepreneurship talents in the new era, interdisciplinary literacy requires students to form comprehensive competitiveness through the integration of interdisciplinary knowledge and skills. Through data analysis, students' learning strengths and weaknesses in different fields can be identified, thereby providing them with interdisciplinary learning resources and practical opportunities to promote the comprehensive improvement of interdisciplinary literacy.

3.2. Data dimension

3.2.1. Data types

In data-driven cultivation of innovation and entrepreneurship talents in universities, multiple types of data need to be collected to support precise decision-making, including learning behavior data, competency assessment data, and practical project data. Learning behavior data, as important indicators reflecting students' learning processes, include access records of online learning platforms, course participation, homework completion, etc. These data can reveal students' learning habits and knowledge mastery. Competency assessment data provides a basis for personalized training through quantitative evaluation of students' innovative abilities and entrepreneurial potential. For example, obtaining students' cognitive styles and creativity levels through psychological assessment tools. Practical project data records students' performance in practical activities, such as competition results and progress of entrepreneurial projects, which can directly reflect their practical abilities and comprehensive qualities. The collection and analysis of various types of data are of great significance for a comprehensive understanding of students' development status, laying a solid foundation for subsequent training interventions.

3.2.2. Data collection methods

To ensure the comprehensiveness and accuracy of data, diversified collection methods should be adopted. Learning behavior data can be automatically recorded through online learning platforms, intelligent teaching tools, and other channels; competency assessment data can be generated through standardized testing tools or artificial intelligence algorithms; while practical project data relies on feedback from the school's internal practice management system or third-party platforms [10]. In terms of data storage and management, a unified data standard and storage architecture should be established to ensure data consistency and accessibility.

3.3. Intervention dimension

3.3.1. Personalized teaching intervention

Based on data analysis results, personalized teaching intervention can be realized by adjusting course content and optimizing teaching methods. According to students' learning preferences and knowledge mastery, course modules matching their interests and abilities are recommended to enhance learning enthusiasm and effectiveness. Meanwhile, teaching pace and difficulty can be adjusted in real-time according to students' learning progress.

3.3.2. Guidance for practical activities

Practical activities are an important part of cultivating innovation and entrepreneurship talents. Data-driven approaches can provide students with personalized guidance for practical activities. Based on data on students' performance in theoretical learning and practical projects, suitable practical projects can be matched for them. For instance, recommending entrepreneurial competitions or internship opportunities that align with their professional background and interests. Targeted skill training can also be provided for weak links exposed by students in practical activities, such as strengthening their teamwork or market research abilities through online courses or workshops.

3.4. Evaluation dimension

3.4.1. Construction of evaluation index system

Establishing a scientific and reasonable data-driven precision training evaluation index system is crucial to ensuring training effectiveness. This system should cover indicators in multiple aspects, including innovative thinking, entrepreneurial ability, and practical achievements. Among them, innovative thinking can be evaluated

through students' creative outputs and problem-solving abilities; entrepreneurial ability can be quantified through resource integration capabilities and team management performance; practical achievements include competition awards and the actual effectiveness of entrepreneurial projects. Through multi-dimensional evaluation indicators, the comprehensive performance of students in innovation and entrepreneurship talent cultivation can be fully reflected, providing a basis for subsequent optimization.

3.4.2. Evaluation methods and feedback mechanisms

In terms of evaluation methods, a combination of formative evaluation and summative evaluation should be adopted to comprehensively track students' learning and development processes. Formative evaluation continuously monitors students' learning behaviors, timely identifies problems in their learning, and provides immediate feedback; summative evaluation tests the achievement of training goals through the assessment of students' final outcomes. Meanwhile, establishing an effective feedback mechanism is an important guarantee for achieving evaluation objectives.

4. Implementation paths of the data-driven training model for innovation and entrepreneurship talents in universities

4.1. Policy support at the university level

As the main driver of educational reform, universities can introduce policies to encourage teachers to carry out data-driven teaching research. For example, special research funds can be established to support teachers in exploring the application of big data, artificial intelligence, and other technologies in innovation and entrepreneurship education. Secondly, universities can establish a sound data governance mechanism, clarify norms for data collection, storage, and use, and ensure data security and compliance. The implementation of these policies can not only create a favorable environment for data-driven teaching but also provide strong support for the overall digital transformation of education in universities.

4.2. Construction of technical platforms

Technical platforms are the core tools for data-driven cultivation of innovation and entrepreneurship talents. They need to integrate modules such as data collection and analysis, and personalized learning. By integrating multi-source data and using technologies such as data cleaning and machine learning, student profiles can be constructed, and their behavior and ability trajectories can be analyzed to provide a basis for precise teaching intervention. The platform should have an intelligent recommendation function to dynamically push resources that match students' individual needs. At the same time, it must ensure good scalability and security to protect data privacy and adapt to future educational development.

4.3. Development of teaching staff

As direct implementers of teaching activities, teachers' data literacy directly affects the effect of data-driven teaching. Therefore, improving teachers' data literacy should be the core task of teaching staff development using the strategies as outlined:

(1) Universities should regularly organize data technology training to help teachers master basic skills in data collection, analysis, and interpretation;

(2) Universities should encourage teachers to participate in practical projects of data-driven teaching, so that

they can accumulate experience through practice and gradually improve their data application capabilities;

(3) Universities can further stimulate teachers' enthusiasm for participating in data-driven teaching by establishing incentive mechanisms, such as incorporating data-driven teaching achievements into the evaluation index system for professional title promotion.

5. Conclusion

This study aims to construct a systematic data-driven theoretical framework for cultivating innovation and entrepreneurship talents in universities, so as to address the problem of mismatch between the "extensive" supply and individual needs in traditional training models. With data as the core driving element, this framework runs through the entire chain of talent training, including goal setting, process intervention, and effect evaluation, realizing a paradigm shift from "experience empowerment" to "data empowerment". In the goal dimension, the framework emphasizes student-centeredness, combines market demands, and accurately positions key training goals such as innovative thinking, entrepreneurial ability, and interdisciplinary literacy. In the data dimension, it provides a scientific basis for personalized training by collecting learning behavior data, competency assessment data, and practical project data. In the intervention dimension, it adjusts course content and teaching methods based on data analysis results, and provides personalized guidance for students' practical activities. In the evaluation dimension, it constructs an evaluation system covering multiple indicators, and adopts a combination of formative and summative evaluations to establish an effective feedback mechanism to optimize the training process.

The operation mechanism of the data-driven training model for innovation and entrepreneurship talents in universities is reflected in the closed-loop system of data collection, analysis, and application. For instance:

(1) Multi-dimensional student data is collected through technical means such as online learning platforms and assessment tools;

(2) Data mining algorithms are used to conduct in-depth analysis of the data, forming accurate insights into students' individual learning and development processes;

(3) The analysis results are transformed into personalized teaching interventions and practical guidance, thereby improving the precision and effectiveness of talent training;

This study proposes paths to realize this model, including policy support at the university level, the construction of technical platforms, and the improvement of teachers' data literacy. These measures together form an integrated ecosystem, providing theoretical reference and practical guidance for the scientific, personalized, and intelligent development of innovation and entrepreneurship education in universities.

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